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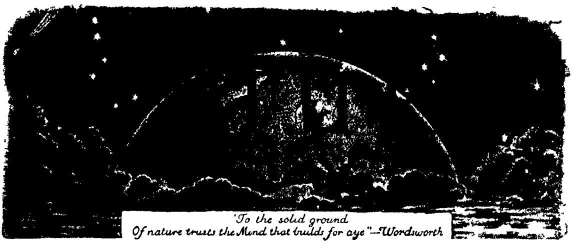
"To the solid ground
Of nature trusts the Mind that builds for aye"—Wordsworth

No 3583 SATURDAY, JULY 2 1938 Vol 142

Education and Intellectual Freedom

IN a noteworthy address at the annual dinner of the University of London held on May 13, the American Ambassador, Mr Kennedy, stressed the importance of the remaining free universities of the world as champions of the undisturbed liberty to seek and expound truth as it is and not 'truth' as it ought to be—in the interests of some totalitarian scheme. The spirit of tolerance and free inquiry has only been kept alive in Great Britain and in the United States by strenuous endeavour, and in spite of our enviable position we should not think that in either country the fight is over.

Mr Kennedy's reminder of our responsibility to truth and justice was coupled with a warning of the danger which threatens to-day not only the quest for new truths regardless of their immediate value, which is the basis of true learning and scholastic integrity, but also education itself, in a world which has seen famous scholars driven into exile and universities staffed only by those who openly subscribe to a dominant political creed. Schools, colleges and universities are being forced to teach not what the professors know to be true, but rather what the political heads of the State want their youth to believe is true. Never was greater vigilance called for even in the free countries to see that the schools do not become the organs of any political party temporarily in control of the destinies of the State, or to permit them to mirror any teaching except the truth as nearly as it is possible to ascertain and impart truth.

It is well, indeed, to be reminded that the struggles by which academic freedom was established in the past are by no means over, for to recognize the threat of a harsher bondage of learning to politics is a long step towards rallying forces to meet the danger. Moreover, the conditions to-day tend to hinder the free exchange of ideas between scholars of different countries, through which the universities can function as agents of international appeasement. On one hand, eminent men of learning are liable to be excluded from certain totalitarian countries, while on the other, the utilization of academic and scientific activity for the advancement of national political ends characterizing those countries has in turn led to a more cautious attitude in other countries in expanding facilities for the movement of professors, lecturers or students from such countries, except under the most express guarantees.

Upon this situation, the recent volume* by Mr S. H Bailey, issued by the Royal Institute of International Affairs, throws a flood of light. While Mr Bailey sets out with admirable lucidity the historical growth, the nature and the extent of the provision now made for research in universities and non-academic institutions and for teaching in higher, secondary and adult education on international relations in a number of European countries and in the United States of America, he never allows his survey to be overburdened with detail. Detail is there indeed, sufficient for those who wish to follow up particular aspects of the survey more fully, but even more valuable is Mr Bailey's analysis of the factors involved and the conditions of progress in this field. Here he brings to light the special responsibilities of the universities, both in the field of research and in the moulding of an informed and alert public opinion, without which even the most enlightened leadership is doomed to frustration and failure

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* International Studies in Modern Education By S H Bailey. Pp. xvii + 309 (London Oxford University Press, 1938) 15s. net.

Discussing the position of research in international relations, Mr Bailey points out that the principal obstacle to objective investigations is not the inadequacy of the financial resources, the dearth of trained personnel or the absence of adequate materials, but the encroachments upon intellectual freedom. The full admission of the principle of intellectual freedom is a vital condition for the objective study of international relations, no less than for scientific work of any kind The twist which has been given to the minds of many in the authoritarian State who carry the responsibility for guarding the scientific tradition makes it difficult to rely upon the objective value of the work of institutions in those countries Even in scientific work, it is almost impossible to estimate at any given moment the pressure of the unseen hand of an authoritarian Government, and the collective study of international relations can easily become a travesty A resonant dogmatism drowns the quieter tones of the cautious comment and query of the scientific investigator, and an exchange of ideas, accompanied by their critical examination, becomes impossible

Mr. Bailey's sober criticism here and elsewhere should go far to convince scientific workers of the reality of the threat in every field, and of the importance of a determined effort for the rigid maintenance of a high academic standard no less in international studies than in scientific questions in the narrowest sense of the word, even at the cost of an apparent slowing down of the pace of development The situation is essentially similar with regard to neutral institutions unconnected with a university, such as the Institute of Pacific Relations and the Royal Institute of International Affairs. It is as necessary as with the universities that such institutes should be independent of political or other affiliations, and be precluded from expressing a corporate opinion if the research conducted by them is to be of real value

Besides outlining the essential conditions for research institutions in this field, Mr. Bailey's notes on the development of the study of international relations in higher education deserve attention. He comments on the devastating effect in the social services of intensive specialization and the need for a general view for the comprehension of social phenomena—and the increasing difficulty of obtaining it—the tendency of students in one branch to overlook the contributions which workers in other fields can make to their work, and on the obstacle which is presented by preoccupation with professional training. In respect of adult education, his criticism of both the issue and the supply of publications of all kinds deserves attention, particularly in respect of those coming from organizations advocating policies, whether Government or not

In both the sphere of research and in the university, the emphasis on the need for objective investigation and objective teaching is unmistakable, and Mr Bailey directs attention particularly to the influence of the reaction against objective teaching in secondary education. In Germany, Italy and the U S S R, the educational policy tends not to prevent the study of international relations but to subordinate it to the immediate political needs of the regimes in power. This in turn leads to a reaction in the field of secondary education corresponding with the close watch over their academic reputations kept by universities in countries where freedom of expression of opinion is still permitted Educationists in such countries hesitate to encourage the movement of teachers and children to countries where freedom of expression of opinion is no longer tolerated and an active policy of political indoctrination pursued, and are also reluctant to receive teachers from authoritarian countries without the most explicit guarantees and the provision of safeguards against foreign propaganda

The situation is thus not one which scientific workers can contemplate without concern. The obstacles to free exchange of thought across national frontiers no less than inside many of those frontiers are growing just when science has in many ways annihilated distance and incredibly multiplied means of communication. Even the almost unlimited possibilities offered by the natural and applied sciences for conveying to the mind a sense of the unity of knowledge and the ubiquitous results of scientific research, and in encouraging the development of the sense of human solidarity and reciprocal good will, can scarcely be utilized in such an atmosphere All the more important it is

that scientific workers should not shirk their responsibility for upholding freedom of thought and investigation in countries where this principle is still honoured, of guarding against abuse of that freedom, of extending the spirit of impartial scientific inquiry into the many complex social, economic and international problems at present so largely dominated by prejudice, and of promoting within their own land and across its frontiers a spirit of respect for facts and the rights of others Upon such a basis alone can be based alike the citizenship which permits enlightened leadership and the understanding and good will which establish justice and peace between nations.

A Philosophy for Socialism

A Philosophy for a Modern Man
By H. Levy Pp 287. (London Victor Gollancz, Ltd , 1938) 7*s* 6*d*. net

ALARMED discontent pervades the minds of most who reflect on the present state of our social organization, or who have to play some conscious part, small or great, in its conduct Some diagnose the trouble as due to an upheaval in the ordained stratification of society, accompanied by and made more evil by failure in the mutual duties of the respective strata (or classes). Their remedy, in general terms, is to restore order mitigated by a cautious benevolence But in their camp are not a few fleeing travellers throwing their load to the pursuing pack in a flurried haste, which, however, does not prevent a determination to make their own property the last sacrifice

Others see that change is inevitable and press ruthlessly towards the realization of their own conception They abstract social organization from the individuals which compose a society and would give to these a meaning and indeed an existence only for and through the society They, like the first group, believe in duty, and that true freedom and happiness can be found only in obedience to duty, but it is fair to make the distinction that the new categorical imperative depends on the will of certain individuals, the old on the fact or the tradition that it is the will of God

Those who wish to understand the object of Prof Levy's sincere and vivid book may well begin by reading first the last chapter He thinks that efforts to "harness the forces of production to the well-being of the people" must fail, and that the failure is inevitable, because hitherto "every form of society has been organised internally to serve the material and spiritual interests of a dominant class, by using the labour power of a subordinate class" His hope is for the emergence of a non-capitalistic, one-class organization of society.

Now the first of the groups to which I have referred believe that their political creed is based on a religious and metaphysical philosophy; the second group plead in their support a somewhat crude adaptation of the Hegelian dialectic Prof. Levy hopes that he has supplied a philosophy which will show that the change he wishes is in the natural order of the universe, is, in fact almost inevitable, but can be accelerated by the conscious activities of men of good intention It follows closely Marxian dialectical materialism, but is reinforced by interpretation of the history of recent years, and by Prof Levy's wider knowledge of economics and of physical and natural science "For us," he writes, "the problems of philosophy are resolved into those of guiding ourselves and others towards this classless society "

I am not quite sure that philosophy with an alien purpose is likely to be a very sound philosophy, or that the wish to make it a support for a social doctrine may not lead it into waters as strange as it was led by the intention to prove or to disprove dogmatic religion But probably I am abnormal in that respect, as it seems to be a comforting habit to attach a philosophy to every new social or scientific discovery, and without doubt Prof Levy has compounded a very fortifying draft

Within a brief space, it is impossible to describe, and therefore foolish to pretend to criticize this "Philosophy for a Modern Man" It begins by explaining a methodology which employs what is to me the new and illuminating conception of 'isolates' An isolate is a thing or process, or group of things and processes, the behaviour of which you study either by isolating it physically as in a laboratory experiment, or by abstraction in thought, so as to understand how far that behaviour is self-determined But outside the conditions of the laboratory, and to a smaller extent even within them, your isolate is in contact with a larger isolate, and that again with one still larger. With your new knowledge you can now study the interactions between internal and external relations. But you have always to remember that your object of study, whether statistical or qualitative, is an isolate, and a way to knowledge, rather than knowledge itself.

The world is a changing world and every isolate and its relations are in constant change. Quantitative changes pass into qualitative changes Under the very stringent conditions of laboratory experiment, such changes are sometimes reversible, but in biological events the series of changes, although they follow in orderly series, are not reversible Hence the observation of experiments has to be replaced by the interpretation of history. It follows, therefore, that a philosophy of history has to be part of the philosophy of a modern man, and one of the most cogent and illuminating parts of Prof Levy's book is his description and interpretation of the rise and failure of previous organizations of society, leading to his thesis that we are at present in a critical phase which will pass inevitably into the one-class society of the future

P CHALMERS MITCHELL.

Skull Morphology

The Development of the Vertebrate Skull
By Dr G R de Beer Pp xxiv + 552 + 143 plates (Oxford Clarendon Press, London Oxford University Press, 1937) 30s net

IT is more than sixty years (1877) since the appearance of the first general text-book on "The Morphology of the Skull" by Parker and Bettany, a work excellent in its day but now out of date The most important general work on the subject since then is the part on the development of the skeleton of the head contributed by E Gaupp to Hertwig's well-known "Handbuch" (1906) It marked a great advance in our knowledge, more especially of the development of the cartilaginous framework of the skull and visceral arches But a vast amount of work has been done since on the skull, and no one has made more important contributions than Dr de Beer himself, whose series of detailed studies on the development of the head and skull in various vertebrates from cyclostome to mammal, published from 1922 onwards, form the basis for this fine monograph illustrated by 143 plates containing a vast number of figures most of which are the author's own

The volume begins with a historical review of work done on cartilage, 'cartilage-bones', and 'membrane-bones', and their relationships from the histological, morphological and phylogenetic points of view There follow discussions on the segmental composition of the skull, the determination of the exact position of its hind limit, and the craniogenic materials of which it is composed. The second, or systematic section, contains detailed accounts of the development of the skull in typical examples of the various groups of Craniata from the lamprey to man A third, comparative, section deals with the general morphological consideration of certain cartilages and bones of particular interest; while in a fourth and general section the author returns to such more general questions as the growth of the skull, the effects of heterochrony, the experimental evidence as to the causal relationships and interdependence of the parts This section also contains most useful summaries of the special characteristics of the various classes

A distinctive feature of this monograph is the detailed account of the relation borne by the skeletal parts to the neighbouring nerves and blood-vessels, and their clear delineation in the figures. The importance of these relations had already been emphasized by Gaupp and particularly by Allis, and they have been worked out in various forms by de Beer with remarkable success

Three main questions are dealt with in this book the fundamental segmentation of the head, and the attempt to trace in development how many segments, corresponding to those of the rest of the body, contribute to the building up of this special region, the development and homology of the various skeletal parts, both cartilaginous and bony, and how far they can be distinguished as constant elements throughout the Craniata, and lastly, the actual phylogeny of the skull and visceral arches in their manifold adaptations in the different groups both living and extinct All fascinating problems

Only a few points can be mentioned in this review It was Balfour who first showed that the head-region consists of segments homodynamous with those of the trunk, and van Wijhe who clearly distinguished between the more dorsal myotomes giving rise to myomeres innervated by the ventral segmental motor nerve-roots, and the more ventral unsegmented lateral plate giving rise to muscles supplied from the segmental dorsal nerve-roots De Beer concludes that there are three, and three only, so-called prootic segments in front of the auditory capsule, and a varying number of metotic segments behind the capsule in different species and groups (for example, nine head-segments altogether in *Squalus*, eleven in *Lepidosteus*, six in *Amblystoma*, nine in *Lacerta*);

that, as shown by Koltzoff, the complete uninterrupted series appears in the embryo and persists even in the adult cyclostome (*Petromyzon*). Moreover, he confirms Ziegler and Goodrich, as against van Wijhe, in maintaining that no segment is suppressed in the region of the third prootic, and that the orderly sequence of myotomes and nerves is here preserved. Further, he shows that in Gnathostomes not more than two myomeres are suppressed behind by the overgrowth of the auditory capsule during the course of development, the sixth of the series being usually the first to produce permanent muscle. Consequently, Furbringer's assumption that a large number of metotic segments have in the course of phylogeny been eliminated, already severely criticized by Goodrich, is here rejected.

The exact position of the occipital joint, which varies in different forms according as more or fewer trunk segments are assimilated from behind and contribute to the formation of the skull, is another point admirably treated. The homology of the trabeculæ cranii has been a subject of much controversy. Long ago, Huxley suggested that they were derived not from the axial chrondrocranium itself but from an anterior pair of visceral arches. From fresh evidence de Beer inclines to the view of Allis that they are, indeed, premandibular arches, and that the pair of gill-slits between them and the mandibular arches has been lost. The text ends with a useful list of problems which remain to be solved by future research.

Throughout full justice is done to the work of previous authors, whose observations and conclusions are carefully considered, and the very complete bibliography at the end of the volume is ingeniously set out so as to refer to the subject dealt with and the page on which the reference occurs.

The writing of such a book must have entailed an immense amount of careful work, and students of the morphology of vertebrates owe a debt of gratitude to the author for having carried it out so successfully. The publishers are to be congratulated on having brought out such a handsome volume at so moderate a price.

Conceptions and Exponents of Human Culture

The History of Ethnological Theory

By Prof. Robert H. Lowie. Pp. xiii+296. (London: G. Harrap and Co., Ltd., 1937.) 10*s*. 6*d*. net.

IN his history of ethnological theory, Prof. Lowie gives a survey of the course of progress in the theoretical study of culture and of the growth of knowledge through the improvement of technique for gathering the requisite information. For these his wide knowledge of the literature of the subject and his critical detachment render him peculiarly well fitted, and he has done so in a most interesting manner. Although the history covers a period of some hundred years, it records the infancy and adolescence of a new branch of learning which only now is attaining recognized scientific status.

The approach by students to ethnology has been very varied. The mental training required for proficiency in law, history, biology, medicine, or philosophy has necessarily given a bias in the several students towards some particular aspect of ethnology and to the manner in which it has been studied. There must also be taken into account the prevalent scientific and philosophical tendencies which must inevitably influence the investigator. For example, ethnologists were irresistibly inclined to adopt the prevailing biological concepts at the time when evolution was in the air.

The subject-matter of ethnology, unlike that of the physical or natural sciences, cannot be discussed purely objectively, as it deals with investigations into human culture and behaviour undertaken by human beings with different personal equations. The conclusions and at times even the integrity of the writers have been criticized by other students, who also exhibit very human traits—lack of poise, rancour, and even distortion being not unknown. The history of ethnological theory is thus bound up with the personality of those who were creating the science, and consequently Prof. Lowie has found it necessary to consider their idiosyncrasies as well as their contributions to ethnology. These personal sketches of dead and living ethnologists are most illuminating and are presented with a dispassionate judgment to which little exception can be made.

The following observations are extracted from Prof. Lowie's final chapter, "Retrospect and Prospect". He refers to four errors that are now definitely discarded: that of culture being a simple function of physical conditions and natural resources. Prelogical primitiveness. Primitive intellectualism. Racialism: since the comparatively small differences in the innate mental endowment of races are not able to account for all the differences in cultural development; such, for example, as the profusion of secret societies in some areas and their absence in others.

There is general agreement that Bastian s genetic law cannot explain specific coincidences While no one has ever denied diffusion *in toto* its importance has been established beyond cavil and what nowadays divides scholars is merely the intensity of their concern with this principle and the nature of their methodological safeguards against error Even the most fervid functionalists occasionally turn to historical sequence As Dr Elsie Clews Parsons remarks Wisdom in ethnology as in life lies in having more than one method of approach Within the space of half a century a number of questions have been settled—so far as we can judge definitively No one now defends the three stage theory of economic progress That promiscuity now exists nowhere and is an unproved hypothesis for the past is the view of most living ethnologists That the family and not the clan is the basic social unit is also widely held though Durkheim still maintains the idea of the priority of the clan

Neither psychology or ethnology can be reduced to the other Ethnology enlarges the psychologist s ken demonstrating the scope of social patterning in individual behaviour The ethnologist inevitably bound to use terms relating to the mind uses the determinations of scientific psychology prophylactically against the snares of vulgar psychology and constructively in refining his analysis of regional differences and of particular processes

Being a science ethnology implies an orderly arrangement of its data the verifiability of its findings a logical basis for its conclusions But in conforming to the canons of all science it must not adopt the particular techniques of physics biology or geology except where the cultural data as such demand such recourse

A C HADDON

Mathematics for Economists

Mathematical Analysis for Economists
By R G D Allen (London School of Economics and Political Science Studies in Statistics and Scientific Method edited by A L Bowley and A Wolf) Pp xvi + 548 (London Macmillan and Co Ltd 1938) 31*s* 6*d* net

THE aim of this book is to provide a course of pure mathematics that will be useful to students of economics The earlier chapters which deal with numbers and variables and their representation with analytical geometry the elements of the calculus etc will as intended by the author be helpful and valuable to the student of economics who has little mathematical equipment but must learn more in order to follow the modern treatment of economic theory for which economists are considerably indebted to the late Prof Alfred Marshall and later writers The later chapters deal with functions of two or more variables with differentials problems of maximum and minimum values differential equations expansions and determinants while a final chapter discusses some problems in the calculus of variations At certain stages especially in the later chapters problems definitely connected with economics are discussed from the theoretical point of view but the author has relied largely on a careful choice of examples to lead the reader from the mathematics to the practical application These examples are particularly well arranged and have been chosen with considerable skill so that taking the book as a whole we think that it will be found interesting to many economists who have passed the stage of student in the educational sense but are still students in the wider sense of the term

There is little in the way of adverse comment that need be urged against the book but we may suggest that in future editions an occasional verbal rearrangement might be advantageous for example on p 297 where in dealing with partial derivatives the author refers to two vertical sections perpendicular to each axis the wording may give the impression that there are only two possible vertical sections It becomes clear on the next page that this is not what is meant but a slight alteration would ease the path of the reader

From time to time mathematical books are published which have been prepared by the authors for particular groups of students and in the not wholly convincing short bibliography one book is mentioned Calculus made Easy which was originally intended for engineering students this is a long way from economics A type of work bearing some points of contact with economics is that of the actuary but the mathematical text book used by actuarial students in Great Britain has little likeness to the book before us Mr Allen might however in dealing with interest adopt for future editions the international actuarial notation

In reading this interesting book it was borne in on us that though each type of student will inevitably read his mathematics for a specific reason it would sometimes be wise for him to put aside books which deal with mathematics from his own point of view and to study instead books written for a different type of student Such a course would not only improve his mathematical equipment but also it would convey to him that there is a field of work outside his own which may be linked with his by the fundamental mathematics or in other ways The thoughtful student might thus be led to a broadminded sympathy with other subjects and to the possible enlargement of his own Mr Allen s book contains much that could be read by students who have no direct interest in economics and it can be whole heartedly recommended W P E

Metallic Systems

Die heterogenen Gleichgewichte
(Handbuch der Metallphysik herausgegeben von Prof Dr G Masing Band 2) Von Prof Rudolf Vogel Pp xxiii +737 (Leipzig Akademische Verlags gesellschaft m b H 1938) 68 gold marks

THE previously published parts of the Handbuch der Metallphysik have dealt with metallic structure and the plastic working of metals The high standard set by those parts of Prof Masing s fine work is worthily upheld by this volume the subject of which is more difficult to treat successfully because of its immense scope The author has not attempted to confine attention to metallic systems but for reasons which are explained in an introduction and with which few will disagree has taken the broadest point of view concentrating on physico chemical fundamentals and illustrating them by examples of both non metallic and metallic systems

The book is divided into five sections in the first of which the principles of thermodynamics are somewhat briefly stated in order to explain the phase rule and the influence of temperature and pressure on equilibrium The second section on single component systems deals with vapour pressure and melting point curves the triple point the derivation of the *p t* diagram from free energy considerations and polymorphism and describes the cases of sulphur ammonium nitrate silica water phosphorus and *allotropic metals* The thermodynamic criteria of equilibrium—the *minimum free energy of the system and the equal* partial free energies of the components—are also explained and their implications illustrated by free energy diagrams Binary systems are considered in the third section which is about equally divided between equilibria in the presence of a vapour phase and condensed systems in which the pressure variable can be neglected Particular metallic systems are not discussed in detail but a list is given of references to the literature concerning more than 450 systems The thermodynamic treatment of equilibrium of the second section is here extended to systems of two components

In the fourth section equilibria of three component systems in the presence of a gaseous phase occupy only 30 out of 350 pages the remainder being of immediate interest to the metallographer since it provides a meticulously thorough explanation of the possible types of ternary equilibrium diagram illustrated by detailed descriptions of the aluminium magnesium copper iron nickel phosphorus iron nickel tungsten iron carbon cobalt and iron iron sulphide iron carbide systems A list is given of references to the literature dealing with more than 200 ternary metallic systems The use of free energy diagrams is further extended The comparatively small amount of knowledge available concerning systems of more than three components is evident from the shortness of the final section in which the difficulties of presentation and the vast field awaiting exploration are clearly indicated A list of 22 quaternary metallic systems which have been investigated emphasizes the artificiality of the distinction between Legierungen ohne Eisen and Legierungen mit Eisen by including among the latter the work of Gwyer Phillips and Mann on the Fe Al Cu Si system

This book is not to be recommended for reading in the train and most metallurgists will probably require a large dose of Lewis and Randall before digesting the whole of it On the other hand it *is not sufficiently comprehensive to form a reference* book on heterogeneous equilibria for the physical *chemist It is in fact a compromise which attains* considerably more than might be expected from *part of a treatise on* Metallphysik for it not only explains the characteristics of equilibrium diagrams *for metallic systems* but it also presents to the metallurgist a wider scope than he is wont to consider and encourages—indeed almost demands—wider reading Comprehensive references are given and the indexing is adequate The publishers have done their work well good printing excellent diagrams and a handsome binding complete a valuable addition to metallurgical literature

H W G H

Constructive Democracy

By Sir Ernest Simon, the Rt Hon. the Viscount Halifax, Arthur Bryant, R. Bassett, the Marquess of Lothian, the Rt Hon C. R Attlee, Sir William Beveridge, E J. Patterson, Sir Alfred Zimmern, H. D. Henderson, Sir Arthur Salter, Moritz J. Bonn Pp 249. (London : George Allen and Unwin, Ltd , 1938) 7*s*. 6*d*. net

THERE can now be few scientific workers who are unaware of the threat to science itself which the disappearance of the spirit of free inquiry in the totalitarian States constitutes, and to any such Sir Alfred Zimmern's pertinent address on "Learning and Leadership" can be heartily commended. The problem of establishing in the democratic States conditions under which the fullest use can be made of science grows ever more urgent in the interests of science no less than of democracy itself. Without the spirit of free inquiry the fundamental disciplines themselves decay, and without them applied science cannot flourish long. This timely essay is both a warning and a challenge to thought and co-operation from scientific workers themselves, and for it alone the volume would be welcome.

There is, however, much else in these essays or addresses, for all their diversity, which has claims on the attention of scientific workers. Sir William Beveridge, for example, writing on "Planning under Democracy", reiterates his proposal for an economic general staff as a means of assisting the impartial scientific study of political, social and economic questions. Between them, these essays state very fairly the claims which democracy has upon the serious attention of the scientific worker, directions in which he might well seek to qualify himself as a citizen without impairing his professional standards or code, and ways in which he might co-operate in the solution of problems urgently demanding attention if standards and ideals which he cherishes no less than other citizens of a democratic State are not to be overthrown by the dictatorships.

The Cause of Cancer

By David Brownlie. Pp. viii + 208. (London : Chapman and Hall, Ltd., 1938.) 7*s*. 6*d*. net

THE author, a fuel technologist, presents the theory that most human cancer is caused by the entry into the body, mainly in the food, of carcinogenic compounds formed by carbonization. He would have us believe that the cooking of food in internally heated gas ovens, and the smoking of meat and fish, are the principal sources of these dangerous substances, but that the breathing of traces of leaking and partially unconsumed domestic gas also contributes.

The evidence here presented is quite inadequate to support the author's theory with any sound basis of experience. In fact, we may even ask if the high-boiling carcinogenic hydrocarbons are actually present in the gas supply. There are also a number of facts which seem to deny that any but a restricted range of cancers could be due to such a cause. For example, two strains of mice may be bred for many generations side by side in the same animal house, receiving the same food, breathing the same (polluted or unpolluted) air ; yet 90 per cent of the females of one strain get cancer while only a small proportion of the other strain suffer from the disease. Moreover, contrary to the author's opinion (p. 20), there is excellent evidence that typical cancer occurs in a variety of animal species. F. D.

Heredity and Politics

By Prof J. B. S. Haldane. Pp 185 (London : George Allen and Unwin, Ltd., 1938.) 7*s* 6*d*. net

THIS book has been skilfully fashioned out of the Muirhead Lectures given by the author at the University of Birmingham last year. It is addressed to such as are unacquainted with the science of genetics, but who are attracted or disturbed by eugenic doctrines. In relation to its purpose, it is an admirable book. Its language is simple and non-technical, yet precise, and its style is smooth and pleasing.

It consists of two parts, the first being a lucid and attractive exposition of the principles of genetics so far as they apply to the human subject, whilst the second half of the book treats with studied fairness of such controversial questions as the fundamental inequality of man, the sterilization of the unfit, the differential birth-rate, the innate superiority of certain races and certain social classes, and the effects of racial crossing. The author is uniquely equipped to deal with these matters, and to those who wish to become acquainted with such scientific knowledge concerning them as exists, and who would care to know what one of the really outstanding intellects of our time thinks about them, this book is strongly recommended. It could be read with great profit by the medical student who seeks an introduction to human genetics. F. A. E. C.

Analytical Chemistry

Based on the German Text of Prof. F. P Treadwell. Translated and revised by Prof William T. Hall. Vol. 1 : Qualitative Analysis. Ninth English edition. Pp. x + 630. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) 22*s*. 6*d*. net.

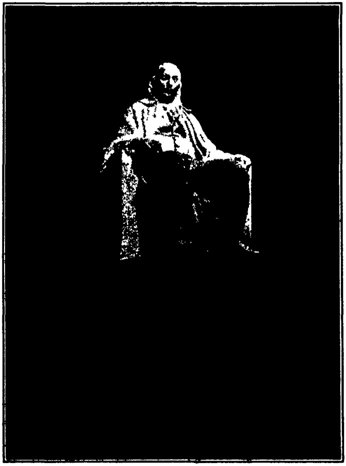
TREADWELL'S "Analytical Chemistry" belongs to the classics of our teaching literature. It now enters its ninth English edition under the guidance of Prof. W. T. Hall. In the interim since the previous edition there have been many changes introduced into modern chemical theory, and these have necessitated alterations in the book. Part 1, dealing with general principles, has been largely rewritten ; part 2 is rearranged in the order of the analytical procedure followed by the student.

Much new material is to be found ; for example, tests based on drop reactions and a certain amount of semi-microchemical analysis. Other matter has been discarded or shortened to keep the book within bounds : for example, the sections on spectroscopy and on the analysis of the rare metals.

It is valuable to have such books kept frequently revised, and the users will owe a debt of gratitude to the author for his labours. Criticism of such a successful work is superfluous.

The Benjamin Franklin Memorial, Philadelphia

THREE days of stately ceremonies, including the unveiling of a heroic white marble statue of Benjamin Franklin, lectures on pure and applied science, a two million dollar philatelic exhibition, military and naval displays, exhibits contrasting the science of Franklin's time with that of to-day, marked the formal dedication of the Benjamin Franklin Memorial on May 19–21, at the Franklin Institute, Philadelphia, Pa



STATUE OF BENJAMIN FRANKLIN IN THE FRANKLIN HALL, FRANKLIN INSTITUTE, PHILADELPHIA

The French Ambassador to the United States, Count René Doynel de Saint Quentin, Herbert C Hoover, former President of the United States, Daniel C Roper, Secretary of Commerce; George Wharton Pepper, formerly a senator of the United States; Roland S Morris, president of the American Philosophical Society and formerly ambassador from the United States to Japan, Sir James Colquhoun Irvine, principal and vice-chancellor of the University of St. Andrews, Scotland, and Dr Louis Martin, director of the Pasteur Institute, Paris, were among the notable figures participating in ceremonies honouring the Philadelphia printer who became a world-famed man of science and statesman.

The annual award of medals by the Franklin Institute; the conferring of degrees by the University of Pennsylvania, which is the outgrowth of an academy founded by Franklin; the participation by thousands of school children in massed choruses and bands and in a colourful "Young Philadelphia Parade"; and a pilgrimage to the new Franklin shrine by representatives of to-day's printing industry were prominent features of the dedication.

"From this time forward the Benjamin Franklin Memorial will be his [Benjamin Franklin's] permanent home, and I extend a hearty invitation to all people everywhere to visit him and make him their friend," said Mr. Pepper in a dedicatory address

The new 'home' of the eighteenth century sage who revealed the identity of lightning and electricity and made important investigations and discoveries in many other fields of natural philosophy, is fittingly located in a classic structure dedicated to scientific progress In the spacious building on Benjamin Franklin Parkway in Philadelphia, the Franklin Institute, founded in 1824 and active in the promotion of science and the mechanic arts, maintains its "Wonderland of Science" Museum, where more than 4,000 action exhibits reveal the part played by science in every-day life; and its Fels Planetarium, noted for its reproductions of the heavens. The spiritual centre of this building, and a public shrine to the memory of the great statesman and natural philosopher, is the new Franklin Memorial. There, in a lofty memorial room inspired by the Pantheon in Rome, rises the heroic statue; a seated figure in white Seravezza marble, more than twice life-size. Upon its huge pedestal of rose aurora marble from Portugal, it extends to a height of 18 feet above the floor The sculptor, James Earle Fraser, whose notable statues, groups and relief portraits grace many parks and public buildings throughout the United States and Canada began work on the Franklin statue five years ago, and has described his own conception in the following words

"A massive figure, tranquil in body with latent power in his hands but with an inquisitive expression in the movement of his head and the alertness of his eyes ready to turn the full force of his keen mind on any problem that concerned life '

In a manner that would have aroused the keen interest of her famous ancestor, ten year old Miss Louisa Johnston Castle of Wilmington, Delaware, a lineal descendant of Franklin, unveiled the statue by turning a searchlight upon a photo electric cell

In the three day programme Franklin was commemorated as "Patriot and Man ', as ' Philosopher and Educator", and as "Printer and Business Man" Special exhibits depicting the advance of science from Franklin's day to the present time, on display in the Wonderland of Science Museum vied with lectures by noted men of science and educators of two continents in the tribute to the great American's scientific achievements Developments in electricity were shown from an electrical machine which Franklin once owned to a modern half million volt surge generator producing man made lightning Progress in printing, 'Poor Richard's' own craft, was demonstrated from a hand press used in Franklin's original printing shop to modern presses that print in four colours Paper making was performed by hand just as it was in Franklin's day, and the entire modern process from pulp to finished paper also was demonstrated on a miniature scale model Fourdrinier paper making machine A replica of the "Pennsylvanian Fireplace", one of Franklin's outstanding inventions was shown in contrast with an exhibition of the development within the last twenty years in automatic oil heating equipment for home use

In a notable series of lectures on pure science, given at the Franklin Institute on May 20, Sir James C Irvine spoke on "Benjamin Franklin in Saint Andrews, 1759 , Dr C E K Mees, director of the Research Laboratory of the Eastman Kodak Company, Rochester N Y , who is a native of Wellingborough, England, and was educated at Harrogate and St Dunstan's, on Photography and the Advance of Pure Science" , Dr Gilbert N Lewis dean of the College of Chemistry, University of California Berkeley Calif , on ' Old and New Views of Acids ' , Dr George D Birkoff, the distinguished mathematician of Harvard University Cambridge, Mass , on "Electricity as a Fluid" Dr Forest Ray Moulton, permanent secretary of the American Association for the Advancement of Science, Washington, D C , on The Influence of Astronomy on Science , Dr Arthur L Day formerly director of the Geophysical Laboratory, Carnegie Institution, Washington D C on Volcanoes Geysers and Hot Springs" , Dr Louis Martin, director of the Pasteur Institute Paris, on L'Hospitalisation des Maladies Contagieuses Dr Thomas H Morgan, of the California Institute of Technology Pasadena, Calif , on ' Human Heredity and Modern Genetics" , and Dr Merritt L Fernald, of Harvard University, on Must All Rare Plants Suffer the Fate of *Franklinia* ?"

Lectures on applied science were given at the Franklin Institute on the following day by Dr Willis R Whitney, vice president in charge of research General Electric Company, Schenectady, N Y , who spoke on 'It's Called Electricity Dr Abel Wolman, professor of sanitary engineering, Johns Hopkins University, Baltimore Md , on ' The Trend of Civil Engineering since Benjamin Franklin ' , and Dr Harvey N Davis president of the Stevens Institute of Technology Hoboken, N J , on ' Engineering and Health'

Delegates from leading learned societies and educational institutions of the United States and Europe were welcomed at the dedication ceremony by Philip C Staples, president, and Dr Henry Butler Allen, secretary and director of the Franklin Institute Sir Albert Seward, delegate from the Royal Society of London, was in attendance with Lady Seward and presented to the Institute a photostat copy of the certificate making Franklin a fellow of the Royal Society in 1756

Artificial Production of Snow Crystals

IN NATURE of August 28, 1937, p 345, an account was given by G Seligman of experiments carried out at the University of Hokkaido by Prof U Nakaya Since that article was written, Prof Nakaya has made considerable progress towards his aim to produce, artificially and under strictly controllable conditions, the great variety of natural snow crystals[*] He assumes that we can trace the entire history of the fallen snow crystal from observations of its size, form and habit, and infer the physical state of its environment during condensation and during its subsequent movements through the atmosphere, if we can establish the laws governing its development.

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[*] Preliminary Experiments on the Artificial Production of Snow Crystals By Ukitirô Nakaya, Isonosuke Satô and Yatarô Sekido Further Experiments on the Artificial Production of Snow Crystals By Ukitirô Nakaya Yasuaki Toda and Syûsô Maruyama (*J Fac Sci*, Hokkaido Univ , Series II, Vol. II, No 1, 1938)

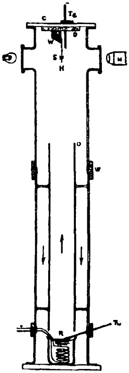

Fig 1
APPARATUS FOR THE ARTIFICIAL PRODUCTION OF SNOW CRYSTALS

Nakaya's experiments were carried out in a cold chamber the temperature of which could be lowered to −50° The apparatus employed for the production of artificial snow crystals is shown in Fig 1 By heating the water in the dish *R* with an electric coil, a flow of saturated, warm air is produced in the inner of two concentric cylinders When the air reaches the point *O* it is chilled by the walls of the cooled outer cylinder. The rabbit hair *H* serves as a nucleus for the condensation of the now supersaturated vapour and the growing crystal *S* can be observed through the telescope *M*. The temperature at the water surface (T_w) and that near the crystal (T_a) are recorded. The apparatus has the advantages that both the temperature and the degree of supersaturation can be varied within wide limits, and that a nucleus for the condensation is provided which allows unhampered growth of the crystal in all directions and yet keeps it stationary in front of the telescope. Fig 2*a* shows a snow crystal grown in this apparatus, still attached to the rabbit hair. It is seen from comparison with the natural snow crystals reproduced in Fig. 2*b* that the artificial product resembles the natural one in regularity as well as in degree of complexity.

Nakaya divides the growth of the snow crystal into two stages the formation of the germ and its subsequent development. He finds that the type of the former greatly influences the final shape of the crystal, however radically he alters T_w and T_a during the second stage Therefore, the first object of his investigations was an enumeration of possible types of germs and a study of the conditions for their formation Schematic drawings of his twelve types of early stage snow crystals are shown in Fig 3, and a record of their history is given in the table which follows Evidently temperatures above −20° C, with a relatively copious supply of water vapour, produce complex shapes such as dendrites or "assemblages of sectors", the latter probably caused by multiple twinning The formation of simpler types appears to be favoured by lower temperatures, while the perfection of the crystals seems to depend primarily on the regularity of the temperature gradient Rapid chilling of highly supersaturated vapour produces clusters of irregular fragments (Type 2) or even frozen droplets.

Fig 2.
SNOW CRYSTALS. (*a*) ARTIFICIAL CRYSTAL. × APPROX. 11. (*b*) NATURAL CRYSTAL. × APPROX. 12.

The actual degree of supersaturation in the neighbourhood of the rabbit hair was not measured in any of Nakaya's experiments, but a supersaturation ratio (s) is given, defined as the ratio of the saturation vapour pressure at the water surface (T_w) to that near the crystal (T_a). It was found, however, that experiments with identical supersaturation ratio did not always produce the same results, since uncontrollable factors such as deposition of hoar crystals on the walls of the cylinders influenced the concentration of moisture at the top of the apparatus. On the other hand, it was observed that the rate of growth, defined as the increase per hour in the diameter of a circle enclosing the crystal, is characteristic for each type and can serve as a qualitative measure of the degree of supersaturation. However, absolute measurements of the supersaturation values in terms of water content per unit volume seem highly desirable in view of the possible applications of Nakaya's researches to meteorology.

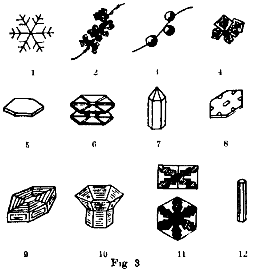

Fig 3

TWELVE TYPES OF SNOW CRYSTALS IN THEIR EARLY STAGES

1. Dendrite.
2. Clusters of irregular fragments.
3. Frozen droplets
4. Assemblages of sectors.
5. Thin hexagonal plate.
6. Cylinder with end plates.
7. Prismatic pyramid.
8. Hexagonal plate with design
9. Thick hexagonal plate.
10. Cup crystal.
11. Prismatic skeleton.
12. Prismatic needle

During the second stage of crystal development, the rates of growth have been measured with considerable accuracy Some of the results are given below :

Fern like dendritic branches of great complexity	10–3 mm. per hr.
More massive hexagonal plates with broad extensions at the corners	1·3 mm per hr
Hexagonal plates and assemblages of sectors of plates	0·7 mm. per hr.
Massive prisms, pyramids, prismatic needles* and 'spirals'	0·5 mm. per hr

The spirals are a peculiar phenomenon which has been observed in crevasse hoar by Seligman and others. They look like ordinary hexagonal prisms, but on closer inspection their cross-section perpendicular to the hexagonal axis is seen to resemble a 'hexagonal clock-spring'. Slow growth of the germ is essential for this type. In Nature, it develops only under calm conditions with a small temperature gradient providing for a slow rate of sublimation.

Nakaya also reports that rhombohedral (β-ice) and cubic ice crystals were produced at temperatures of about −30° C and low saturations. In view of the fact that neither X-rays nor polarized light were employed for their identification, these results must be regarded as rather uncertain Finally, snow crystals were grown from heavy water. It is interesting to note that their external structure was very similar to that of snow crystals grown from ordinary water

Nakaya has taken many thousands of photomicrographs of artificial snow crystals. By his elaborate researches he has created an invaluable new implement for the meteorologist and provided the research worker on snow with a most interesting collection of new facts It is to be hoped that by a more systematic presentation of his results, by improvement of his nomenclature along more accepted crystallographic lines and by quantitative measurement of his supersaturation values, he will justify the expectations of those who have followed his earlier work. **MAX PERUTZ.**

Type No	Type	T_w			T_a			t (in hours)
		Initial	Middle	Final	Initial	Middle	Final	
1	Small dendrite	+ 5° C	+ 10° C	+ 15° C	− 19° C	− 17° C	− 18° C	0·5
2	Clusters of irregular fragments	+ 3	+ 35	+ 20	− 20	− 13	− 15	0·5
3	Frozen droplets	+ 6	+ 46	+ 25	− 22	− 10	− 12	0·5
4	Assemblages of sectors	+ 10	+ 16	+ 19	− 15	− 13	− 12	1·5
5	Thin hexagonal plate	+ 6	+ 10	+ 12	− 24	− 22	− 16	2
6	Cylinder with end plates	0	+ 8	+ 20	− 20	− 20	− 14	5·5
7	Prismatic pyramid	+ 3	+ 5	+ 10	− 29	− 27	− 25	7
8	Hexagonal plate with design	+ 4	+ 4·5	+ 4·5	− 26	− 27	− 28	15
9	Thick hexagonal plate	+ 2	+ 4	+ 1	− 38	− 36	− 39	18
10	Cup crystal	+ 5	+ 4·5	+ 4	− 21	− 21	− 19	17
11	Prismatic skeleton	+ 6	+ 8	+ 10	− 22	− 22	− 20	20
12	Prismatic needle	+ 4	+ 4	+ 4	− 30	− 30	− 28	25

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* In his article in NATURE, Mr Seligman expressed his surprise that Nakaya observed needles and prisms at different ends of the temperature scale in snowfalls, the needles occurring under warm and the prisms under extremely cold conditions It may be suggested that these needles are not prismatic, but consist of branches of dendrites which have broken off from their base and lost the details of their structure by melting

Obituary Notice

Prof A E Boycott, F R S

ARTHUR EDWIN BOYCOTT whose death occurred on May 12 last was an eminent pathologist He was also a distinguished naturalist He was listened to with the same respectful attention by an assembly of malacologists as by one of pathologists His wide knowledge of biology is notable in his writings and gave a special character to his teaching of pathology

Boycott was born at Hereford in 1877 and educated at the Cathedral School In 1894 he entered Oriel College Oxford, with an open classical scholarship He gained a first class in Classical Moderations and then turned to medicine pursuing his preliminary scientific studies in the Natural Science Schools He studied physiology under Burdon Sanderson Gotch Mann and Haldane and pathology under Ritchie He was particularly influenced by the last two both of whom became life long friends He graduated with first class honours in natural science and was elected to a Fraser Research Scholarship In October 1899 he went to St Thomas s Hospital where he completed his medical course and graduated M B (Oxon) in 1902

Boycott wanted to devote his life to investigation rather than to practice of the healing art and in the following year the first step towards satisfying this ambition was achieved by his appointment to a subsidiary lectureship in pathology at Guy s Hospital and election to a fellowship at Brasenose In 1904 he accepted the position of assistant bacteriologist at the Lister Institute Three years later he was recalled to Guy s to become the first whole time lecturer in pathology In 1912 the chair of pathology at Manchester became vacant and Boycott was appointed He liked the University but disliked the climate of Manchester and in 1915 he returned to London to occupy the Graham chair of pathology at University College, which carried with it the supervision of the research laboratory of the new clinical school Here he remained until 1935 when continued ill health obliged him to resign and retire to the country

Boycott s scientific activities covered a wide range His individual researches and those conducted in collaboration with various colleagues and pupils on physiological, pathological and zoological subjects are contained in some eighty papers, and it is impossible to do more than indicate the scope of some of the more important in a short article

The earliest work published by Boycott on the effect of cold on the conductivity of nerves in the frog and rabbit respectively was done under Gotch The publication of these two papers stamped him as a capable investigator, but he did not follow up this line of inquiry after leaving Oxford

In 1903 the co operation of Boycott was enlisted by his former teacher, John Haldane, in an investigation of the anæmia of Cornish miners Haldane had discovered that the trouble was due to ankylostomiasis a disease hitherto unrecognized in Britain Together they embarked upon a comprehensive research into this disease which continued by Boycott lasted some three years This investigation left not much unknown about its pathology its epidemiology in mines in Great Britain and the life history of the parasite

Whilst at the Lister Institute Boycott made a useful contribution to the immunology of typhoid and paratyphoid fevers and also a study of the seasonal distribution of the diphtheria bacillus and Hoffmann s pseudo diphtheria bacillus in the throats of a London population but he was mainly occupied with Haldane during this period with an extensive investigation of the effects of compressed and rarified air upon the animal body That on increased atmospheric pressures in which Damant also collaborated was called forth in order to explain and if possible to find means to prevent, the often fatal accidents to which caisson workers and deep sea divers are liable

Much valuable information was obtained about the pathology of compressed air illness It was shown to be due to the formation of bubbles of nitrogen in the tissues during the period of decompression if this were too hastily brought about The relationship between this occurrence to both the amount and duration of the compression and to the rate of decompression was determined experimentally The correctness of Haldane s prediction that if decompression were carried out by stages instead of continuously the time required for safety could be greatly reduced was also demonstrated and their experiments were sufficiently quantitative and numerous to permit time tables for decompressing divers by stages to be drawn up which afforded a margin of safety These are now universally employed Incidentally the working time under pressure and the depth attainable by divers has thereby been materially increased The investigation by Haldane and Boycott of the regulation of respiration at reduced atmospheric pressure and of the pathology of mountain sickness, in which Ogier Ward was a partner was also a fine piece of work The results furnished a completer understanding of the causes of the respiratory embarrassment when the tension of oxygen is reduced by rarefication of the air and of the body's methods of acclimatization to high altitudes

Boycott was engaged in yet another research with Haldane on the physiological adaptation of man to an environment of high temperature and great humidity in which the limitations of adjustment were ascertained both when idle and performing increasing amounts of work They published only one short paper together on this subject , the bulk of the observations for which Boycott was responsible were incorporated in reports and lectures by Haldane

The contribution to the above three researches made by Boycott has been somewhat obscured by the fame of the senior partner Haldane originated them and doubtless had much say in the planning of the experiments, but Boycott had most to do with carrying them out

Boycott s scientific output during the three years spent at the Lister Institute was very considerable The partnership with Haldane was a delight, and mutually advantageous Boycott was young and vigorous, and had neither teaching nor administrative duties Henceforth, he occupied professorial posts, and responsibility for the pathology of great hospitals teaching, the direction of the work of others and the editorship of the principal pathological journal in Britain greatly reduced the time left for individual researches Nevertheless he continued to be an active experimenter

From 1908 onwards a great part of Boycott s researches, in most of which various colleagues collaborated, was concerned with some aspect of blood as a tissue Whilst a student at Oxford, he had become an adept with the method of Haldane and Lorrain Smith for determining the total volume of blood in the body Years afterwards, he and Douglas critically re examined the method and showed that with minor improvements in technique reliable results could be obtained and that in skilled hands it was free from danger Boycott afterwards made good use of this powerful engine of research in investigating various types of anæmia and polycythemia occurring in patients and experimentally produced in animals These have led to a clearer conception of the pathological features of these diseases

A subject which especially aroused Boycott s interest and to the investigation of which he returned again and again was the power possessed by the body to restore the volume and composition of the blood to normal after disturbance by hæmorrhage or transfusion Some of his best work is that designed to throw light on the way these reparative adjustments are brought about He found that the rate of restoration was increased by education and that the destruction of superabundant elements after a transfusion only occurred if they were not wanted He discovered a number of interesting facts and, although complete understanding of how such adjustments are brought about is still far off, these facts and the emphasis he laid upon them are highly important

Another experimental inquiry which was begun at Guy's with Ryffel and continued at Manchester with Douglas as partner had for its purpose the study of the part played by the kidney in the regulation of the volume and composition of the blood With this object, Boycott and his colleague studied the effects of withdrawal and addition of fluids and the action of diuretics on normal animals and others in which the secretory tubules of the kidney had been put out of action by poisoning with salts of uranium Adjustment was found to be much delayed in the latter The interpretation of some of their experimental results was not clear at the time, but later work by others has afforded an explanation of some of them

Boycott was distinguished from other prominent hæmatologists in that he was interested in blood as a whole and not more particularly in its cellular constituents His discoveries constituted an important contribution from several angles to the physiology and pathology of blood Many of them were incorporated into the excellent article on the subject written for Pembrey and Ritchie's "Text Book of General Pathology" in 1913 That is still good reading

During the earlier years of the Great War, Boycott was occupied in doing the work of younger colleagues who had joined the army He served upon various Government committees for which his special knowledge and sound judgment rendered him suitable It was an unhappy time as he found himself out of sympathy with the attitude of many of his friends towards the conflict In 1917 he joined the R A M C and was associated with Barcroft and other physiologists at the experimental station at Porton in the investigation of the physiological action of poisonous gases used or likely to be used by the combatants In this work he rendered valuable service, and its scientific interest mitigated the misery he endured in the contemplation of the purposes to which the materials were being put

As assistant editor of the *Journal of Pathology* for fifteen, and editor for twelve years, Boycott rendered a great service to pathology in Great Britain He was peculiarly well fitted for the work by his wide knowledge, critical judgment and keen appreciation of orderly presentation and literary form It was a labour of love and he devoted much of his time to the work He was a helpful editor, and many an author has to thank him for reducing his manuscript to readable shape, a process which sometimes meant re writing it The debt which the Pathological Society owes to Boycott will not easily be forgotten Under his editorship, its journal increased in prestige as well as in size

The briefest account of Boycott s scientific work would be inadequate without reference to his observations on snails As a boy he was fond of snails and catalogued those of Herefordshire The attachment lasted through life, and the last scientific papers he published were two memoirs on the habitats of the land and freshwater Mollusca in Britain These are not mere catalogues of distribution, they are full of information about the habits and life history of these creatures in so far as it appears to have determined their distribution A zoologist friend tells me they are regarded as classics, and that they contain more information to the page than anything he has read

Boycott is also responsible for a serious research in genetics It began some twenty years ago when his attention was directed to the occurrence of some left handed staircases in the shells of a common water snail, *Limnæus peregra*, in a pond in Yorkshire, and is still going on Usually dextral, the nature of its spiral depends upon the asymmetry of its soft parts. Boycott perceived that he had encountered first rate material for genetic research, the character, sinistrality, being readily discernible and no intermediate condition possible Furthermore, *Limnæus peregra*, although preferring cross fertilization, could readily be induced to propagate parthenogenetically He forthwith began to breed snails from selected parents or parent and to determine the proportion of right and left handed ones in successive generations As the generations increased and notwithstanding the enlistment of collaborators, the labour became almost overwhelming A few years ago the total progeny exceeded a million ! The results of this prodigious experiment were communicated from time to time in appropriate journals and in 1930 gathered together in a memoir published by the Royal Society in its *Philosophical Transactions* Briefly stated, sinistrality was found to be a Mendelian recessive character complicated by a tendency towards dextral mutations

The transfer of so much of Boycott's energy to zoology was regretted by his brother pathologists, and the fact that his love for biology was responsible for his wide outlook on pathology did not appease their jealousy

As well as being a fine experimenter, Boycott was equally good at contemplation and an artist in expression Of recent years he gave several stimulating addresses which have more than ephemeral value In these essays he found an opportunity for displaying the rare combination of knowledge, philosophical insight and literary charm which he possessed He used them to review knowledge of some subject in pathology and its implications, or for an expression of his views on the proper attitude towards the study of pathology His conception of the content of pathology was different from that of most He defined it as the study of how organisms resist and repair injury In the post mortem room and the museum are recorded only the failures on which he thought, attention had been too much concentrated The phenomena of protection and repair certainly represent the more cheerful side of pathology and were particularly attractive to Boycott because of the evidence of purpose apparent in them

Boycott was one of those who are said to pursue knowledge for its own sake which means that he was curious and found sufficient satisfaction in making experiments with a sporting chance that he might have imagined the right question to ask and planned the appropriate experiment to obtain an answer Whether the knowledge to be gained was likely to be of any immediate service, ought, he maintained to be immaterial The exclusion of utility as a righteous motive for embarking upon an investigation was, I believe largely a reaction to the commercialism which he feared was trespassing upon the sanctity of scientific laboratories

He was a charming companion and a staunch friend always ready with help and sympathy in time of trouble He held strong views on most subjects and refused to compromise even on small matters when he imagined a principle was involved, but as he could be depended upon to be on the side of the angels, a measure of intransigence was unimportant

C J M

News and Views

Long-Range Weather Forecasts

In a series of questions asked by Mr S F Markham in the House of Commons on June 22, relating to the stations and research staff of the Meteorological Office, one referred to weather forecasts for a fortnight or longer, now being published in Great Britain and in Germany, and suggested that the Office might supplement its present forecasts by such long range predictions In his reply, the Secretary of State for Air said "I am aware of the long range weather forecasts being attempted by various methods in many different countries These efforts are being carefully studied by the Meteorological Office, but so far none of the methods has attained the accuracy which would justify the issue of such forecasts in this country" This reply may not satisfy the public, which fails entirely to distinguish between weather forecasts based upon established scientific principles and observations, from prophecies of an astrological nature or any system which has not been submitted to a scientific society for disinterested consideration Whatever is known about long range weather forecasting is understood by our Meteorological Office, and if any practical end could be served by applying such knowledge, advantage would certainly be taken of the opportunity. In science it is not enough for an observer to satisfy himself that his investigations prove a principle, but the evidence has to convince other scientific workers before the principle is accepted. Until this has been done, any long range weather forecasts published in the daily Press, whatever accuracy is claimed for them, are altogether unworthy of being placed in the same category as the daily forecasts at present issued

Air Survey and Archæology in Germany

Early in the current year, Mr O G S Crawford, archæological officer of the Ordnance Survey, received an official invitation from Germany to organize an exhibition of the results of archæological air photography in Great Britain, and to deliver a lecture on the subject in March An account of the exhibition is contributed by Mr Crawford to *Antiquity* of June 1938 With the consent of the Ordnance Survey, about forty enlarged, and about one hundred small photographs were shown, together with a selection from the remarkable collection of photographs taken by Major Allen, which Mr Crawford remarks, "so brilliantly illustrates the archæological value of air photography The exhibition was held in what was the Upper House of the former Prussian Parliament, the arrangements being made by the Lilienthal gesellschaft, and invitations sent to pilots of the German Air Force and to the leading German archæologists. The exhibition also included a selection of photographs taken by German pilots, who are now keenly interested in the subject and have begun to collaborate with the archæologists. It would appear that the exhibition, which lasted for two days, and of which the proceedings were devoted to the discussion of technical problems, was a great success. The meeting closed with a lecture by Mr. Crawford, when Dr. Buttler and Ministerialrat Ewald were present and also spoke. To this lecture members of the public were admitted, and several hundreds of people were present. An account of the proceedings is to be published by Lufthansa as an illustrated monograph.

AT the conclusion of the meeting, Mr. Crawford, in proceeding by air to Athens on business connected with the Greek portion of the map of the Roman Empire, was able to make a number of interesting observations. On his way to Berlin he had observed traces of an early, probably medieval field system between Brussels and Cologne, of which he had also detected indications on some of the German air photographs. Similar evidence was obtained in the soil marks—long white bands forming a pattern—between Budapest and Belgrade. These, in his opinion, are the vestiges of an ancient field system. Whatever their age and original intent, they seem to have no relation to the existing field system, which itself has the appearance of considerable antiquity. To decide the point, a large area should be photographed from the air in suitable conditions, and a mosaic constructed with subsequent excavation at selected points to decide the matter. In addition Mr. Crawford observed three Roman camps on arable land and the course of several defensive dykes, some of post-Roman date, which though long known to exist have never been properly investigated. Mr. Crawford concludes by pointing out that this region is one of the best fields in Europe for combined field work from the air and on the ground, and expresses the hope that our archæological colleagues of Yugoslavia will follow the example of Germany and inaugurate work in this unexplored and most promising field.

Excavations in the Egyptian Sudan, 1937-8

THE annual exhibition of the Egypt Exploration Society opened at the Society's rooms, 2 Hinde Street, Manchester Square, London, W.1, on June 23. It will remain open daily until July 14. In 1937–38 excavation was continued on the site of the fortress town of Sesebi on the banks of the Nile, about one hundred and eighty miles south of Wady Halfa. Shortly before the close of the season, the site had been completely excavated, and the expedition spent twelve days in a preliminary examination of the new concession at Amarah West, about sixty miles north of Sesebi, where it is hoped to begin systematic excavation in 1938–39. Although the number of finds at Sesebi this year was small, they are of no little archæological and historical interest. Faience objects bearing the name of Amenhotep IV from intact foundation deposits under the walls of the town indicate that the town, as well as the temple, was built by this king about 1480 B.C., before he adopted Aten worship and changed his name to Akhenaten. A sandstone block bearing a representation of the god Amun, or of Amenhotep wearing the plumes of the god, which was found built upside down in the sanctuary of the temple erected by Seti I, is of no less interest as an example of the art of the period before Akhenaten changed the canons of art, as well as his religion. Both these finds are of importance as belonging to a period from which material is scanty. A black granite fragment showing a daughter of the king, embraced by a sister or a parent, is the only clearly Amarna piece that has been discovered at Sesebi. An interesting sandstone bust of a dead man, swathed in mummy bands, which when in position would appear to be bursting from the ground, is a rare example of a symbol of resurrection.

THE most interesting and significant fact which emerges from the excavation at Sesebi is that though built in the conventional form of a fortress town, it had no moat, no special defences for its gates, and there was, apparently, no strategic reason for its position. It could not withstand a prolonged attack, whereas other previously known fortress towns of this region command strategic points on the Sudanese trade routes, have deep moats, and are strongly fortified. Hence it would appear that by the time Sesebi was built the political and economic dominance of the Egyptian Empire in the Sudan was sufficiently firmly established to make the establishment of fortress towns like Sesebi as anything more than trade and religious centres superfluous—an important piece of evidence of the organization of the Egyptian Empire in the Eighteenth and Nineteenth Dynasties. At Amarah West there has come to light in the preliminary tests evidence which suggests that there may have been a late Eighteenth Dynasty occupation as well as that of the Nineteenth, of which the remains, in the form of temple and town, crown the mound of the site under a deposit of some six feet of blown sand. This deposit has kept the walls in an excellent state of preservation, to a height of six feet, and holds out promise of inscriptional material, and possibly statuary, in the temple. An interesting find, of which it is hoped more will be heard in future excavation, is an axe celt and two agate arrow heads, which appear to afford evidence here of a new and little known Sudanese culture.

Exhibition of History of Handwriting

AN exhibition now open at the London County Council's Horniman Museum, Forest Hill, London, S.E., illustrates the development of handwriting and its different systems. It begins with pictographic and hieroglyphic forms, and shows how the conventionalized breaking down of the picture produced the alphabetic systems, tracing the development through early Phœnician to Greek and Latin. The development of Babylonian cuneiform is also shown, demonstrating how its character was determined by the nature of the material used for record, the clay tablet, which necessitated the use of a stylus in the form of a stamp lending itself to ready and relatively rapid duplication. Among later developments shown are the Lombardic, Merovingian, Visigothic, Anglo-Saxon and Irish 'hands', as well as the still later and contrasting forms of Italian and English Secretary—Shakespeare's signature is an example of the latter—between which rivalry lasted in England until well into the seventeenth century. The exhibits include illuminated manuscripts, samplers and tally sticks, facsimiles of important historical documents, such as Magna Charta, and of the signatures of prominent personages, ancient and modern. The exhibition will remain open until August 31.

"Druid" Temple near Glasgow

A LARGE part of this temple on the Anniesland-Duntocher Boulevard at Glasgow, near Clydebank and Kilbowie, has now been re-constructed. New wood has been substituted for the decayed and carbonized original timber. The circular area of the sanctuary appears to have a diameter of 245 feet, bounded probably by a ring of nineteen large, white, hard sandstone pillars equidistantly set and each about 8 feet in height. Numerous graves have been found under the floor or old surface. As indicated by the pottery and other relics, the burials near the centre are of the Stone Age. The outer graves belong to later prehistoric periods, the various phases of the Bronze Age. The temple was evidently a favourite place for interments for a very long period. Four graves, very close to the centre of the temple, have just been opened and may be inspected during the next few days, after which they will be again covered over. These four graves are all built of large stones and in two cases contain much decayed timber and wicker work. The topmost stones in several cases bear curious devices belonging to the class of carvings known as 'cups and rings'. Stone implements were found in some of the tombs. The largest of the four tombs has a depth of 8 feet. The walling of its shaft contains about fifty stones. The excavation of this site has been carried out by Mr. Ludovic Mann, 183 West George Street, Glasgow, C 2.

New Pathological Institute at Guy's

THE new Pathological Institute of Guy's Hospital Medical School was opened on June 23, by the chancellor of the University of London, the Earl of Athlone, supported by the vice-chancellor, Sir Robert Pickard, and the principal, Dr. H. L. Eason. The Governing Body was represented by Viscount Goschen, Viscount Nuffield, Lord Cunliffe, and Mr. R. C. Nesbitt. The building is a large eight-story fire-proof extension behind the present anatomy, physiology and chemistry departments on a site formerly occupied by Spur Inn Yard, the outbuildings of a famous medieval Southwark inn. It combines in a single unit the former scattered laboratories of pathology, clinical chemistry and bacteriology, originally housed in old adapted warehouses. Ample laboratory accommodation is also provided for the Clinical Research Unit recently established by the Medical Research Council at Guy's and for the Guy's Hospital clinical research fellow. The connexion between the Medical School and the Hospital will be fully maintained by the provision of extensive accommodation for the hospital routine investigations. Thirty fully equipped laboratories have been provided for original investigations. The total cost of the building and equipment has been between £85,000 and £90,000, of which £10,000 has been contributed in the form of a capital grant by the University Court. There remains a debt of some £40,000, which, until paid off, will prevent the full realization of the objects for which the building has been provided.

The Newcomen Society

FAVOURED with beautiful weather the Newcomen Society held its summer meeting in the Lake District on June 15-18. The programme was a very full one and included visits to mines, iron furnaces, snuff mills, an organ building works, a bobbin mill, a paper mill and Kendal Museum. At Lindale in Cartmel a short stay was made to inspect the cast iron obelisk to the memory of the great iron master John Wilkinson, and in a small engineering shop near Kendal the members found a very early iron planing machine, which it is to be hoped will one day find a place in a museum, instead of passing to the scrap heap. With its many streams, the Lake District abounds in turbines and water wheels several of which are of considerable interest. Not the least interesting items in the programme were the visits to the Greenside Lead Mines, Glenridding, which, after being worked for two hundred years, are being modernized, and to the old copper mine at Goldscope, a short way from Keswick, which was worked in the days of Queen Elizabeth by the Society for the Mines Royal. At a meeting on the evening of June 15, a paper was read on the works at Goldscope, by Mr. Rhys Jenkins, who has traced the immigration into the district of some 150–200 German miners from the Tyrol. The principal figure in the venture was Daniel Hochstetter, while much of the capital was provided by the Augsburg firm, Haug and Co., the account books of which are still preserved.

The Dartmoor Catchments

AMONG the papers presented at the annual general meeting of the British Waterworks Association on June 22 were two containing certain features of general scientific interest. The paper on "The Dartmoor Catchments" by Mr. Hansford Worth gave a detailed description of the physical features of the great granite highland occupying an area of 248 square miles in the county of Devon. He divided it into three districts, the eastern, the northern and the southern, according to differences of elevation. He explained how the weathering of the granite results in a product, locally known as 'Growan'. Owing to the softening of the rock and the loss of its coherence as the result of the decay of the felspars, there is evolved a sandy, and not a clayey mass, which, near the surface, shows the movement known as 'hill-creep', an excellent example of which is to be seen on the roadside near the Sheepstor Dam The porosity of the growan affords ample storage for rainfall, which in Devon is high, ranging up to more than 80 inches per annum The monthly distribution is remarkably regular, when long periods are averaged, but wholly irregular in any one year Mr Worth went on to analyse the run off resulting from rainfall and found that there is a drought regime for every stream, and that following any day in which there has been no actual flood, it is possible from the ascertained flow on that day accurately to predict the flow of the stream for the next 24 hours, in the absence of rain Instances were given of several notable floods and their havoc

Protection of Underground Water Supplies

THE second paper, on The Protection of Underground Sources of Water Supply ', by Mr Edgar Morton, had special reference to the Town and Country Planning Acts, and was directed to two aspects of protection, namely, protection of an existing source of public supply against exploitation for industrial purposes, and, secondly, protection against the possibility of pollution from external sources As regards the former, pointing out that in most private Acts involving underground waterworks, there is a clause for the protection of existing sources of supply—wells, boreholes and springs—within a specified radius of the authorized works, Mr Norton stated that within recent years there has been a tendency to extend such protection to include streams, ponds and pools, in so far as they are fed by springs which originate within the protected zone, although the user of such streams, ponds or pools may be outside the zone A serious aspect of the inadequacy of existing legislation is that, while Parliament imposes upon the promoters seeking new sources of supply for public benefit at the least possible cost, restrictions respecting their boreholes, no reciprocal protection has until recently been given to the promoters against the exploitation of their water resources by industrial enterprise As regards protection against pollution, various ways were enumerated by which it could be obtained in limestone and chalk areas and in sandstone areas respectively, with instances of specific cases

The Argyll National Forest Park

REFERENCE to the Argyll National Forest Park was made in NATURE of October 16, 1937, p 692, and now a small brochure with the title "The Argyll National Forest Park Guide ' has recently been issued by the Forestry Commissioners The Guide has been edited by Prof John Walton, regius professor of botany in the University of Glasgow, and has a foreword by Sir Roy Robinson, chairman of the Forestry Commission The National Park consists of large stretches of mountain and moorland lying to the west of Loch Long It is divided into two main areas. The northern consists of Ardgartan and Ardgoil and forms a wedge of mountains between Loch Goil and Loch Long The southern area is bounded on the east by Loch Long and Loch Goil The two areas are built up of a group of estates, the Ardgoil Estate having been presented to the Corporation of the City of Glasgow by Mr Cameron Corbett, the others having been acquired by the Forestry Commission, which has since afforested large areas The total area of the estates amounts to 54,000 acres about 19,000 of which are reserved for afforestation, leaving approximately 35,000 acres available for use as a National Park At the southern end of this Park are situated Benmore House and its finely laid out gardens and shrubberies which were presented to the Forestry Commissioners by Mr Harry G Younger This Park presents interests for every taste and the Guide deals with its history (Prof J D Mackie) geological structure (Dr J G C Anderson), vegetation (Prof J Walton), forests and plantations (Mr J M Murray, assistant commissioner for Scotland), and fauna (Prof E Hindle), all, with the exception of Mr Murray, on the staff of the University of Glasgow

British Museum (Natural History). Acquisitions

AMONG recent additions to the zoological collections is the skull of a swamp deer (*Rucervus duvauceli*) from India presented by Mr D H Keelan The specimen is remarkable for the symmetry of the antlers A collection of mammals formed by the late Captain H D Hilton Simpson has been presented by Mrs Hilton Simpson, included in this series is a mounted head and a skull of a race of buffalo named by the late Richard Lydekker after Captain Hilton Simpson, *Syncerus caffer simpsoni* A number of mammals from Kenya Colony, including a specimen of a rare crested bush rat, *Lophiomys testudo*, and twenty small mammals from Sierra Leone are the gifts respectively of Colonel C H Stockley and Mr R R Glanville An 'ivory pearl from the tusk of a Uganda elephant has been presented by Mr Q O Grogan This concretion is an especially large one and shaped rather like a small potato Among recent donations received from the Rowland Ward Trustees is an African tiger cat, *Felis celidogaster*, mounted for the galleries, and the skull of an African dwarf buffalo A splendid group of slender prisms of stibnite (antimony sulphide) and another specimen of baryte on stibnite from Baia Sprie, Rumania, are the most interesting of the purchases made for the Department of Mineralogy The Geological Survey of India has presented to the same Department three samples of different grades of diamondiferous gravel from the Karnool District, Madras Presidency Diamonds in this district are obtained from alluvial deposits and also from a conglomerate at the base of the Karnool Series among rocks of Precambrian age These gravels have been presented in response to a request for specimens to illustrate the modes of occurrence of diamond, which is the subject of the first section of the diamond case (near entrance to the Mineral Gallery) recently rearranged

THE Department of Botany has purchased about 700 drawings and some manuscript of J J Dillenius, the first Sherardian professor of botany at Oxford In 1719, Dillenius published his "Catalogus Plantarum

(*Continued on page* 31)

NATURE

SUPPLEMENT

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Science in the Seventeenth Century*

By Prof. E. N. da C. Andrade, F.R.S.

THE AUTHORITY OF ARISTOTLE

THE sixteenth century was a period of reference to written authority, and in science the supreme rulers were Aristotle in all that pertained to the exact sciences and to general biology, and Galen in all that pertained to medicine. Occasionally a doubter arose, such as Paracelsus, only to be, at best, overwhelmed with ridicule and contempt, or, at worst, more drastically suppressed, as exemplified by the case of Giordano Bruno, who was burnt in 1600. The opinion widely expressed was that the world, Nature and particularly the human intellect, were in process of decay which had set in since the glorious times of classical Greece: it was seriously contended that the great minds of antiquity represented a race of giants which had died out just as the race of physical giants had died out. In particular, the works of Aristotle were supposed to fix the limits to which the human intelligence could reach, and the obvious thing to do, when seeking information as to the way in which Nature worked, was to refer to these works.

The method of Aristotle was, of course, speculative. Starting with certain philosophical ideas as to the nature of matter, derived partly by direct apprehension, partly by reasoning from a few observed facts of Nature, such as the circular motion of the stars, he proceeded by logical processes to argue how Nature should behave in order to conform with his innate ideas as to harmony and balance. This is no place to discuss the Aristotelian doctrine of form, which exercised so profound an influence on those who came after him, but it is necessary for our purpose to refer briefly to his ideas on motion and mechanics in general. He made a clear distinction between natural motion and violent, or artificial, motion. From the motion of the heavens he concluded that motion in circles was a natural motion. From the spontaneous motion of dropped bodies downwards, and of smoke and fire upwards, he concluded that a vertical motion was also a natural motion, adding to the idea of gravity downwards that of levity upwards. The four elements, earth, fire, air, and water played an essential part in the Aristotelian scheme; earth and water strove downwards, air and fire upwards.

The motion of a projectile or any propelled body, was a violent, or non-natural, motion. His fundamental error in considering these non-natural motions lay in his belief that bodies only moved so long as a force was acting upon them; he supposed that a thrown body continued in motion after it left the hand only because the moved air beat on it behind and carried it forward. It may be pointed out that this was an idealization, not an observed fact. A body set in motion by a force is observed ultimately to come to rest, he supposed that it would come to rest at once if the force ceased at once, but that the action of the force was continued by the air, ultimately dying out. Another idealization of the observed fact is to suppose that a body set in motion would continue to move, after the force had ceased to act, with a uniform velocity for

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* Friday evening discourse delivered at the Royal Institution on February 18.

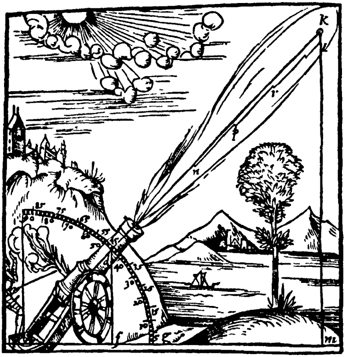

Fig. 1.
SANTBECH'S CONCEPTION OF THE TRAJECTORY OF A PROJECTILE, MODUS VIOLENTUS AND MODUS NATURALIS

ever, were it not that adventitious forces, such as friction, act upon it, and ultimately bring it to rest The latter is Galileo and Newton's idealization, which now lies at the basis of our mechanics Neither of the two is inherently more probable than the other, only experiment and observation have convinced us that the modern view is the scientifically correct one

As regards fall in particular, Aristotle considered that a moving body was acted upon by a power moving it and by a resistance if power and resistance were equal the body did not move This is a fundamental mistake It was argued by others (but apparently not explicitly by him) from his fundamental conceptions that the time of fall of a body was inversely as its weight. Experiment had no part in his scheme, probably because he was dealing with first causes, and isolated material phenomena he held to be without fundamental significance. Form was more important than matter. We see something of his point of view in the works of certain modern economists, who regard actual economic events as of little significance.

How profound was the influence of Aristotelian mechanics in the sixteenth century, even in discussion of practical matters, is well exemplified in Santbech's discussion of the motion of projectiles, published in 1561 He states that the motion of a projectile consists of an oblique violent motion which suddenly ceases, and is succeeded by a natural motion of vertical fall. He gives diagrams (of which Fig 1 is an example) showing the path of a cannon ball as two sides of a right-angled triangle, the hypotenuse representing the violent motion, and the vertical side representing the vertical fall on to the object aimed at On this basis he proceeds to solve problems in ballistics Other writers of about this time, apparently feeling uneasy about the sharp angle at the highest point of the trajectory, replaced it by a circular arc joining the straight-line oblique motion to the straight-line natural fall, the motion in this arc being a mixed mode, so that the whole trajectory consists of a straight line *modus violentus*, a curved *modus mixtus*, and a straight vertical *modus naturalis* (Fig 2). It is a strange comment on the way in which these writers refused to let observation influence them that in a book by Rivius, published in 1547, the discussion of ballistics is carried out in terms of trajectories of this kind,

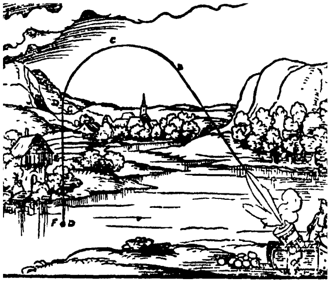

Fig. 2.
MODUS VIOLENTUS, MODUS MIXTUS AND MODUS NATURALIS

while in pictures in the same book, in which the artist shows the bombardment of a town, the trajectories of the bombs are shown as tolerably correct representations of the path of a real projectile

Let us look at the position at the opening of the seventeenth century Copernicus had published his "De Revolutionibus" in 1543, when he was on his death-bed, but the astronomers who followed him were divided in their attitude towards his theory Giordano Bruno, who upheld the Copernican hypothesis, was burnt in 1600 , Rheticus, Reinhold and Mästlin contended for the theory , not only Luther and Melanchthon, but also the great observer Tycho Brahe, who died in 1601, pronounced against it Kepler (1571–1630) was, on the other hand, a Copernican He had published his "Prodromus" in 1596, in which book he traced a mystical connexion between the distances of the planets, and the radii of six concentric spheres, between which the five regular solids were fitted. This was, of course, in the spirit of Pythagoras, who saw in the heavens a mysterious harmony which could be expressed in numbers.

Kepler's famous laws were not published until the century had well started, the first and second in the "Astronomia Nova", 1609, and the third in the "Harmonices Mundi", 1619 These laws gave the geometrical form of the planetary orbit, and a time-table for their progress in these orbits, but envisaged no quantitative mechanism to account for that form and that timetable At the beginning of the century he considered that planets must have some kind of souls to urge them on in their paths, but later he resorted to a magnetic influence emanating from the sun, of a kind, however, that did not in any way correspond to the laws of magnetism as we know them, for he supposed that it was the rotation of the sun on its axis that was responsible for the urge His great difficulty in the way of mechanics was that he had no conception of inertia Of mutual gravitation he had, however, some idea, and even explained the tides as due to an attraction of the moon for the waters of the earth Probably his magnetic hypothesis was due to Gilbert's book, "De Magnete", the appearance of which in 1600 aptly inaugurated the century which saw the triumph of the experimental method

THE MECHANICS OF GALILEO

The first great name with which we have to deal, if we wish to trace the rise of modern mechanics, is Galileo, who was born in 1564, the year in which Michelangelo died Everybody knows the legend that, as a young man in Pisa, he confuted the Aristotelians by letting spheres of different masses fall from the tower of Pisa, and observing that they all took the same time to reach the ground—a legend, because the indefatigable researches of Wohlwill have shown that it is highly improbable that he ever carried out this experiment The story that he did so is due to Viviani, who published his book in 1654, twelve years after Galileo's death, and who first met Galileo towards the end of his life Galileo was in Pisa from the seventeenth to the twenty-eighth year of his age, and there seems no doubt, that, as we should expect, when he first began to lecture he believed what he had been taught, and was a devout Aristotelian The experiment which he actually carried out was to let fall a lead and a wooden sphere, and what he noted was that the wood fell more quickly at first, but that later on the lead overtook it, and reached the ground first ! He was at the time too much of an Aristotelian to attach much importance to this finding that, of two bodies of equal size, the heavier fell slower at first but afterwards quicker[*]

Later he turned against the pseudo-Aristotelian belief that the rate of fall was proportional to the weight This was not due to experiment, but to an appeal as to what was reasonable He says "If we let two stones fall from a high tower, one twice as big as the other, it is ridiculous to suppose that when the big one has reached the ground, the other will be only half way down", but he adds "we will work more with reasoning than with examples, for what we seek is the cause of phenomena, which experience does not provide", a very Aristotelian sentiment. It was not until later that he showed that genius for experiment which is one of his great claims to fame In short, he did not suddenly, as a young man, reject the whole body of knowledge in which he had been brought up, but he gradually freed himself from the scholastic point of view, and laid the foundations of modern science

In popular estimation, Galileo is, perhaps, best known as the man who first turned the telescope to the serious study of the heavens—in fact he is often attributed with the discovery of the telescope although actually what happened was that having heard that such an instrument had been made in Holland he himself made one without being supplied with details as to the method of construction His observations were of the first importance The discovery of the mountains of the moon struck the popular fancy It is the one point to which Milton who visited Galileo in his old age refers in Paradise Lost

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[*] The question of the supposed experiment at Pisa is discussed in a very scholarly manner by Prof Lane Cooper in a little book "Aristotle, Galileo and the Tower of Pisa", which has come to my notice since this discourse was delivered. The learned author, who is professor of the English language and literature in Cornell University, sets an example to some of his scientific brethren who write on such matters, by his constant reference to the original sources. I am glad to find that his conclusions support what is written above

> his pond rous shield
> Ethereal temper massy large and round
> Behind him cast the broad circumference
> Hung on his shoulders like the Moon whose Orb
> Through Optic Glass the *Tuscan* Artist views
> At Ev ning from the top of *Fesolé*
> Or in *Valdarno* to descry new Lands
> Rivers or Mountains on her spotty Globe

The lunar landscape at once suggested that the moon might be inhabited as discussed for example in Wilkins The Discovery of a World in the Moone (1638) The discovery of the phases of Venus established the rotation of that planet round the sun and as a matter of fact the fact that they were not observed with the naked eye had been recognized as a difficulty by Copernicus who explained it away by suggesting that Venus was transparent In the discovery of sunspots which was a blow for the Aristotelians since it showed that the eye of the world was not perfect he was anticipated by Fabricius He observed that the Milky Way consisted of innumerable stars As regards Saturn owing to the position of the rings and the imperfect resolution of his telescope he concluded that the planet was accompanied by two satellites practically touching it or as he said I have observed the planet Saturn to be triple — *altissimum planetam tergeminum observavi*

Probably the most important discovery which Galileo announced in his Siderius Nuntius or Messenger from the Stars was the existence of the satellites of Jupiter which revolving round the planet gave a picture of the Copernican system His astronomical discoveries then form an imposing collection but Lagrange whose opinion on anything that pertains to the science of mechanics must carry immense weight makes light of them in comparison with Galileo s services as the founder of the science of mechanics Les découvertes des satellites de Jupiter des phases de Vénus des taches du Soleil etc ne demandaient que des télescopes et de l assiduité mais il fallait un génie extraordinaire pour démêler les lois de la nature dans des phénomènes que l on avait toujours eus sous les yeux mais dont l explication avait néanmoins toujours échappe aux recherches des philosophes Although we may not agree that anyone with a telescope—especially such a telescope as Galileo possessed—and industry could have made his astronomical discoveries yet there is no doubt that the way in which Galileo made mechanics into a science is a most striking testimony to his genius

The great book in which he announced his fundamental discoveries in mechanics Discorsi e dimostrazioni matematiche intorno a due nuove scienze appeared in 1638 In it he established the law of fall and the parabolic motion of a projectile in a non resisting medium He deduced the law of fall from the supposition that there were equal increments of velocity in equal small intervals of time in the course of his arguments he considered any time interval as capable of being divided into an infinite number of instants and so foreshadowed the differential method He did not however connect a uniform acceleration with a uniform force but apparently attributed the increase in velocity to an increase in force during the fall and further he did not think of the fall as due to the attraction of the earth but rather to some urge inherent in the body As to the true cause of the acceleration however he expresses the same kind of reticence as was shown by Newton concerning the nature of the gravitational force We may take for example Salviati s speech on the third day of the dialogues The present does not seem to be the proper time to investigate the causes of the acceleration of natural motions concerning which various opinions have been expressed by various philosophers some explaining it by attraction to the centre others by repulsion between the very small parts of the body whilst others attribute it to a certain stress in the surrounding medium which closes in behind the falling body and drives it from one of its positions to another which fantasies and others like them create problems requiring examination but there would be little gain were they solved At present it is the purpose of our author merely to investigate and to demonstrate some of the properties of accelerated motion whatever the cause of the acceleration may be

Galileo perfectly understood inertia in the case of horizontal travel and used the fact that in the absence of horizontal force a body travels horizontally with a uniform speed in his investigation of the path of a projectile It is strange then, that he seems to have no conception of inertia in the case of the vertical motion of free fall. It has been suggested that this is possibly a relic of his Aristotelian training, a horizontal motion in the direction of the earth's surface, that is, in a very large circle, being a perfect motion, like that of the heavenly bodies There seems no need, however, to resort to this supposition , an accelerated motion is clearly harder to bring into any scheme than a uniform translation, as is sufficiently shown by the history of Einstein's theory of relativity. In any event, assuming equal increments of velocity in equal elements of time, he found, by what is essentially graphical integration, that the space traversed was proportional to the square of the time

He verified this law experimentally by measuring the time taken by a body rolling on an inclined plane to traverse various distances, measuring the time by a water clock, and "in such experiments, repeated a full hundred times, we always found that the spaces traversed were to each other as the squares of the times, and this was true for all inclinations of the plane along which we rolled the ball. We also observed that the times of descent for various inclinations of the plane bore to one another precisely that relation which, as we shall see later, the author had predicted and demonstrated for them "*

The law referred to in the last sentence is essentially that the velocity is given uniquely by the vertical drop. This Galileo proved in a most ingenious way by drawing aside the bob of a heavy pendulum until it reached a fixed height, and letting it fall so that the string struck a nail vertically under the point of support. No matter at what height this nail was placed, that is, no matter what the curvature of the arc along which the bob rose, the height which it attained was always the same, and equal to that through which it fell. The velocity at the lowest point being always the same, it follows, considering the motion reversed, that the velocity is independent of the curvature of the arc along which the bob is constrained to move. From this he concluded that a similar result would hold true for planes of different slopes.

The parabolic law for projectiles Galileo proved by combining a uniform velocity in the horizontal direction with the law of fall, having previously proved that, with a body projected vertically upwards, the time of rise to the highest point is equal to the time of fall from that point. With great ingenuity he verified the parabolic form by rolling a metal ball on a slightly inclined plane metallic mirror "In the execution of this method, it is advisable to heat and moisten the ball slightly by rolling it in the hand in order that its trace upon the mirror may be more distinct " The experiment may be carried out to-day by covering with carbon copying paper a sheet of white paper attached to a board and rolling a heavy metal ball over it

It is hoped that these few words will be enough to suggest the acumen and experimental skill with which Galileo founded the science of particle dynamics. This work was the first great step towards the Newtonian synthesis, but of universal gravitation he had not the slightest inkling, as a passage where he speaks of dropping stones from the moon on to the earth is sufficient to show

BACON AND DESCARTES

In any account of the scientific thought of the seventeenth century there are two philosophers whose names always appear prominently, Francis Bacon and Descartes Bacon was a Lord Chancellor and Descartes was a great mathematician, but what we have here to consider are their writings on method, especially scientific method. As regards Bacon's services to science, we have a great diversity of opinion among those who have made a careful study of his works Macaulay, Spedding, and very recently, Prof R F Jones of the University of Washington, speak of him in terms of the highest commendation. On the other hand, William Harvey, the discoverer of the circulation of the blood , Liebig, the great chemist ; the philosophers Lasson and Duhring , the Anglo-American man of science J W Draper, who carried out important researches in photo-chemistry and was the author of the "History of the Intellectual Development of Europe" , and Sir Oliver Lodge, all speak strongly against his claims to be considered an important influence in the history of science.

Macaulay says of Bacon, for example, "As we have lying before us that incomparable volume, the noblest and most useful of all the works of the human reason, the Novum Organum . . .", which passage we may, perhaps, characterize in Macaulay's own words as the "noxious sweetness of his undiscerning praise". On the other hand, Aubrey tells us of Harvey that "he had been physician to the Lord Chancellor Bacon, whom he esteemed much for his wit and style, but would not allow him to be a great philosopher. . . .

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* It need scarcely be said, perhaps, that the author referred to in this quotation is himself.

He wrote philosophy like a Lord Chancellor he said to me speaking in derision Draper is violent in his condemnation saying of Bacon that he was a pretender in science a time serving politician an insidious lawyer a corrupt judge a treacherous friend a bad man but he is no more violent than Liebig Elsewhere Draper says with justice that Bacon s chief admirers have been persons of a literary turn who have an idea that scientific discoveries are accomplished by a mechanico mental operation Finally we may quote Sir Oliver Lodge the kindliest and most courteous of men whose verdict is that on the solid progress of science he may be said to have had little or no effect

Bacon had a purely utilitarian view of science saying that the real and legitimate good of the sciences is the endowment of human life with new inventions and order To him is often attributed the adoption of the experimental method as distinguished from the speculative method of Aristotle and he himself is continually boasting that he brings a new method to the overthrow of Aristotle but his whole terminology is scholastic with its sensible qualities matter and form and he totally lacks any feeling for the methods by which science has been advanced He was a stranger to quantitative work and he had an aversion from the method of the working hypothesis to which science actually owes its advances One instance of this is his condemnation of the Copernican system which he holds to be the speculations of one who cares not what fictions he introduces into nature provided his calculations answer

It is characteristic of Bacon that while continually laying stress on his own work as a forerunner and of his importance as *instaurator artium* he totally ignores the pioneering scientific work of his great contemporaries He says nothing of Galileo although it is quite clear from a letter of Sir Tobie Matthew s which we possess that the work had been brought to his notice He derides Gilbert and when he himself discusses the magnet he ignores the repulsion between like poles Kepler and Harvey made no impression upon him although as we have seen he was in close personal touch with the latter In short he could not recognize real scientific advances when he saw them

In spite of Bacon s attack on Aristotle his outlook was really Aristotelian He says for example that we must investigate what bodies are light what heavy and what neither light nor heavy His whole treatment of motion is spun from his own mind in the Aristotelian tradition He lays down for example in the Novum Organum that there are nineteen different kinds of motion which he describes at length in the spirit of the Middle Ages rather than that of science as we understand it Of the last kind of motion for example he says let the nineteenth and last motion i e one which can scarcely be termed a motion and yet is one and which we may call the motion of *repose* or of abhorrence of motion It is by this motion that the earth stands by its own weight It is owing to the same tendency that all bodies of considerable density abhor motion and their only tendency is not to move which nature they preserve although excited and urged in a variety of ways to motion

For a general description of Bacon s method we will so as to avoid any appearance of prejudice adopt that of his worshipper Macaulay Make as large a list as possible of those bodies in which however widely they differ from each other in appearance we perceive heat and as large a list as possible of those which while they bear a general resemblance to hot bodies are nevertheless not hot Observe the different degrees of heat in different hot bodies and then if there be something which is found in all hot bodies and of which the increase or diminution is always accompanied by an increase or diminution of heat we may hope that we have really discovered the object of our search We will only add that among the hot bodies which he classifies are horse dung and pepper

The collection of the material Bacon was prepared to delegate to any journeyman The man of science was then to go through this material in a mechanical way according to the prescribed rules and so make great discoveries I hold that we can without unfairness say that he worked out elaborate and impossible schemes for investigating phenomena of no importance On the other hand it is indisputable that he was often cited with admiration by some of the great experimenters who founded the Royal Society and held up as the man who fought for the experimental method He appears for example in the frontispiece designed by John Evelyn and etched by Wenceslas Hollar for Spratt s History of the Royal Society which published in 1667 is really a history of the foundation and objects of the Royal Society Robert Boyle in particular always speaks of him with the highest praise even though he points out that Bacon's determination of the specific gravity of quicksilver is somewhat incorrect. "Whereby it appears the weight of water to quicksilver is as 1 : 13½⅝ though our illustrious Verulam (questionless not for want of judgement or care, but of exact instruments) makes the proportion between these two liquors to be greater than 1 : 17."

Newton, however, never refers to Bacon and Hooke certainly very seldom. I believe that the respect that some working men of science in the seventeenth century felt for him was due to his lofty position as Lord Chancellor and to the fact that he, influential and exalted as he was, spoke so strongly of the need for the experimental method and attacked Aristotle. That Bacon had no conception of the right way of applying the experimental method and himself used the terminology and almost the method of Aristotle is unimportant compared with the fact that he continually spoke of the need for a new method which should handle observed properties. Again, in the "New Atlantis" Bacon describes Solomon's House "dedicated to the study of the Works and Creatures of God", which was his scheme of a great institution for experimental research. A foundation of this kind was the dream of the men who did most to found the Royal Society, and Bacon's fiction of a munificently endowed college for scientific research was one that set him high in the esteem of the enthusiasts of the new learning.

Renée Descartes offered a mechanical explanation of the universe evolved by him from a philosophical theory of first causes. His system had a far-reaching influence. Its ready acceptance was no doubt due to the way in which he explained all phenomena in general and pictorial terms which could be followed without any mathematical discipline, for great as were Descartes's mathematical powers his mechanism of the universe was purely quantitative. In spite of the overthrow of the system by Newton in 1687 his influence continued far beyond the end of the seventeenth century, especially in France, where great controversies between Cartesians and Newtonians took place round about 1735.

Descartes set out in the Aristotelian spirit to build up his scheme from first causes, and he criticizes Galileo for ignoring such causes, saying that by doing so he had built without foundation. Descartes assumed extension as the essential property of matter; as there could be no extension without matter there could be no vacuum. Motion of matter was only possible if something material occupied the space vacated by the moving body. It was from arguments of this kind that Descartes evolved his vortices, in which matter moved in closed paths. He distinguished three kinds of matter. The original kind called into being by the Creator consisted of medium-sized particles which, from his fundamental ideas, cannot have been spherical but must have filled

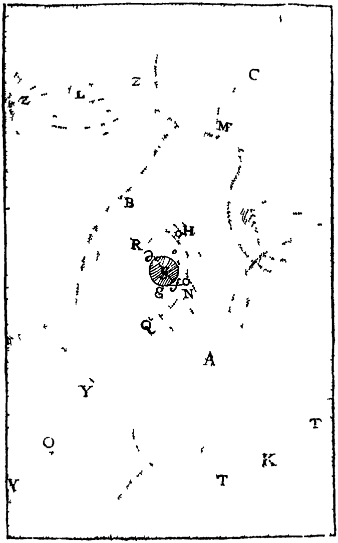

Fig. 3

DESCARTES'S SCHEME OF VORTICES, SHOWING THE VORTEX OF THE SOLAR SYSTEM IN THE MIDDLE.

all space without interstices These particles, when rubbed down by their continual motion, constituted his second kind of particles, or heavenly matter The dust rubbed off from them constituted the first kind of matter Some of these particles forced through the interstices of the particles of the second kind became spiral and matted together to form the third kind of particles The luminous sun and stars were formed of the first kind of matter, the heavens of the second and the crust of the earth and planets were formed of the third kind of particle

The heavenly vortices (Fig 3) themselves consisted of circulations of particles of the second kind, carried round by the rotation of the central bodies The planets were carried round by the sun's vortex Descartes develops his system in great detail, making it account for the formation of the earth, with its mountains due to the movements of the crust (Fig 4), for the phenomena of light and magnetism, in which latter connexion he was the first to show magnetic lines of force by means of iron filings, and for the motion of the heavenly bodies, including the comets, although the latter gave him particular difficulty The whole of his heavenly mechanics is purely descriptive he gives the particles of his vortices any velocities and properties that he likes, and he makes no attempt, for example to express quantitative laws, such as Kepler's laws, in terms of his fundamental conceptions

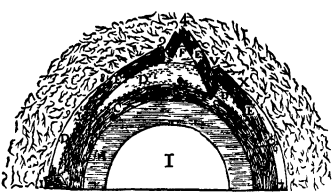

Fig 4

DESCARTES S SCHEME OF THE EARTH SHOWING THE FORMATION OF MOUNTAINS

Nevertheless, Descartes does lay down laws of motion, which foreshadow Newton's laws His first law is practically the law of inertia—every body, so far as it can, will persist in its particular state, so that what is once in movement will always be in movement The second law is that every body tends to move in a straight line and that bodies which move in a circle always tend to move away from the centre of the circle The third law dealt with impact

THE ROYAL SOCIETY AND ROBERT HOOKE

Although he dealt with the laws of impact, and with the laws of optics, Descartes laid no emphasis on experiment He did, however, attempt a general synthesis, explaining heavenly and terrestrial mechanics in terms of the same conceptions, and so made a great advance Descartes's life ran from 1596 to 1650 Somewhere towards the end of it (the exact time is not known) Guericke carried out his great experiment on the formation of a vacuum but Guericke's book De Vacuo Spatio' was not published until 1672

In the meantime Copernican views were gaining strength In 1638 for example, John Wilkins published a stout defence of the Copernican system John Wilkins is a figure of great importance for English science although he carried out no original work for he was instrumental in the formation of the Royal Society, the foundation of which, with the other great European academies, the Académie Royale des Sciences and the Accademia del Cimento, gave an immense impulse to the experimental method

It was in 1645 that Wilkins began to have in his rooms those gatherings of natural philosophers which formed the beginnings of the Royal Society We have not leisure to trace the history of these meetings nor the relative parts played by Oxford and London Suffice it to say that the Royal Society was founded in 1662, with Wilkins as the first secretary, and numbered among its original members Seth Ward, Robert Boyle Sir William Petty, Lord Brouncker Robert Hooke, John Wallis, Francis Willughby and Sir Christopher Wren, as well as Christian Huygens

The foundation of the Royal Society was followed by a burst of scientific discovery, in which Robert Hooke played a great part Robert Hooke, physically insignificant, crooked and weakly, was one of the greatest mechanical geniuses that the world has seen Pepys wrote of him "who is the most, and promises the least, of any man in the world that ever I saw" He lacked Newton's gigantic mathematical powers and searching analysis, but he had a wonderful instinct for scientific truth, and an extraordinary fertility of invention One or two quotations from his Attempt to prove the motion of the earth published in 1674 may give a taste of his quality In this treatise he describes among other things a very careful attempt which he made to measure the parallax due to the earth s motion with reference to the fixed stars and he correctly attributes his negative result to the distances of these stars saying

> To me indeed the Universe seems to be vastly bigger then tis hitherto asserted by any Writer when I consider the many differing magnitudes of the fixt Stars and the continual increase of their number according as they are looked after with better and longer Telescopes And could we certainly determine and measure their Diameters and distinguish what part of their appearing magnitude were to be attributed to their bulk and what to their brightness I am apt to believe we should make another distribution of their magnitudes then what is already made by *Ptolomy Ticho Kepler Bayer Clavius Grienbergerus Piff Hevelius* and others

At the end of the treatise Hooke quotes three suppositions upon which he says the system of the world should be founded

> First That all Cœlestial Bodies whatsoever have an attraction or gravitating power towards their own Centers whereby they attract not only their own parts and keep them from flying from them as we may observe the Earth to do but that they do also attract all the other Cœlestial Bodies that are within the sphere of their activity
>
> The second supposition is this That all bodies whatsoever that are put into a direct and simple motion will so continue to move forward in a streight line till they are by some other effectual powers deflected and bent into a Motion describing a Circle Ellipsis or some other compounded Curve Line The third supposition is That their attractive powers are so much the more powerful in operating by how much the nearer the body wrought upon is to their own Centers Now what these several degrees are I have not yet experimentally verified but it is a notion which if fully prosecuted as it ought to be will mightily assist the Astronomer to reduce all the Cœlestial Motions to a certain rule which I doubt will never be done true without it

Before saying anything further about the part that Hooke played as a forerunner of Newton we will briefly refer to some of his performances in other fields He was the first man to make a really successful compound microscope and with it made numerous discoveries including that of cells in plants which he was the first to name In connexion with his work on springs he enunciated Hooke's law, and he discovered the balance wheel of watches which probably Huygens discovered independently—the matter is disputed He invented a group of meteorological instruments—a hygrometer an anemometer a self registering thermometer and a self registering rain gauge In astronomy he devised the first clock driven telescope (Fig 5) and the first circle dividing machine which Ramsden afterwards perfected and he insisted upon the importance of telescopic sights in this connexion explaining and measuring the resolving power of the eye He was the first to carry out systematic experiments on the colours of thin plates and he invented an early form of Savart s wheel to be used as a siren His geological work especially that on fossils is fundamental Many other instances could be given of his fertile genius

Returning to the laws of celestial motion in 1679 Hooke who was then secretary of the Royal Society wrote to Newton to ask him for a paper to be read before the Society Newton replied with a letter concerning the place where a falling body would hit the surface of the earth pointing out that owing to the motion of the earth it would fall east of the perpendicular He also stated that the path should be a portion of a spiral terminating at the centre of the earth Commenting on this letter Hooke said that Newton was in error the path would be an eccentrical elliptoid supposing no resistance of the medium but supposing a resistance it would be an eccentric ellipti spiral the fall of the body would not be perfectly east as Mr Newton supposed but to the south east and more to the south than the east What Hooke meant by an eccentrical elliptoid we can only conjecture Probably he meant a curve something like an ellipse with the attracting point away from the centre his extraordinary physical instinct may well have been sufficient to assure him of this without his being able to prove that it was an ellipse Hooke s criticisms were substantially correct as Newton realized and to be caught in error irritated Newton in the highest degree In his reply Newton admitted that the body would fall to the south and that if gravity be supposed uniform it will not descend in the spiral to the very centre but circulate with an alternating ascent and descent made by its *vis centrifuga* and gravity alternately overbalancing one another

It is clear from this and the rest of the reply that Newton had not yet attained his later clarity on the problem of gravitation There is little doubt that this correspondence revived his interest in the problem, which, as we shall see, had been very keen some thirteen years earlier The bitterness between Newton and Hooke, which continued until Hooke's death, was a sad feature of the lives of two great men, both wholeheartedly devoted to scientific truth It seems certain that by the intercession of tactful friends it might have been much diminished, if not entirely removed Unfortunately, it was exacerbated by Oldenburg, long the secretary of the Royal Society, who missed no opportunity of embittering the relationship

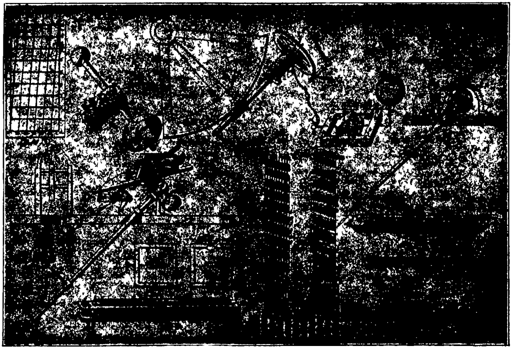

Fig 5

An engraving from Hooke's "Animadversions", showing Hooke's joint, the clock-driven telescope, the method of diagonal divisions, stepped and helical gears and the bubble level The last named is claimed for Thevenot, but there seems no doubt that Hooke invented it independently

Isaac Newton: Laws and Hypotheses

There is general agreement that Newton is the greatest scientific mind that the world has known. He produced that body of mechanics, founded on a few precise laws—the three laws of motion and the inverse square law of gravitation—which, in its essence, is still sufficient to cover the whole body of celestial and terrestrial mechanics of macroscopic bodies moving with velocities small compared with that of light He founded the science of mathematical physics, and was, in addition, an experimenter of the very highest order, as his "Opticks" and, for example, his experiments with pendulums suffice to show He also stated with the greatest clarity the attitude which has dominated physics from his time until the present day, with possibly one or two very recent exceptions This attitude we cannot express better than in his own words,

> "Hitherto I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses, *hypotheses non fingo*, for whatever is not deduced from the phenomena is to be called an hypothesis, and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy. In this philosophy particular propositions are inferred from the phenomena, and afterwards rendered general by induction Thus it was that the impenetrability, the mobility, and the impulsive force of bodies, and the laws of motion and of gravitation, were discovered To us it is enough that gravity does really exist, and act according to the laws which we have explained, and abundantly serves to account for all the motions of the celestial bodies, and of our sea "

His attitude here expressed is in direct contradiction to that of Descartes, who made hypotheses as a result of pure reflection and from these hypotheses constructed the world.

The history of Newton's theory of gravity begins at Woolsthorpe, where he was in 1665–66 to avoid the plague His own account of this period was written in 1714, and his recollections may have been coloured by what had happened in the intervening period, but his words are of such interest that I cannot refrain from giving them .

> "In the same year (1666) I began to think of gravity extending to the orb of the moon, and having found out how to estimate the force with which a globe revolving within a sphere presses the surface of the sphere, from Kepler's Rule of the periodical times of the planets being in a sesquialterate proportion of their distances from the centres of their orbs I deduced that the forces which keep the planets in their orbs must [be] reciprocally as the squares of their distances from the centres about which they revolve and thereby compared the force requisite to keep the moon in her orb with the force of gravity at the surface of the earth, and found them answer pretty nearly All this was in the two plague years of 1665 and 1666, for in those days I was in the prime of my age for invention, and minded mathematics and philosophy more than at any time since "

The extraordinary thing is that, at the time, Newton published nothing on the subject—extraordinary, perhaps, but less extraordinary with Newton than with any other man, because he always had to be urged to publication, largely, I think, because of his horror of controversy The generally accepted story is that, owing to a discrepancy of some 16 per cent, due to his taking an incorrect radius of the earth then current, Newton put the work aside, being dissatisfied with this degree of accuracy This does not, however, seem likely nobody better than Newton could estimate what degree of precision was likely to have been attained in a given measurement We must remember the hypotheses on which the calculation is based, namely, that the gravitational effect of the earth extends to the moon, falling off inversely as the square of the distance, and that the gravitational acceleration at the surface of the earth is only another manifestation of the earth's attraction. It is clear that when we are considering the moon it does not much matter at what particular point of the earth we consider the earth's mass to be concentrated, but when we are considering the surface acceleration this point is of the greatest importance. It is far from being obvious that the gravitational force at the surface of a sphere, each small part of which is exerting a force proportional to its mass and inversely proportional to the square of the distance, is the same as it would be if the whole of the mass of the sphere were concentrated at its centre Until this has been proved the whole calculation is unsatisfactory, especially to a mind so acute and so scientifically honest as that of Newton He would see at once that criticism could fasten on this point, and it seems far more likely that he put aside the work on account of his inability to answer such criticism than on account of the discrepancy to which his silence is usually attributed

By 1685 Newton had succeeded in proving that the gravitational attraction of a spherical shell of uniform density on an external point is the same as it would be if the mass were concentrated at the centre There was another point of difficulty it was by no means clear *a priori* that the gravitational attraction was proportional to the motional inertia of a body, or that the ratio of the two was the same for all bodies This point Newton settled by his famous experiments of the hollow pendulum carried out with enclosures of equal masses of very different substances—metals, glass, sand, salt, wood, wheat

The incident of 1679, to which we have referred, brought Newton back to the problem of the orbit of a particle in a central gravitational field In January 1683/4, Edmond Halley had a talk with Christopher Wren and Hooke on this problem All three, apparently, tended towards the belief that celestial mechanics could be explained on the inverse square law of attraction, and Hooke declared that he was able to demonstrate this mathematically Wren said that he would give a prize of "a book of 40s " to either of the others who could, in fact, bring a convincing demonstration It is quite clear that Hooke never did so, and equally clear that he was incapable of such a mathematical feat In August 1684, Halley, being at Cambridge, asked Newton what would be the curve described by a planet in an inverse square field of force and Newton immediately answered, "An ellipse", and, in reply to an amazed inquiry, said that he had calculated it Later he produced the proof

There is no space here to discuss how Halley instigated Newton to write the "Principia", saw the work through the press, and, although not a rich man, bore the charges It is pleasant to reflect that he probably got his money back, as the work sold very quickly. As a minor historical mystery there seems no certainty at what price it was sold. More says probably for ten or twelve shillings a copy.

The spirit of the Principia may be said to be summarized in the first sentence of the Opticks

My design in this Book is not to explain the Properties of Light by Hypotheses but to propose and prove them by Reason and Experiments The book is astonishingly rich in matter fundamental to mathematical physics containing for example the foundations of the theory of sound and of hydrodynamics The treatment of Descartes s theory of vortices is typical Newton points out that it is impossible on Descartes s theory to give a quantitative explanation of celestial mechanics in particular to deduce Kepler s laws In order to drag the planets round the fluid matter of the vortices must behave in a viscous manner Newton does not actually use the phrase viscous liquid but he lays down the fundamental behaviour of such liquids in the following hypothesis the resistance arising from the want of lubricity in the paths of a fluid is other things being equal proportional to the velocity with which the parts are separated from one another that is the shear in a viscous fluid is proportional to the velocity gradient From this he deduces that the periodic times of the paths of a fluid surrounding a revolving sphere are proportional to the squares of the distances from the centre of the sphere He further points out fundamental difficulties in the vortex hypothesis in connexion with the motions at perihelion He does not discuss the adequacy of the vortex hypothesis in general terms but demonstrates clearly that the hypothesis could not account for the observed laws of planetary motion The situation reminds us of the fate of the nineteenth century ether of space which gave the same kind of easily grasped picture as did the vortices but which had to be abandoned because it would not give the quantitative results required by the Michelson Morley experiment

Newton s attitude towards the question of the nature of gravitational force is typical of the man Richard Bentley pressed him strongly to declare himself on this point and we possess the letters which passed on both sides Two passages may be cited as of particular interest incidentally in the Royal Institution copy of Horsley s Newton these passages are marked in pencil and in each case we have the note at the side in Dr Bence Jones s handwriting Mr Faraday s marks Newton says

> You sometimes speak of gravity as essential and inherent to matter Pray do not ascribe that notion to me for the cause of gravity is what I do not pretend to know and therefore would take some time to consider it and again It is inconceivable that inanimate brute matter should without the mediation of something else which is not material operate upon and affect other matter without mutual contact as it must do if gravitation in the sense of *Epicurus* be essential and inherent in it And this is one reason why I desired you would not ascribe innate gravity to me That gravity should be innate inherent and essential to matter so that one body may act upon another at a distance through a *vacuum* without the meditation of any thing else by and through which their action and force may be conveyed from one to another is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it Gravity must be caused by an agent acting constantly according to certain laws but whether this agent be material or immaterial I have left to the consideration of my readers

This completes the particular story which I have tried to tell What Newton ignores is what Aristotle and Descartes tried to start with

I have endeavoured to show how within a century the method of constructing Nature by reasoning more or less logically from accepted philosophical ideas was replaced by the method of appealing to Nature by experiment and adopting only such laws as were in quantitative agreement with the results of experiment I have tried to point out how the search in the mind for first causes gave way to a search in Nature for observable order and regularity coupled with a disinclination to speculate beyond the facts In a recent Friday Evening Discourse at the Royal Institution Prof Dingle spoke of a return to the Aristotelian method which he detected and deprecated in the writings of one or two of our great contemporaries in science What s to come is still unsure—it may be that a new spirit in science is being born just as it may be that future ages will envy us for having been contemporary with the creation of Mr T S Eliot s austere poems and Mr Epstein s mighty monoliths Be the future however what it may it is the spirit of Newton that has guided us hitherto and that is the legitimate father of the work of a Faraday a Rutherford and a Bragg

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sponte circa Gissam nascentium which gained for him a considerable reputation The knowledge he showed of cryptogams induced William Sherard to persuade him to come to England mainly to help with the 'Pinex" he had undertaken on Tournefort's advice When Sherard died he left an endowment to found a chair of botany at Oxford stipulating that Dillenius should be its first occupant The drawings now received cover the whole period of Dillenius's activities, and include a set of copies from published works apparently made in his student days, the coloured figures of the fungi described in the Giessen catalogue, drawings of garden plants from Giessen, those in the third edition of Ray's Synopsis (which Dillenius edited) and many prepared and not used plants found on a Welsh tour in 1726, about 200 of plants growing in the Oxford Botanic Garden, 1744–46, Junci and Gramina Most of the material which Vines and Druce mention in 'The Dillenian Herbarium (1907) as having passed into the hands of Prof Humphrey Sibthorp and eventually disappearing and being no doubt irrevocably lost' has thus come to light The drawings show that Dillenius ranks much higher as a botanical artist than was generally thought It would be highly satisfactory if the numerous letters received by Dillenius from botanical correspondents could be similarly retrieved

Astrophysical Monographs

A VALUABLE new series of monographs on astrophysical subjects is being planned by the University of Chicago Press under the auspices of the *Astrophysical Journal*, the editorial board of this journal serving in a similar capacity for the new series Each monograph aims at being an exhaustive, comprehensive summary of a limited field written by an authority on the subject, and the whole should form a growing library of great use to astronomers and advanced students In the first monograph ("The Distribution of the Stars in Space" Sup Roy 8vo Pp xvi+124 Chicago University of Chicago Press, London Cambridge University Press, 1937 11*s* 6*d* net), Prof B J Bok deals with stellar statistics and galactic structure, dividing his subject into three sections—the methods of analysis, the data of observation, and problems of galactic structure In the first section a fuller treatment of the earlier mathematical methods, especially those developed by Charlier and others, would have been welcomed by many if the space had been available, but the necessary condensation has not impaired either the general sequence or clarity of this very readable mathematical section It has had also the advantage of allowing more complete and critical accounts of modern numerical methods of analysis and their application to determining the distance and absorbing power of a dark nebula The second section gives a useful summary of the relevant data of observation, and indicates where the need for further observations arises, while the last section deals with general problems of galactic structure of a more or less controversial nature Although his own views are freely expressed, the author succeeds in giving an impartial and stimulating account of the subject, together with some tentative conclusions suggested as working hypotheses to encourage further observational studies

History of Chemistry

WE have received a pamphlet by Prof E Pietsch, editor in chief of *Gmelins Handbuch der anorganischen Chemie*, which is entitled Sinn und Aufgabe der Geschichte der Chemie This is published by Verlag Chemie, Berlin, price 1 mark Prof Pietsch shows in a very convincing way the great utility of a study of the history of chemistry in the education of young chemists He deals with the subject in its cultural aspects and makes clear how such a study can do much to remove the dangers of over specialization now threatening chemists in the enormous development of minute detail which is occurring in the science He also shows that a knowledge of past problems can lead to a great economy of time and effort, since in many cases large amounts of time and trouble have been expended on matters which have been fully dealt with before but forgotten A knowledge of the history of applied chemistry also has a distinct commercial value, examples of which are given The text includes a very brief but surprisingly complete sketch of the history of chemistry taken as a whole, with its great periods of development The pamphlet is characterized by a maturity and a philosophical outlook which recommend it to all thoughtful students of science, and to chemists in particular it should prove stimulating and suggestive

Midland Naturalists' Union

REPRESENTATIVES of natural history societies in the Midlands meeting in the rooms of the Birmingham Natural History and Philosophical Society on June 18 unanimously decided to form a Midland Naturalists Union, membership of which is open to natural history archæological and similar societies in the counties of Monmouth, Hereford, Worcester, Warwick Leicester Rutland, Nottingham and Lincoln It is intended to organize an annual congress, several field meetings and in larger towns, a number of lectures during the winter months A list of lecturers willing to visit societies, a panel of referees for specimens and information in the various groups of plants and animals and other branches of natural history and archæology and a system of lantern slide exchange among members, are also being organized It is felt that the Union will facilitate co operative work among the societies as well as bring workers into touch with others in their own branches of the subject Further information may be obtained from the honorary secretary, G Brian Hindle, 55 Newhall Street, Birmingham

"Dechema"

THE annual meeting of the "Dechema" held in Berlin at the end of April was attended by about 500 people, a testimony both to the interest attached to chemical engineering subjects and to the organizing energy of its director, Dr Bretschneider Three reports dealt with standardization, one having relation to technical terms, another to drawings and a third to corrosion from the point of view of rendering measurements of corrosion made in different laboratories comparable At the Rome Conference of Chemistry it was agreed that certain questions of chemical standardization should be discussed internationally A further subject was the possible methods of testing chemical apparatus, which is notably subject to rapid wearing, without destroying it as is usual in engineering practice with test pieces A second lecture on corrosion dealt with recent efforts to make metal vessels stand up to hydrochloric acid, this is one of the outstanding problems of the chemical industry

Dismissals of Scientists in Vienna

IN addition to the scientific workers named in the letter under this title in NATURE of June 18, p 1101, Miss Margaret Gardiner has received the following further list of dismissals University of Vienna Prof Emil Dittler, mineralogist, Prof Arnold Durig, physiologist, Prof Kasimir Graff, astronomer Prof Friedrich Kottler, physicist, Prof Karl Menger, mathematician, Prof Hans Leitmeier, mineralogist, Prof Hans Przibram zoologist, Technical High School Prof Alfons Klemenc, chemist, Prof Wolfgang Johannes Muller, chemist

Conference on Elasticity and Plasticity

A CONFERENCE on 'Elasticity and Plasticity will be held under the auspices of the Institute of Physics (Manchester and District Branch) in the Physics Department of the University of Manchester on July 4–5 On July 4 the opening lecture by Prof G I Taylor will take the form of a general theoretical survey, and will be followed by lectures on the elastic properties of metals by Dr R W Bailey, and on the plastic properties of single crystals by Prof E N da C Andrade On July 5, lectures will be given by Dr F T Peirce on the elastic properties of fibres, by Dr J B Speakman on the elastic properties of wool, and by Dr W G Wearmouth on the elastic and plastic properties of synthetic resins Each lecture will be followed by discussion Visitors will be welcome Further particulars may be obtained from the Honorary Secretary of the Branch, Dr W H Taylor, Physics Department, College of Technology, Manchester, 1

Royal Sanitary Institute

THE Health Congress of the Royal Sanitary Institute will be held at Portsmouth under the presidency of the Earl of Bessborough on July 11–16, when the following subjects among others will be discussed the future of the general hospital, the defects found in school entrants and the steps to be taken before entering school life, behaviour and nervous diseases in children, food manufacturers contributions to public health, the Food and Drugs Act 1937, meat and food inspection and air raid precautions The Health Exhibition arranged in connexion with the Congress will include foods, sanitary appliances, and exhibits illustrating municipal action and hygiene in the home Further information can be obtained from the Secretary of the Institute, 90 Buckingham Palace Road, London, S W 1.

Announcements

THE Committee of the Privy Council for the Organisation and Development of Agricultural Research has appointed the Earl of Radnor, lord warden of the Stanneries, chairman of the Lawes Agricultural Trust, and a member of the Council of the Royal Agricultural Society of England, and (after consultation with the president of the Royal Society) Sir Joseph Barcroft, emeritus professor of physiology in the University of Cambridge, and formerly Fullerian professor of physiology in the Royal Institution, to be members of the Agricultural Research Council in succession to Lord Richard Cavendish and Sir Frederick Gowland Hopkins Sir Thomas Middleton is succeeding Lord Richard Cavendish as chairman of the Council

PROF MAX PLANCK of Berlin, who is an honorary fellow of the Royal Society of Edinburgh was the guest at a dinner held in his honour in the rooms of the Society on June 23 The president, Sir D'Arcy Wentworth Thompson, was in the chair

DR W H GEORGE, lecturer in physics at University College, Southampton has been appointed head of the Department of Physics at Chelsea Polytechnic, in succession to Dr L Lownds, who is retiring after thirty seven years service

DR C E FORD, demonstrator in botany, King's College University of London has been appointed geneticist to the Government Rubber Research Scheme, Ceylon

COLONEL CECIL BIRT, late I A M S, who died on March 18, left estate of the gross value of about £35 000 He bequeathed all his property, subject to life interest to the Library Endowment Fund of the Royal Society of Medicine in appreciation of the services which the library renders to fellows

The Selborne Society has started a fund for a memorial to the late Lord Leigh, who, during the ten years that he was president of its section which arranges visits to people and places of interest, took an active part in the work of the Society Mrs E M Richardson Rice, who introduced Lord Leigh to the Selborne Society in the year 1926, has consented to receive contributions at 67 Eardley Crescent, Earl's Court, S W 5

PROF HEINRICH GINS, director of the Robert Koch Institute for Infectious Diseases of Berlin, has been elected an honorary member of the Bulgarian Postgraduate Institute of Veterinary Surgeons

AN international course in leprosy will be held on July 18–September 17 at the Institute of Malariology in Rome The lectures, which are intended for foreign medical men, will be delivered in French. Further information can be obtained from the director of the Institute, Prof G Bastianelli, Policlinico Umberto 1, Roma.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 40.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Optical and X-Ray Examination and Direct Measurement of Built-up Protein Films

Blodgett, Langmuir and co-workers[1] have described how piles of protein monolayers may be built up on a chromium plated metal slide by successive vertical movements of the latter through a monolayer spread on a liquid substrate. Following this technique, we have built up from recrystallized egg albumin at its isoelectric point films composed of up to 1,764 monolayers.

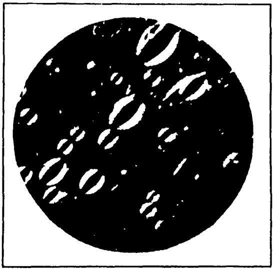
Our first apparatus was operated by hand, but a later design, which will be described in detail elsewhere, was automatic and enclosed, the film being dried for four minutes in a stream of nitrogen after each upward movement.

X-ray examination of even the thickest films *in situ* gave only disappointing results, because of the overwhelming effect of reflections from the metal slide itself; but fortunately it was found that the thicker films could be stripped off, and the way was at once opened up to a variety of experiments.

The first observation of significance was that the films tend to tear parallel to the direction in which the slide was moved through the liquid surface. The next was that, unlike built-up films of barium stearate for example[2], they are birefringent when viewed perpendicular to the surface, and the slow vibration is also parallel to the direction of movement of the slide. The most striking discovery, however, was that our first thicker films show numerous boat-shaped holes—presumably negative tactoids—again all pointing parallel to the direction of movement of the slide, and framed by regions of much higher birefringence still. The accompanying illustration is a photomicrograph between crossed nicols of a stripped film of 1,764 monolayers at 45° to the extinction position. The birefringence of the intact film approaches that of wool, while in the immediate neighbourhood of the holes it is at least as high as that of natural silk (0·05)*. This preliminary optical examination indicates also that the fastest vibration lies in the plane of the film, and the intermediate vibration lies perpendicular to the film.

The most perfect film, of 1,450 monolayers, was built up with the improved apparatus. Its optical properties were similar, but the boat-shaped holes were absent. In compensation, though, it offered a piece of evidence perhaps even more convincing than that of the tactoids—a fringe of delicate, but very real, fibres, once more parallel to the direction of movement!

By dint of repeated folding, stripped ribbons of film were formed into flat, correctly oriented, pads and photographed by X-rays. The photographs correspond to polypeptide chains lying roughly parallel to the direction of movement of the slide, with their side-chains roughly perpendicular to the plane of the film. The dried films are obviously imperfect in the crystallographic sense, whatever they were at the moment of laying down; and they are not composed of 'globular' protein, in the sense of the original egg albumin molecule. The cohesive forces evoked by drying seem to have brought about aggregation at the expense of orientation, as one would rather expect, in view of the fact that the main chains, and still less the side chains, of successive monolayers will in general neither fit nor match. The simplest description of the X-ray photographs so far obtained is that they are analogous to those of keratin that has been squeezed laterally in steam[3]; this treatment not only brings about the α–β transformation, but also tends to orient the side chains perpendicular to the plane of flattening. Actually, some of the film photographs show more reflections than those of keratin, and there is a distinct hope that with better orientation of the main chains it may be found possible to determine the amino acid period.



Two further deductions deserve special emphasis. The first is that since the up and down movement of the slide through the monolayer on the substrate has resulted in the deposition of polypeptide chains roughly parallel to the direction of movement, we have here the familiar process of spinning long-chain molecules[4], *and the chains must pre-exist on the surface of the substrate*: there cannot be groups closed more tightly than can be opened and oriented by the movement of the slide. The second deduction is that since there is apparently no thickening of the film round the negative tactoids comparable with the great increase in birefringence, the latter must be due to more perfect parallelism of the chains , and since the enhanced birefringence agrees with that of oriented polypeptide chains almost devoid of all but the shortest side chains, namely, those of natural silk, we have a peculiarly satisfying demonstration, quite apart from the X ray evidence that the side chains do indeed tend to lie perpendicular to the plane of the film, as had already been inferred from monolayer studies[5] and from independent X ray data[6]

Finally, we have succeeded in measuring the thickness per monolayer by direct mechanical means Our first method was to insert the film under one of the feet of a small three legged interferometer*, thus altering the angle of an air wedge included between two pieces of optically flat glass, the upper piece being attached to a balanced metal frame supported by the three legs, and the lower forming the actual table on which rested the film and the three feet By this means—and it should be noticed that no optical properties of the film itself are invoked—we have measured the thickness of films composed of 600, 800, 1,000, 1,450 and 1 764 monolayers, respectively, and the results all agree in fixing the thickness per monolayer at about 9½ A , and not 20 A as was first suggested[7] The value 9½ A agrees well with the side chain spacing given not only by the films under discussion, but also by β proteins in general

The second method was by way of being a *tour de force*, but it was sufficiently accurate to point once again to a thickness per monolayer of about 10 A It consisted in measuring the thicknesses of various folded pads of film with a screw micrometer ! Need less to say, the thrill of being able for the first time to measure the thickness of a protein chain by such a means far outweighed the satisfaction derived from the more elegant methods

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Florence O Bell
Textile Physics Laboratory,
University of Leeds

E Gorter
J Van Ormondt
Hospital for Children s Diseases,
Leyden

June 10

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* For this measurement of the birefringence of silk and also for collaboration in constructing the small interferometer we are indebted to Mr H J Woods

[1] Blodgett, K M *J Amer Chem Soc*, 57 1007 (1935) Langmuir I Schaefer V J and Wrinch D M *Science* 85 ~6 (1937)

[2] Blodgett K M and Langmuir I *Phys Rev* 51 964 (1937)

[3] Astbury W T and Sisson W A *Proc Roy Soc* A 150 533 (1935)

[4] Cf the spinning of fibres from denatured globular protein Astbury W T Dickinson S and Bailey K *Biochem J* 29 2351 (1935)

See numerous papers by Gorter Rideal and co-workers

[6] Astbury, W T, *Trans Faraday Soc*, 29 193 (1933) Nature 137 803 (1936) *Chem Weekbl* 33 778 (1936)

[7] Langmuir, I. Schaefer V J and Wrinch D M *Science* 85 76 (1937)

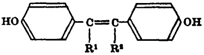
Œstrogenic Activity of Alkylated Stilbœstrols

In a previous communication[1] we described the œstrogenic activity of 4 4'-dihydroxy α β diethyl stilbene (diethylstilbœstrol) It was shown that this substance was fully œstrogenic in doses of 0 004 mgm given subcutaneously dissolved in oil, and 0 001 mgm. when given by mouth It is thus several times more potent than œstrone and at least as potent as œstradiol The following communication is concerned with the activity of a series of compounds in which substituents other than the ethyl group are attached to the α and β carbon atoms The method of testing was on ovariectomized rats by the usual technique

Table 1 indicates the results in this series of compounds and gives the potency of the substances in relationship to œstrone In view of the fact that maximum activity is represented by diethylstilbœstrol, a number of esters of this substance have been prepared and are being tested

In Table 2 will be found the activity of a series of derivatives of dihydroxydiphenylbutadienes Here again the maximum activity is present in 4 4' dihydroxy γ δ diphenyl β δ hexadiene This substance appears to possess an activity equal to that of diethylstilbœstrol The correspondence in the effects of substituents in the two series is noteworthy and the large effects of relatively small changes may be thought to support our view that the middle section of the molecule conforms to the œstrone pattern when the substituents are ethyl or ethylidene groups

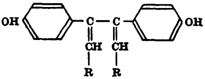
Table 1



R^1	R^2	Dose in mgm	% Positive	Units per gram estimated
H	H	5	80	140
		10	100	
H	C_2H_5	0 1	50	5 000
CH_3	CH_3	0 02	80	40 000
		0 03	100	
CH_3	C_2H_5	0 0005	30	1 000 000
		0 001	100	
C_2H_5	C_2H_5	0 0003	80	3 000 000
		0 0004	100	
C_2H_5	n C_3H_7	0 001	trace	300 000
		0 01	100	
n C_3H_7	n C_3H_7	0 01	75	50 000
		0 1	100	
n C_4H_9	n C_4H_9	0 01	nil	5 000
		0 1	40	
Monohydroxy diethylstilbene		0 1	trace	
		1 0	100	

Œstrone administered in oil under the same conditions has activity approx 700 000 units per gram

Table 2



	Dose in mgm	% Positive
4 4 Dihydroxy β γ-diphenyl butadiene (R = H)	10	100
	1	trace
4 4 Dihydroxy γ δ diphenyl β δ-hexadiene (R = CH_3)	0 0005	100
	0 0004	70
4 4 Dihydroxy-δ ε diphenyl γ ε-octadiene (R = C_2H_5)	0 01	100
	0 002	nil
β γ-Di(4 hydroxyphenyl)-α δ-diphenyl butadiene (R = C_6H_5)	10	nil

The substances mentioned in Table 2 were prepared by dehydration of the appropriate pinacols and the new substituted stilbenes were obtained by applications of the methods previously described.

In the former communication[1] the name of one of us (L. G) was spelt incorrectly.

Courtauld Institute of
Biochemistry,
Middlesex Hospital, W 1
Dyson Perrins Laboratory,
University of Oxford

E C Dodds.
L Golberg
W Lawson.
R. Robinson.

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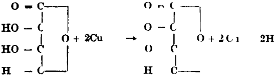
[1] Dodds, Golberg, Lawson and Robinson, Nature, 141, 247 (1938).

Polarographic Estimation of Vitamin C

AQUEOUS solutions of vitamin C, when electrolysed at the dropping mercury cathode, do not produce any effect on the current voltage curves. If, however, to a solution of vitamin C—freed from air—a mild oxidizing agent, such as cupric chloride, silver nitrate, gold chloride, ferric chloride or iodine is added, a polarographic wave appears on the current voltage curve at − 1·60 v. (from the calomel zero). This wave has been shown to be due to the deposition of free hydrions liberated in the solution by the reaction

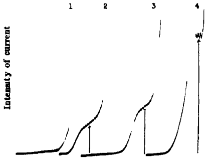


ascorbic acid

dehydroascorbic acid (anhydrous form)

This polarographic effect is not specific for vitamin C, as it may be also caused by the presence of other oxidizable compounds like glutathione or cysteine. It is remarkable that the oxidized form of vitamin C, namely, the dehydroascorbic acid, is not electro-reducible at the dropping mercury cathode. It probably changes irreversibly into a hydrated form.

However, a characteristic polarographic effect of vitamin C is obtained when the dropping mercury electrode is polarized as anode. Then a polarographic wave appears at about + 0·3 v. from the potential of a reversible hydrogen electrode and is shifted according to the pH of the solution. For practical purposes it is best to keep the solution at pH 7 in an $N/15$ phosphate buffer solution, in which the anodic effect of chloride ions or of glutathione does not interfere with the position of the polarographic wave of ascorbic acid (see the accompanying graph).



ANODIC WAVES DUE TO VITAMIN C.
CURVE 1: PURE $N/15$ PHOSPHATE BUFFER pH 7. CURVES 2 and 3: 0·5 AND 1·0 C.C. ORANGE JUICE ADDED TO 4 C.C. BUFFER SOLUTION. CURVE 4: 0·5 C.C. OF 0·01 M ASCORBIC ACID ADDED TO 4 C.C. BUFFER SOLUTION.
SENSITIVITY OF THE GALVANOMETER 10^{-7} AMP./MM. 1 CM. OF ABSCISSA = 0·2 VOLT.

We have ascertained that vitamin C may be estimated with the usual polarographic sensitivity and accuracy, like hydroquinone[1], that is, down to concentrations of 10^{-5} molar, which means 1 γ of vitamin C in the 1 c.c. necessary to carry out the analysis.

As vitamin C is polarographically active only in the reduced form, the analysis should be carried out in absence of air. For that purpose 0·5–1 c.c. of the fresh lemon or orange juice is added to 4 c.c. of the phosphate buffer (pH 7) freed from atmospheric oxygen. If the polarographic curve is recorded shortly after mixing, good results are obtained even in the presence of air.

Extractions from animal tissues, however, offer difficulties, inasmuch as other constituents seem to hinder the electrode reaction.

Full details of this investigation will be published elsewhere.

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IInd Internal Clinic,
Charles University,
Prague. May 22.

F. KODÍČEK.
K. WENIG.

[1] Müller, O. H., and Baumberger, J. P., *Trans. Electrochem. Soc.*, 71, 1 9 (1937).

Biological Assay of Vitamin E

THE recent communication from Karrer *et al.*[1] makes it inevitable that comparisons will soon be needed between the biological activities of various substances having the properties of the anti-sterility vitamin. In particular, interest is likely to centre round the relative potencies of the various tocopherols and of synthetic substances. The preparation in these laboratories of a curve relating dosage and response to vitamin E[2] has enabled us to interpret the results obtained with specimens of highly purified tocopherol allophanates, and so to contribute some evidence as to the relative activities of the α- and β-forms, a matter on which the literature contains rather indefinite reports.

In accordance with our practice, we have compared the mean fertility doses of the substances—that is, the doses that will cause 50 per cent of implanted animals to bear live litters. During the test all conditions are kept as uniform as possible, virgin animals only being used and the doses being divided into ten equal portions and administered every day for the ten days following positive mating. The table below summarizes the results so obtained; the figures for the mean fertility doses refer to weights of tocopherol calculated from the weights of the allophanates which were carefully hydrolysed and dissolved in cod liver oil for feeding to the test animals.

Substance	M.P.	No. of animals used	Mean fertility dose
α-tocopherol	160° C.	*9	1·2 mgm. (weighted)
β-tocopherol	142·3° C.	†6	1·9 mgm.

* At two different levels; a still higher dose gave 100 per cent fertility.
† At one dose level; tests at several lower doses gave almost complete sterility.

The specimens of tocopherol were both derived from wheat germ oil concentrates. The highly purified allophanates were prepared by Dr. A. R. Todd, for whose assistance we are very grateful, from crude allophanates supplied by Dr. B. K. Blount, of the Chemical Research Department in these laboratories.

Glaxo Laboratories Ltd.,
Greenford,
Middlesex. June 16.

A. L. BACHARACH.

[1] Karrer, P., Fritzsche, H., Ringier, B. H., and Salomon, H., NATURE, 141, 1057 (1938).

[2] Bacharach, A. L., Allchorne, E., *Chem. and Ind.*, 57, 600 (1938).

Vitamin E Synthesis of α-Tocopherol

THE recent announcement by Karrer Fritzsche Ringier and Salomon[1] makes it desirable for us to place on record the fact that we have also synthesized racemic α tocopherol by a rather simpler method namely, direct condensation of phytol with ψ cumoquinol by heating a mixture of these two substances in presence of a little zinc chloride This synthesis like that of the Swiss workers while it confirms the view originally expressed by ourselves[2] and by Fernholz[3] that the tocopherols are chroman or coumaran derivatives nevertheless fails to distinguish between the two types of structure

Karrer s arguments[4] in favour of a coumaran structure for the synthetic product rest on an assumption that phytyl bromide will condense with a phenol in exactly the same way as allyl bromide This assumption seems to us unjustifiable and it is indeed more probable that condensations of this type would lead to chroman structures when phytol derivatives are used Recent degradative evidence although inconclusive is on the whole more indicative of a chroman structure for the tocopherols[3,5]

On the synthetic side we have found that 6 hydroxychromans 5 hydroxycoumarans and α and β tocopherol are nearly identical as regards absorption spectrum reducing properties and effect of esterification on absorption spectrum

We are at present engaged on the synthesis of the tocopherols by unequivocal methods since it seems that only in this way can a final decision be reached as to their structure

F BERGEL
A JACOB
A R TODD
T S WORK

Biochemical Department
Lister Institute
London S W 1
June 17

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[1] NATURE 141 1057 (1938)

[2] Bergel Todd and Work *J Chem Soc* 253 (1938) Bergel Jacob Todd and Work NATURE 141 646 (1938)

[3] Fernholz *J Amer Chem Soc* 60 700 (1938)

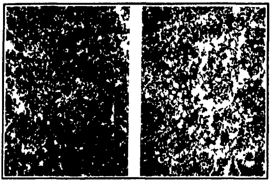
[4] Karrer Fritzsche Ringier and Salomon *Helv chim Acta* 21 520 (1938)

[5] Dietzel Günther and Emte *Naturwiss* 366 (1938)

Formation of Hæmolymph Glands in Tumour-Bearing Rats

A CHANGE has been observed in the appearance of the lymph glands of rats bearing a Jensen sarcoma, the animals being examined usually fifteen to eighteen days after the subcutaneous inoculation of the tumour While the lymph glands of normal rats were found to be almost entirely of a light yellowish colour a more or less large number of the lymph glands of the tumour bearing rats showed, to a varying extent and degree a red discoloration The change occurred in glands of all regions although unequally and in an irregular manner in different animals The size of the tumour and the age of the animal, within the given limits, appeared to have little influence

Microscopical examination of these lymph glands showed that a conversion into more or less pronounced hæmolymph glands had taken place The normal lymph tissue had to a varying extent disappeared Its place was, in the first instance taken by red blood corpuscles, which were more or less densely aggregated Among them could be observed, in most cases, a considerable number of particularly large, sometimes pigmented cells, probably the descendants of normal (non lymphocytic) tissue cells The whole of this structural change is evident from a comparison of the accompanying illustrations In each is illustrated part of a section through a lymph gland taken from the left axilla of a female rat (*a*) referring to a normal animal (weight about 170 gm) and (*b*) to an animal bearing, at the right side a sarcoma of more than 50 gm weight (animal weight without tumour about 160 gm inoculation fifteen days before examination)


(*a*) (*b*)

STRUCTURE OF A LYMPH GLAND (*a*) FROM A NORMAL RAT (*b*) FROM A TUMOUR BEARING RAT HÆMATOXYLIN—EOSIN (× 120)

The simplest explanation of the origin of this change appears to be that it is due to the action of a certain substance produced by the growing tumour cell Investigations with the aim of finding out the chemical nature of this substance are now in progress In this connexion it is of interest to note that a similar change was previously observed in the lymph glands of rats which had received a series of subcutaneous injections of a preparation of carcinogenic tar[1] Further it is important that Clarkson Mayneord and Parsons[2] have obtained a corresponding result with the lymph glands of animals which had been irradiated with X rays In addition the authors mentioned that a derivative of 1 2 5 6 dibenzanthracene was likewise capable of producing the change

A LASNITZKI
M LASNITZKI

Cancer Research Department
University of Manchester
June 2

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[1] Lasnitzki A *J Hygiene* in the press

[2] Clarkson J R Mayneord W V and Parsons L D *J Path and Bact* 46 221 (1938)

Kallikrein as a Reynals Factor

THE spreading or diffusing factors also termed Reynals factors or shortly *R* factors after F Duran Reynals[1], who found these factors in watery extracts of testicle of mammals are endowed with the property of enhancing tissue permeability When indicators, such as Indian ink, trypan blue or diphtheria toxin are added to such extracts and a certain amount of the mixture is injected intracutaneously in rabbits, an extensive spread of the particles of Indian ink trypan blue or the toxin takes place, resulting in much larger coloured or inflamed areas than can be obtained by mixing other substances (excluding the few other *R* factors) with the indicators As a control in experiments with *R* factors a mixture of 0 9 per cent sodium chloride with the indicator is generally used

Duran-Reynals has found the *R* factors in lesser amounts in several other organs D McClean[2] found the factors in certain anaerobic bacteria. E. Boyland and D. McClean[3] showed the existence in relatively great amounts of spreading factors in malignant transplantable tumours, in embryos and in placenta A. Claude[4] demonstrated the factors in leech extract, especially in extracts of the head of the leech

Recently, *R.* factors were found constantly present in human urine (J F. Christensen[5]) In a search for the substance responsible for the spreading effect of urine, an examination was made of Kallikrein, which was found in repeated experiments to be as active as, or even more active than, the *R* factor from testis in spreading properties An example will illustrate this : Solutions containing 30 mgm. of Kallikrein per c.c. and 3 mgm. Kallikrein per c c and solutions of the same concentrations of a purified testis extract were prepared To these solutions and to a control solution of 0·9 per cent sodium chloride were added equal amounts of diphtheria toxin diluted 1–1,000, 0·25 of each solution was injected intracutaneously in rabbits, in the shaved skin of the back.

With the Kallikrein solutions, the areas of inflammation produced were 47·8 cm ^{2} and 33·9 cm ^{2} respectively. With testis extract the areas obtained measured 29 6 cm ^{2} and 21·1 cm ^{2} respectively The control area . 5·6 cm ^{2} Measurements were made 24 hours after injection

Titrations to the end-point are being carried out A new method for standardizing Kallikrein seems possible

The identity of the various *R* factors has never been established and little is known of their chemistry. In all known respects—solubility, precipitability, sulphur reaction, diazo-reaction, non-diffusibility and nitrogen content—Kallikrein is in accordance with the testis factor. It seems as if testis extract (*R* factors) has not been examined for blood pressure lowering effect. As the preparation of *R* factors from testis by the methods used hitherto involves at least a contamination with activated Kallikrein from the blood content of the organ, a blood-pressure lowering effect of the *R.* factor preparations from testis may be expected

Details and further experiments will be published shortly.

J F CHRISTENSEN

Radiumstationen for Jylland,
Aarhus, Denmark
June 1.

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[1] Duran-Reynals, F , *J Exp. Med* , **65**, 661 (1937)

[2] McClean, D , *J Path and Bact* , **42**, 457 (1936)

[3] Boyland, E , and McClean, L , *J Path and Bact* , **41**, 553 (1935)

[4] Claude, A , *J Exp Med* , **66**, 353 (1937)

[5] Christensen, J. F , *Hospitalstidende*, **81**, 572 (1938)

Intense Radioactivity of the Superficial Ocean Floor

IN connexion with a recent discussion on the relation of the existing degree of terrestrial isostasy to the broken stratification that often accompanies it[1], a report of delicate investigations of core samples of some length taken from the mud of the deep ocean bottom (where there is excess of isostasy by stretching[2]) initiated and carried out for some years with great ingenuity by the Carnegie Geophysical Laboratory at Washington, D.C., thus exposing the course of recent geological history, and especially the excessive radioactivity (already somewhat in evidence) revealed in these superficial soft cores, is a development not to be overlooked[3].

The early results of the present Lord Rayleigh, Dr Joly, and others had shown that if the radium content of the surface rocks were to continue undiminished downward towards the centre of the earth the generation of heat arising from its degradation alone would be far in excess of the observed total output of terrestrial heat at the surface It has to be presumed, therefore, that when the earth's contents settled down originally into a planet, the deposition of uranium, the parent of radium, in the central parts was prohibited, by some agency which it is for the chemists to explore, so that it was gradually pushed up towards the surface The point now to be made is that this would be quite in keeping with Dr Piggot's ingenious and interesting theory, that it is to the chemical interactions endured by the uranium in the oceanic waters that the excessive deposit downward of uranium, and therefore of the more transient radium, which is found on the outer skin of the oceanic floor, must be traced[4] This additional indication towards the ways in which the various features of the geophysical landscape, such as stratigraphy, isostasy, radioactivity, can unexpectedly interlock must here suffice

JOSEPH LARMOR.

Holywood,
N Ireland
May 30

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[1] NATURE, **141**, 603, 906 (1938)

[2] Note that the hyper-isostasy, and the stretching that has thinned the ocean bed, and its depression which could not be primeval, are here all correlated

[3] Piggot, C S , "Core Samples of the Ocean Bottom and their Significance", in recent "Papers from the Geophysical Laboratory"

[4] It is reported that investigation as to the total depth of the deposit is now in progress at Cambridge by E C Bullard

Micro-Organic Rock Weathering

THE following results obtained in 1922 by the late Sir John Harrison, formerly director of science and agriculture in British Guiana, may interest pedologists They represent the chemical composition of percolated water that had passed through sterilized granular masses of dolerite and of granite packed into four glass cylinders set up in the laboratory. In two experiments, the materials were inoculated with washings from the surfaces of weathering rock of the same kind , in the other two, the conditions throughout were sterile.

The comminuted rock, passing a 40 mesh to the inch sieve, but not a 100 mesh sieve, weighed about one kilogram in each experiment Sterilized water was added to each cylinder every other day on twenty-five occasions The volume of the collected drainings in each experiment was 1,600 c.c., the rate of percolation being adjusted to 13 c.c. per hour during the successive 5-hour periods of the treatment. The rock grains were thus intermittently covered with stationary water-films for a total period of 1,075 hours.

The chemical analyses were performed by Mr. G. C. L. Bourne, assistant chemist in the British Guiana Department of Agriculture ; thanks are due to him for abstracting the data from Sir John Harrison's posthumous records, and to Prof. J S. Dash, director of agriculture, for permission to publish them

The degree of hydrolytic weathering is greater (by 33 and 19 per cent respectively) for the inoculated rock materials ; the increases mainly concern calcium and magnesium among the basic radicals, and carbonate (or bicarbonate) among the acidic radicals. Ferrous iron seems to have been oxidized to ferric in the inoculated materials.

Analytical Results (expressed in parts per million)

Radical	Dolerite		Granite	
	Sterile	Inoculated	Sterile	Inoculated
K	11.6	14.6	16.9	14.1
Na	33.6	48.0	29.3	24.5
Ca	47.7	69.5	13.3	33.4
Mg	12.6	20.8	2.0	3.4
Fe (ous)	2.9	0.8	4.3	1.4
CO_3	64.6	134.8	63.7	93.0
SO_4	154.7	150.1	21.5	14.4
Cl	1.7	1.6	1.9	1.6
SiO_3	11.1	10.9	12.5	11.1
Salinity	339.5	451.1	165.4	196.9
per cent increase		3		19

That micro-organisms may be involved in rock weathering had previously been suggested by Sir Thomas Holland in his account of the origin of laterite in the humid tropics[1]; other authorities have more recently suggested that they might also be involved in the decay of building stones.

F. Hardy.

Imperial College of Tropical Agriculture,
Trinidad.
May 4.

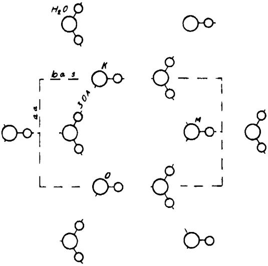
[1] *Geol. Mag.*, 10, 59-69 (1903).

Crystal Structures of the Clay Mineral Hydrates

The manner in which water is adsorbed on clays has long been a matter for speculation. Structure determinations for the clay mineral hydrates throw new light on this question. These hydrates are the minerals vermiculite, hydrated halloysite and montmorillonite. Their compositions, subject to isomorphous replacements, are $(OH)_4Mg_6Si_8O_{20}.8H_2O$, $(OH)_8Al_4Si_4O_{10}.4H_2O$ and $(OH)_4Al_4Si_8O_{20}.nH_2O$ respectively. Each structure contains sheets formed by joining tetrahedra of oxygen atoms around silicon atoms into interlocked hexagonal groupings as first described by Pauling[1]. These are combined with octahedra of oxygen atoms and hydroxyl ions about magnesium and aluminium ions forming layers the compositions of which in a unit are given by the above formulæ.

It is now shown that such hydrates contain layers of water molecules as illustrated in the accompanying figure and that these are interleaved with the silicate structure. Their stability derives from the attraction between hydrogen atoms of one water molecule and oxygen atoms of other water molecules after the manner of hydroxyl binding as described by Bernal and Megaw[2]. Since each side of a hexagon corresponds to a single hydrogen atom, hydrogen atoms of half the water molecules, *K*, *M* and *O* of the figure, must be directed away from the net. These bind the water network to oxygen atoms in the top of the silicate layer, there being similarly placed oxygen atoms in that layer. In vermiculite there are two such sheets of water molecules between the silicate layers, the upper and lower surfaces of which are formed of oxygen atoms. Hydrated halloysite, on the other hand, has but a single sheet since hydroxyl groups form the bottom of the silicate layer[3].

Montmorillonite, the swelling clay, also probably forms hydrates of this type. Information in the literature is misleading in that it indicates (*a*) too great an amount of water and (*b*) a continuous change of (001) spacing with water content. In the first instance the total water is not a measure of the amount between the layers since it includes surface adsorption which is also of the sheet type. Continuous change of spacing does not mean a continuously varying separation of layers but can as well arise from random combination of a few definite values corresponding to 0, 1, 2, etc., sheets of water molecules per silicate layer.



This hexagonal network of water molecules is somewhat related to the hexagonal rings of hydroxyl groups in boric acid, H_3BO_3[4]. It more closely resembles the hexagonal ring of water molecules in $(CH_3CHNH)_3.3H_2O$, which is the hydrated polymer of acetaldehyde ammonia[5]. However, the clay mineral hydrates differ from this compound in that the oxygen atoms form an hexagonal network in which they are quite closely coplanar.

Sterling B. Hendricks.

U.S. Bureau of Chemistry and Soils,
Washington, D.C.
May 28.

[1] *Proc. Nat. Acad. Sci.*, 16, 578 (1930).
[2] *Proc. Roy. Soc.*, A, 151, 384 (1935).
[3] Hendricks, *Am. Mineralogist*, 23, 295 (1938).
[4] Zachariasen, *Z. Krist.*, 88, 150 (1934).
[5] Moerman, *Z. Krist.*, 98, 447 (1938).

Model Experiments on the Minimization of Structural Vibrations caused by Seismic Disturbances

Even should the design of earthquake-resistant structures be based on stiff constructions resistant even under resonance against seismic vibrations of relatively low frequencies, it has not been possible as yet to average out the pronounced peaks in the seismic vibration curves of resonances; in the seismic vibration the amplitude is particularly large in the horizontal direction and the vibration of structures is most sensible for the horizontal movement of the foundations. Experiments have been made therefore on the horizontal movement of a model foundation table. After several experiments with different conditions of loading, it was found that vertical loads placed on a group of shot (ball or spheres of equal diameter) are very effective as a practical method of flattening the resonance curve, the load on the shot acts as a very good damper of the vibration, and is more effective the nearer to the roof it is placed.

Fig. 1 shows the free vibration curve of a frame structure (4 × 20 cm = 80 cm high, 20 cm. bay and 1 cm thick), the load conditions and period of which are indicated in the figure Fig 2 shows the same free vibration curve damped by an indirect load on ball-bearings, the load conditions of which are indicated in the figure These damping characteristics are the principal object of the studies described in the present note

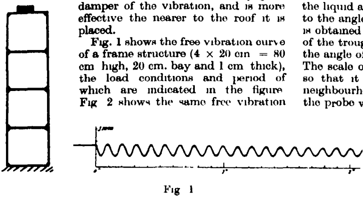


Fig 1

DIRECT LOAD, 435 gm , DEAD LOAD, 860 gm , PERIOD, 0·125 sec

I wish to express my thanks to the Council of the Japan Society for the Promotion of Scientific Research, with the aid of which the present investigation, including some hundred model experiments of a similar kind, has been made possible

F TAKABEYA.

Hokkaido Imperial University,
Sapporo

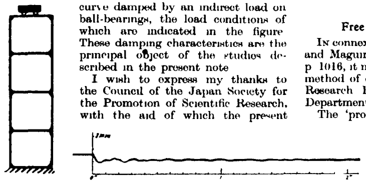


Fig. 2

INDIRECT LOAD ON BALL-BEARINGS, 400 gm , WEIGHT OF BALL-BEARINGS, 35 gm , DEAD LOAD, 860 gm

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Electrolytic Field Plotting Trough for Circularly Symmetric Systems

THE method of plotting electrostatic equipotentials between conductors by measuring the potentials in a geometrically similar problem in conduction is very old and well known. We have applied this to a modified form of electrolytic trough which we have been using in this laboratory for the past four years. This has been specially designed for circularly symmetric systems.

It is always permissible in problems of conduction to introduce along any surface an insulating barrier across which there is no flow of current. We have applied this to circularly symmetric systems by cutting the system along two diametrical planes, thus obtaining a liquid wedge. Such a wedge is realized in practice by a tilted trough containing electrolyte resting on a plane insulating bottom. If the angle of the wedge is small, the electrodes used in it need not be surfaces of revolution but can be replaced by pieces of metal sheet bent to the shape of a longitudinal section of the actual electrode

A trough of the type described gives very satisfactory results if a few minor precautions are taken. It is necessary to produce a contact angle between the liquid and insulating bottom which approximates to the angle of the wedge as nearly as possible This is obtained by allowing the liquid to wet the bottom of the trough only up to the axis. Then by reducing the angle of tilt the desired contact angle can be got. The scale of the system is made as large as possible so that it is unnecessary to plot the field in the neighbourhood of the axis where capillary rise on the probe would introduce serious error In addition to the above-mentioned precautions it is, of course, necessary to observe all the usual points in working with an A C electrolytic bridge

M BOWMAN-MANIFOLD
F H NICOLL.

Research Laboratories,
Electric and Musical Industries, Ltd ,
Hayes, Middlesex May 27.

Free Field Calibration of Microphones

IN connexion with the contribution by Messrs King and Maguire to this subject in NATURE of June 4, p 1016, it may be of interest to refer to a very similar method of calibration which has been in use by the Research Branch of the Post Office Engineering Department since 1933

The 'probe tube' device to which I refer[1] is so constructed that reflections of sound in the tube are practically eliminated This means that the acoustical impedance presented by the open end of the tube is substantially non-reactive The open end can therefore be exposed at one of the closed ends of the resonant air column which is used for calibrating, without affecting the positions of the nodes and anti nodes in the stationary wave system set up in the air column. The air particle velocity is measured by a Rayleigh disk located at the centre of the air column at any frequency of resonance at which the length of the column is an odd multiple of half a wave-length, and the sound pressure at the end of the column, that is, at the open end of the probe tube, is thus known. Since the tube is small, the calibration is the same as a free field calibration

With an air column about seven feet in length, calibration can be effected at more than forty values of frequency, extending from 80 to more than 6,400 cycles per second, without any readjustment of either the length of the air column or the position of the probe tube.

The absence of resonance in the probe tube enables the device to be used for measuring sound pressures at a point, not only in an unobstructed sound field, but also at the surfaces of solid obstacles or near the openings of resonators, without appreciably altering the pattern of the sound field

W. WEST.

Post Office Research Station,
Dollis Hill,
London, N.W.2.
June 13.

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[1] West, W , *Post Office Elec Eng J* , 26, 260 (Jan. 1934).

Relativity and the Speed of Light

THE hypothesis that light always seems to have the same speed in spite of relative motion of source and observer can be tested directly by measuring the speed of light received from approaching and receding stars This measurement can be made with high accuracy and a very short light path by W C Anderson s development of the Kerr cell method[1] Anderson s apparatus can be used at the eyepiece of coudé or polar telescopes and might perhaps be adapted for mounting on equatorials

If light from a star in motion ± v relative to the earth has speed c the hypothesis will be proved but if the light has speed $c \pm v$ the hypothesis will be upset and the Michelson Morley result very simply explained Only actual measurement can decide and it is surprising that relativity enthusiasts have not asked for the experiment to be tried

F H C SMITH

Stratford Road
Birmingham
June 9

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[1] *Rev Sci Inst* **8** 239 (July 1937) summarized *Sci Prog* **32** 13 17 (April 1938)

Combined Ascorbic Acid in Plant Tissues

THE letter from Guha and Sen Gupta recently published in NATURE[1] prompts us to give very briefly the results of some of our own experiments The technique we have used is based on that described for urine[2] We find that in cauliflower juice (to quote one experiment) the total indophenol reducing substances amount to about 0 280 m mol per 100 ml Of this free ascorbic acid accounts for some 0 007 m mol dehydroascorbic acid for 0 110 m mol and combined ascorbic acid (liberated by acid hydrolysis) for 0 150 mol The non ascorbic acid reducing substances are almost entirely in the combined form (liberated by acid hydrolysis) and amount to only 0 012 m mol per 100 ml of juice The combined ascorbic acid is non dialysable and is incompletely precipitated when the proteins are removed by metaphosphoric acid

HAROLD SCARBOROUGH
C P STEWART

Clinical Laboratory
Royal Infirmary
Edinburgh
June 14

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[1] Guha and Sen Gupta NATURE **141** 974 (1938)

[2] Scarborough and Stewart *Biochem J* **31** 2232 (1937)

Points from Foregoing Letters

Dr W T Astbury Miss Florence Bell Prof F Gorter and Dr J van Ormondt have built up protein films composed of up to 1 764 monolayers of egg albumin and having observed that such films may be stripped from their metal base have examined them optically and by X rays and measured their thickness by direct mechanical means The thickness per monolayer is about 9½ A agreeing with the X ray patterns and previous indirect estimates and the structure is one of polypeptide chains lying roughly parallel to the direction of movement of the slide with the side chains roughly perpendicular to the surface They infer that polypeptide chains pre exist in the monolayer on the liquid substrate

A table showing the œstrogenic activity of several derivatives of stilbœstrol is submitted by Prof E C Dodds L Golberg W Lawson and Prof R Robinson One of these synthetic compounds 4 4 dihydroxy γ δ diphenyl β δ hexadiene has an activity several times that of the sex hormone œstrone and equal to that of diethylstilbœstrol a synthetic compound previously investigated

Vitamin C (ascorbic acid) produces a characteristic polarographic curve with a dropping mercury electrode polarized as anode The effect may be used according to E Kodíček and K Wenig for the estimation of small amounts (1 γ) of ascorbic acid in orange and lemon juice but not in extracts of animal tissues

Determination of the relative vitamin E activity of α and β tocopherol separated as allophanates from wheat germ oil is discussed by A L Bacharach The β form has a somewhat greater antisterility action

Dr F Bergel A Jacob Dr A R Todd and T S Work state that they have synthesized α tocopherol by a simpler method than that employed by Karrer and co workers namely, by the direct condensation of phytol with ψ cumoquinol The authors consider that the tocopherols have a chroman rather than a coumaran structure

In rats bearing a Jensen sarcoma Drs A and M Lasnitzki have found a conversion of normal lymph glands into more or less pronounced hæmolymph glands A similar change has been observed in animals which had received injections of carcinogenic tar

Kallikrein injected in the skin of rabbits together with extract of testis is found by Dr J F Christensen to increase the area of inflammation as compared with the effect of extract of testis alone This indicates that Kallikrein acts as a diffusing or Reynals factor that is one which increases the permeability of tissues

Sir Joseph Larmor directs attention to the greater radioactivity of the ocean floor a fact explained by Piggot as due to the precipitation of uranium parent of radium from the ocean water Rayleigh and Joly have calculated that the amount of radium at the surface of the earth must be greater than in the interior These facts Sir Joseph considers are connected with the problem of terrestrial isostasy

Results obtained by the late Sir John Harrison showing that water containing micro organisms attacks granulated rocks (granite and dolerite) more rapidly than ordinary water are submitted by Prof F Hardy

According to Dr S B Hendricks hydrates of the clay minerals contain layers formed by association of water molecules into hexagonal networks Adsorbed water on these and related layer minerals such as micas chlorites talc etc is also probably of this type

Prof F Takabeya finds that a load supported on balls or spheres of equal diameter and placed near the top of a frame structure is very effective in damping vibrations

The calibration of a probe tube device for measuring sound pressures in air is described by W West The tube is non resonant and can be used for measuring sound pressures near solid surfaces as well as in an unobstructed sound field

Research Items

Mesolithic Site at Piscop (Seine-et-Oise)

A MESOLITHIC site at Piscop (Seine-et-Oise) discovered by M. E. Giraud in 1930, has been excavated over a period of five years by MM. Giraud, C. Vaché and E. Vignard (*L'Anthropologie*, 48, 2–3; 1938). The site is situated on a slope of the Montmorency plateau. Stratification downward is as follows: (1) humus, 10–15 cm. thick, dark grey in colour, with a neolithic industry; (2) sandy soil, 20 cm.–1·8 m. thick, or more or less grey, with a mesolithic industry; (3) blackened indurated sand with a few objects of Upper Palæolithic date; (4) Fontainebleau sands of tertiary age, ochre yellow, sterile. In (1) no neolithic object was found at a depth greater than 15 cm. In the deposits of (2) the surface of the occupation level had been irregular. It also showed depressions and pits, the latter it was inferred from the contents being the remains of semi-subterranean dwellings. Smaller excavations may have been burials, though no bones, but only a considerable number of flakes and implements, were found in them. Four hearths were located and quantities of well-preserved charcoal, in which were implements of flint showing the action of fire. In all, 2,909 implements were found, of which 1,193 are classified as micro-burins, 422 as Tardenoisian 'pointes', 206 as triangular or scalene, and 243 as segments of a circle. Occupation of the site extended over a considerable period of time. Two phases are to be observed—an earlier, contemporary with the proto-Tardenoisian Sauveterrian, and a later, in which the Tardenoisian industry is accompanied by some hundreds of implements of sandstone, of which the *pic-plane* is characteristic, occurring for the most part on the habitation sites, and none at a depth greater than 70 cm. These *pic-plane* implements suggest (1) a greatly increased activity in wood-working and (2) that the Tardenoisian tribes, essentially mobile, used implements heavier than their hunting equipment when settling down for any length of time. Their occurrence here in conditions which made their pre-Campignian dating certain, show that this class of implement is older than has been thought, and contributes to discussion of the occurrence of Tardenois and neolithic together.

Diagonal Law of Birth-Rate Decline

IN a statistical study of the decline in the birth-rate in various European countries, by Mr. R. S. Barclay and Dr. W. O. Kermack (*Proc. Roy. Soc. Edin.*, 58, 55; 1938), several significant facts are brought out. It is first shown that for Scotland since 1860 and for England and Wales since 1841, when age at death began to be recorded, the specific death-rates in each age-group decrease at a constant rate for each age-group, giving what is called the diagonal law. The same method is then applied to birth-rates. This cannot be applied to Great Britain because the age of the mother at each birth has only just begun to be recorded. But from birth-rate data of Sweden, Denmark and Finland, when the specific fertility rates for any age-group (except 15–20) are expressed as percentages of a standard rate before the fall in the birth rate began, these percentages also conform to a diagonal law. This holds approximately for both the total fertility rates and the legitimate fertility rate. The diagonals for death-rates and birth rates are, however, at right angles, which means that the decline in fertility first began with the older women while the decline in mortality affected first the younger age-groups and then spread upwards. The wave of reduced fertility passes from one quinquennial age-group of women to the next in five years. The same linear relationships are indicated in Norway and France, but marked deviations occurred in all countries during and immediately after the Great War. This diagonal law is applied in predicting the fertility rates in England and Wales until 1951.

A New Strepsipterous Insect

MR. T. W. KIRKPATRICK, of the Amani Research Station, Tanganyika Territory, has published a notable paper on the above subject (*Trans. Roy. Entom. Soc. Lond.*, December 1937). The insect in question, *Corioxenos antestiae* Blair, parasitizes coffee bugs of the genus *Antestia* after the manner of a stylops. Since the work of the Russian observer, Nassonov, published in 1892–93, very little has been added to what is known of the biology of Strepsiptera. Knowledge is especially meagre of those forms which 'stylopize' Hemiptera, and Mr. Kirkpatrick's paper provides the only detailed account available of the biology and metamorphosis of a form which parasitizes members of this order. It is well known that the hosts of Strepsiptera often differ in their external characters from unstylopized examples, but *Corioxenos* produces no such effects. Its influence on the internal sexual organs, however, is very marked: female hosts are invariably infertile and the males are usually so. The male *Corioxenos* passes through eight instars before becoming adult, and each of them is figured and described. The adult male only lives for two to three hours, but during that time it is able to pair with a number of females. The females produce more than 3,500 triungulins apiece during a period of about three months.

Chilopoda of New Zealand

THE Chilopoda or centipedes of New Zealand form the subject of a revisional monograph by Mr. G. Archey, who is director of the Auckland Museum, N.Z. (*Rec. Auck. Inst. Mus.*, 2; 1936–37). Prior to the completion of this study, some 64 species of New Zealand Chilopoda had been named. The results of the present work, instead of adding to this list, have entailed the reduction of this number to 37 species. This reduction has resulted from the examination of many specimens of several of the species, which with a study of those characters hitherto regarded as of diagnostic value, has shown that such features fall within the normal range of variation of widely distributed species. Only a single new species is described. As regards their zoo-geographical relationships, the New Zealand centipedes appear to be more closely akin to those of southern Australia than elsewhere.

Absorption of Gas Bubbles in Wood Vessels

H Dickson and V H Blackman have recently published experimental observations on the absorption of bubbles of air, nitrogen and oxygen introduced into the xylem vessels of both living and dead tissues of *Impatiens parviflora* (*Ann Bot* New Series, 2 No 6 293, April 1938) The bubbles were found to decrease in size until they were dissolved in the cell sap of the surrounding tissues Rate of absorption varied the average sized bubble taking 12 20 minutes to be completely absorbed The disappearance of these artificially introduced air bubbles is attributed mainly to the increased partial pressures of the gases of the bubbles resulting from the high surface tension forces acting on the small bubbles No evidence was obtained to support the suggestion (P K Sen and V H Blackman *Ann Bot*, **47**, 663 1933) that increase in the partial pressure of nitrogen in the bubbles, resulting from the absorption of oxygen by the surrounding living tissues, plays any part, though the authors state that some such effect would seem inevitable The bearing of these results on the ability of cut flower shoots to absorb water, after the cut surfaces of their stems have been exposed to the air is discussed

Magnetic Susceptibility of Iron in Ferrohæmoglobin

THE iron in oxyhæmoglobin and carbon monoxide hæmoglobin is diamagnetic and the iron atom is bonded to six neighbours with covalent bonds The iron atom in ferrohæmoglobin has a magnetic moment about equal to that expected for a ferrous ion held by electrostatic bonds but somewhat larger than usual for ionic ferrous complexes With the technique now in use, hæmoglobin concentrations can be measured as accurately by magnetic methods as by the more tedious gasometric methods D S Taylor and C D Coryell (*J Amer Chem Soc*, **60**, 1177, 1938) have determined the magnetic susceptibilities per formula weight of iron in hæmoglobins as cow, 12 290 horse, 12,260 sheep 12 390 human, 11,910 all $\times 10^{-6}$ c g s units at 25° The magnetic moments for the hæmoglobins are calculated as 5 435 5 43, 5 46 and 5 35 Bohr magnetons respectively assuming independent iron atoms In an extensive study of cow hæmoglobin the susceptibility was found to be constant from individual to individual and to be unaffected by hæmolysis Normal blood and oxyhæmoglobin solutions contain hæmoglobin like compounds probably containing ferric iron, which do not combine with oxygen It was established that the hæmoglobin concentration determined from the carbon monoxide capacity after reduction agrees with that determined from the iron content The accurate determination of the paramagnetic susceptibility of the iron in hæmoglobin now makes it possible to determine hæmoglobin concentrations magnetometrically with high precision

Arrangement of Molecules in Mono- and Multi-Layers

IN an extension of their investigations of the arrangement of molecules in mono and multi layers, L H Germer and K H Storks (*J Chem Phys*, **6** 280, 1938) record observations by electron diffraction methods on layers of stearic acid and of barium stearate deposited on a chromium plated surface, and by electron transmission methods on layers of the same substances deposited on a thin foil of 'Resoglas' When the chromium plated block is dipped through a monolayer of either substance, a single layer of the substance is deposited on the chromium surface The hydrocarbon chains of such a layer are closely packed but arranged irregularly, and the axes of the chains are practically normal to the surface On each subsequent dipping of the block, *two* layers are deposited, and in these layers the molecules are regularly arranged in a characteristic crystal unit with chain axes normal to the surface When Resoglaz is dipped through mono layers, each dipping including the first results in the deposition of two layers, and the molecules are always arranged regularly in the characteristic crystal unit On 'Resoglaz the hydrocarbon end of the molecule is in contact with the support, whereas it is the barium or the carboxyl group which makes contact with the chromium Deposition of stearic acid on polished steel indicates an irregular arrangement of molecules in the first layer Presumably this irregularity in the first layer on a metal surface is due to interaction between the stearic acid and the metal The paper contains an interesting suggested extension of these methods to the investigation of boundary lubrication Another predicted extension is to the investigation of layers of adsorbed gas

Measuring Bridge for Conductimetric Titrations, etc.

WE have had an opportunity of using one of the measuring bridges Type *G M* 4140, designed by the Mullard Wireless Service Co Ltd, 225 Tottenham Court Road W 1 This is a very compact instrument made up in a strong metal box the cost being £12 12s With connexions to the mains and an earth resistances from 0 1 ohm to 10 megohm can be measured directly with the mains frequency of 50 cycles The balance point is very ingeniously read visually by means of an electron beam tube in conjunction with a high magnification pentode valve This arrangement gives very clear and sharp balance points, and the absence of galvanometers or telephones makes the whole lay out most compact and handy The electron beam indicator can be made very sensitive near the point of balance Several conductimetric titrations with various substances were made with a cell also supplied by the makers of the instrument, and it was found possible without any difficulty to attain an accuracy of 1 per cent, this accuracy being limited by the scale reading and adjustment by the milled head carrying a pointer It would be possible to increase the accuracy somewhat by a fine adjustment screw and vernier The results were equally good with low and high resistances The bridge potential is only 1 volt and hence it is probable that even with a frequency so low as 50 cycles per second, there is no appreciable polarization error in normal cases, when this voltage does not exceed the decomposition voltage of the electrolyte used With silver nitrate solution and silver electrodes, we found that an end point could not be obtained, since here the decomposition voltage is below 1 volt The makers supply a separate oscillator with a frequency of about 2500 cycles per second for use when polarization effects are noticeable, but we had no opportunity of testing this The instrument examined is also capable of application to capacity measurements, condenser loss measurements and inductance measurements It should prove a great service in technical laboratories, and also in research laboratories where the highest accuracy is not essential No great skill is necessary in order to obtain very good results

Oxford Museum of the History of Science

THE historic interest of the Old Ashmolean Oxford, and the association of the founder of the original *Musæum Ashmoleanum* with the pioneer promoters of the new philosophy whose names were inscribed as original fellows of the Royal Society have been referred to on many occasions in these columns, particularly in connexion with the unceasing labours of Dr R T Gunther to establish a Museum for the History of Science in the Old Ashmolean Building The purposes and scope of this Museum are not, however, widely known, so that the sequence of events which have led to the appeal for financial support in *The Times* of June 21 may be of interest

In 1924, the University accepted from Dr Lewis Evans the gift of a valuable collection of astrolabes and other astronomical and mathematical instruments The donor was a member of a remarkable family, responsible for a number of entries in the Dictionary of National Biography He was the brother of Sir Arthur Evans son of Sir John Evans and great grandson of the Rev Lewis Evans, F R S (1755 1827) who became mathematical instructor at the Royal Military Academy, Woolwich in 1799 and with whom the collection seems to have started The gift might presumably have been housed in the Science Museum of the University, in the building of which Ruskin played a large part But the donor had other ideas The old Ashmolean Museum had been diverted from its original purpose The collections of Elias Ashmole had been removed to more modern and commodious premises In the vacated building, the School of Geography and the offices of the 'Oxford Dictionary had found a temporary home Here Dr Evans saw a suitable site for his collection, and the University accepted the condition

In these circumstances of isolation, a museum however small, needs a curator, and in this case an enthusiastic and energetic curator was readily found in Dr R T Gunther, of Magdalen College The next step is easily foreseen A small museum under a keen curator has a natural tendency to grow especially when the contents are of this particular kind An obsolete instrument, which is a positive embarrassment in one place, becomes a valuable accession here This is not to suggest that additions have been accepted without judicious care, or that the resulting collection is not an interesting and valuable one The admission in the letter that it was difficult to forecast the position only a short time ago, must therefore, be taken as a proof of candour rather than of any sense of intelligent anticipation

It is candidly admitted that the University has other pressing needs , and in view of the recent comprehensive appeal on behalf of the University it seems a little difficult to understand how far the present letter claims an official character It is signed by the Chancellor and the Vice Chancellor , the other signatories are four Magdalen men and four Cambridge men, the last of the highest eminence in the scientific world but not perhaps very intimately acquainted with the financial position at Oxford In the circumstances, particular importance should be attached to the unofficial element, and the plea for the Museum of the History of Science should perhaps be treated strictly on its merits, which are no doubt considerable

An appeal of this kind raises however, the whole question of voluntary contributions for scientific and similar purposes Rightly or wrongly, Great Britain is committed at present to the system of voluntary hospitals One consequence is that the bulk of public benefactions is drawn into a single channel Very little money is left to supply the needs of culture and pure science, which elsewhere gain liberal support from voluntary sources Here the fund is notoriously inadequate, and this fact ought always to be borne in mind when competitive claims to public assistance are put forward The lack of means to carry on important scientific work is familiar to all those who have been connected with its administration Thus, though the position is now rather easier through the working of international organization, for many years the Seismological Committee of the British Association was sorely hampered for want of funds It is but fair to recall that the burden of keeping alive an infant science in Great Britain fell in that instance largely on the University of Oxford Another example may be found in that admirable institution, the Norman Lockyer Observatory at Sidmouth, which could enlarge its activities with ease were the necessary funds available It is needless to multiply illustrations of a general problem

The question arises, therefore, whether appeals to the public on behalf of individual institutions offer the most effective solution of this problem Even the hospitals have found the advantage of organizing a central fund from which a fair distribution can be made It seems possible that science also may have something to gain by similar action The Government Grant Fund administered by the Royal Society is useful within a restricted range, and the same body is enabled to do more by its own endowments, which are steadily increasing But still more could be done if the means were forthcoming Competitive appeals, the relative merits of which can scarcely be gauged by the public may not be the right method It seems possible that a unified scheme administered by a competent body might produce a larger fund and a fairer distribution in accordance with the true interests of pure science Applied science and industrial research are in a happier position, and the problem is less urgent in that field

It is to be feared that this suggestion even if it were found worthy of consideration, might not give much help in a case like that of the Oxford Museum of the History of Science Just as its interests are admittedly subordinate to the needs of the teaching departments, so in a wider scheme the claims of pure research would probably take the first place Hence the present appeal must in any event stand on its own merits, and the increasing interest taken in the history of science should ensure a satisfactory response to it Though the main responsibility of supporting this Museum will probably fall on Oxford, the signatories to the appeal are fully justified in inviting assistance from outside the University to ensure that the Museum is provided with the relatively modest amount required for its maintenance of the valuable collections which Dr Gunther has been so successful in bringing together, and to which he has devoted so much careful attention

International Engineering Congress at Glasgow

THE selection of Glasgow for the sessions of the International Engineering Congress, organized with the co-operation of the ten leading British technical institutions, not only enabled the delegates and members to visit the numerous works and industrial establishments in and around the City, but also afforded the opportunity of holding the Congress at the Empire Exhibition at Bellahouston, with its varied and extensive display of manufactures, machinery and plant. Fully a thousand members attended the Congress, representative of the United Kingdom, the Dominions, France, Germany, Italy, Belgium, Denmark, Finland, Hungary, the United States and other countries—about twenty in all.

The opening address on June 21 was delivered by the president of the Congress, Lord Weir, who declared that it is the province of the modern engineer to restore a balance of sanity in a world containing an order of society planned for the utter destruction of civilization, characterized by the minimum of international commercial intercourse, and in which the life of every individual is limited and conditioned by the constant fear of a potential enemy. "Against this sombre picture,' he said, 'wherein the law of the jungle appears to be the chosen principle of evolution, it is with relief that we can descry the compensating forces of science and reason."

Mr. John Colville, Secretary of State for Scotland, and Lord Elgin, president of the Exhibition Committee, also addressed the Congress and extended to the members a cordial welcome to the metropolis of Scottish industry, the latter emphasizing his view that at a moment when all the nations of the world are thinking how to protect themselves, "it is more important to think further as to what science can do and will do in making this place better than it has been—a place where we can meet together as friends."

The papers afterwards read at the meetings on June 21–23 dealt with such varied subjects as British shipbuilding, coal, municipal and industrial planning, developments in electrical engineering, the internal combustion engine, the iron and steel industry, international air transport, naval and mechanical construction in Italy, gas, and materials research, with one of appropriate local interest—the River Clyde and the Harbour of Glasgow.

Among some striking passages contained in these papers were the statements of Lord Sempill that the total mileage of airways which in 1919 was 3,000, to-day has attained a figure of much more than 300,000. Civil aircraft are now flying about 167 million miles, of which America accounts for 72 millions. The speed attained is as much as 450 miles per hour, and there is no reason why it should not be increased. An eminent French engineer, M. Mercier, president of the Union d'Electricité, stated that the total world production of electrical energy has been estimated at 310 milliard kwh. for the year 1929 and at 450 milliard kwh. for 1937. Far from having attained its limit, consumption of electricity is developing fully with very wide possibilities before it.

On the evening of June 21, the president of the Congress gave a dinner to the official delegates, which was followed by a civic reception in the City Chambers by the Lord Provost and Corporation to all the Congress members. Through the courtesy of manufacturing firms, numerous facilities were afforded for visits to local works and factories, while excursions were also made to centres of interest farther afield.

BRYSSON CUNNINGHAM

South-Eastern Union of Scientific Societies

Annual Congress

FOR its forty-third annual congress, the South-Eastern Union of Scientific Societies met at Worthing on June 21–25, a five days congress. At the inaugural meeting, Prof. Julian Huxley, who succeeded Prof. F. E. Weiss as president, took as the subject of his presidential address "Natural History, Taxonomy and General Biology". Naturalists are now engaged, he said, in tidying up and arranging the enormous number of insects and other forms of life, and those engaged in so doing call themselves taxonomists. There are more than five thousand kinds of two-winged insects in the British Isles and nearly as many beetles. Separate species of life already catalogued number somewhere about a million. Taxonomy is becoming one of the focal points of biological research. The staffs of the museums are overburdened with their share of the work. Local naturalists can take a part, and the Association for the Study of Systematics is endeavouring to form a panel of amateur workers. Prof. Huxley advocated detailed mapping of animal and plant life distribution. Evolution is going on all around us in the quiet country-side, just as much as in the deep sea, or the tropical jungle, although difficult to detect.

At the meeting of the Zoological Section Sir Edward Poulton gave one of his fascinating lectures on 'Lamarckian and Darwinian Conceptions of the Struggle for Existence", which was listened to with the attention due to one of so great authority. He was followed by Mr. J. Hornell, who read a paper on "Designing of Public Aquaria". After reviewing the mistakes made in the past in the aquaria at such places as Brighton, Southport, Blackpool and elsewhere, where amusement was mixed up with the attempts to teach science, he showed how he would design a future aquarium. Mr. Hornell was formerly director of fisheries to the Madras Government, and the erection under his guidance of the aquarium at Madras resulted in a great popular movement to study the contents of the tanks he installed.

The Re colonisation of a Burnt Patch at Cissbury" was the title of a paper by Mr B T Lowne The Jubilee and Coronation bonfires of 1935 and 1937 left a scar more than 50 ft in diameter with a thickness of some 8 inches of ash These sterilized the soil to some depth The creeping thistle was the first plant to establish itself followed by the blackberry Several plants not native to the spot made an appearance notably the evening primrose but this may have been carried to the spot in the footwear of one of the builders of the fire Late visits to the spot showed that thirty nine species of plants have established themselves and downland plants are gradually again growing there Mr Lowne also exhibited a hybrid between two species of geranium which he discovered on the Downs and found that the hybrids had bred true many specimens having been found

Miss F Gerard curator of the Worthing Museum showed maps of Sussex from the earliest times of map making including a copy of the Armada map and another of the Palmer map of 1587 The many changes in the coast line were clearly shown

Other papers of a high order were contributed amongst them being Ecology of the Selborne District by Dr C P Chatwin Recent Progress in the Study of Insect Migration by Dr C B Williams The Coastal Plain by Mr C T Caster and Mr E C Martin British Herbals of the 17th Century by Dr T A Sprague and A Proposed Survey of Chalk Springs and Bournes by Mr E H Edmunds

It was announced that John Selden s cottage known as Lacies at Salvington where Selden was born in 1584 had been offered as a freehold to the Worthing Corporation by Mr Alfred W Oke

The Union having been requested to arrange for the delivery of the Alexander Pedler Lecture of the British Science Guild now incorporated in the British Association this was entrusted to Prof H L Hawkins who took as his subject Humanity in Geological Perspective After discussing many outworn theories he said that he suspected that true geological knowledge is even now held but by the few and is brushed aside by those who have it but do not wish to own its teachings Truth chivalry and kindness are he said inconsistent with the struggle for existence but nevertheless the idealist who faces noble thoughts is a man Men can learn their capacity for appreciating wisdom shows that its acquisition is not beyond their powers And wisdom which makes men human is better than the rubies of material success that may leave him bestial

The excursions were very varied suiting all tastes visits to Cissbury Amberley Sompting the Broadwater Waterworks the Angmering Roman Villa Swanbourne and the Arun and the Highdown House Gardens having been arranged

A reception at the Town Hall was given to members by the Mayor and Mayoress Councillor and Mrs W C Birkett whose co operation in making the Congress a success was greatly appreciated by the Union

Scientific and Industrial Research in Australia

THE eleventh annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia which covers the year ended June 30 1937, refers to the establishment of a Fisheries Section to conduct researches into Australian Fisheries problems This is at present housed in temporary quarters but a properly trained staff is being built up while the problems determining the location of the research station are being reviewed and an investigation vessel is under construction Experimental flights have already indicated that aerial observations can considerably assist the work of the investigation vessel Considerable progress was also made during the year in the provision of adequate laboratory facilities The Forest Products Laboratory was officially opened on April 7, 1937 the Viticultural Research Station, Merbein has been occupied and it was anticipated that the headquarters laboratories and experimental cool stores of the Section of Food Preservation and Transport and the new Animal Health Laboratory would be ready for occupation at the end of 1937

The Division of Plant Industry has continued its investigation into plant pasture problems as well as of physiological diseases of fruit in the field and disorders following storage Evidence has been obtained that high soil temperatures increase resistance to pest seedling development of flag smut in certain varieties of wheat and lowers it in others In the fumigation of seed beds for control of downy mildew or blue mould of tobacco, benzene vapour always gave the best results and attention is being turned to control under field conditions The Division of Economic Entomology has given much time to the sheep blowfly pest including studies both of the sheep and the flies as well as the prevention and treatment of strike Search has been made for substitutes for lead arsenate in insecticides for codling moth sprays and a good deal of the Division s time has been occupied with work on the biological control of noxious weeds as well as on chemical methods of weed control Investigations by the Animal Health laboratories have again ranged over a wide field including bovine mastitis studies in fleece chemistry and fibre measurement fertility in sheep dairy products research and in addition the Animal Nutrition Laboratory at Adelaide has been responsible for investigations on phosphorus metabolism of sheep and on coast disease

The Forest Products Division s investigations also cover a wide field from the seasoning of timber timber physics, wood structure and utilization to the preservation of wood where the value of arsenicals as termiticides in Australia and of sodium silicofluoride for protection against *Lyctus* attack has been established Many important investigations have also been carried out at the Viticultural Research Station on irrigation and drainage as well as by the Food Preservation Section, including investigations on chilled beef such as loss of bloom, on diseases of bananas and their control, citrus packing house problems, including the colouring of citrus fruits, and problems relating to the storage and diseases of apples, pears, plums, peaches, etc

Science News a Century Ago

Jean Marc Gaspard Itard (1775 1838)

July 5 marks the centenary of the death of this famous pioneer in otology who was born in 1775 at Oraison a small town in Provence At nineteen years of age, he became assistant to the celebrated surgeon Larrey at Toulon and afterwards accompanied him to Paris where he studied medicine under Pinel and Corvisart He qualified with a thesis on pneumothorax and shortly afterward was appointed physician to the Institute for Deaf Mutes where he gained a great reputation by his detailed study of the idiot boy known as the Sauvage de l Aveyron His chief work on the composition of which he spent eleven years entitled Traité des maladies de l oreille et de l audition appeared in 1821 and a second edition was published posthumously in 1842 He invented an acoumeter which was the first instrument of its kind as well as a form of Eustachian catheter and an instrument for the improvement of hearing He was also the author of articles on stammering intermittent fever and dropsy and translated Willich s book on domestic hygiene In 1816 he became joint editor of the *Journal Universel les sciences médicales* and in 1822 of the *Revue Médicale* while in 1832 he was made editor of the ' Dictionnaire de Médecine

Launch of the *Robert F Stockton*

On July 7 1838 Lairds of Birkenhead launched the iron screw steamer *Robert F Stockton* which being sent to the United States the following year became the first screw driven vessel to be used for practical purposes in that country She was built to the order of Captain R F Stockton (1795 1866) of the United States Navy and fitted with the screw propeller invented by John Ericsson She was 63 4 ft long 10 ft beam 7 ft deep 33 tons register and 33 horse power She was fitted with a two cylinder engine driving the propeller shaft directly and not through gearing In January 1839 she carried out trials in the River Thames when she successfully towed four coal barges from Southwark to Waterloo Bridge Referring to her trials *The Times* said that they appeared quite conclusive as to the success of this important improvement in steam navigation The vessel was sent to America under sail and afterwards was used as a steam tug on the Delaware and Raritan Canal being renamed the *New Jersey*

Supply of Pure Milk

On July 7 1838 the *Mechanics Magazine* contained a communication from J Fordred directing attention to an essay on milk supply by M Barreul recently published in Paris The essay contained a remarkable review of the methods used for adulterating milk Some of the more wealthy inhabitants it said who obtained their milk direct from the dairies at a good price had it pure but the mass of milk sold in Paris was more or less adulterated with water brown sugar flour or emulsion of sweet almonds It was suggested therefore, that the authorities should ordain that no milk should be sold except in sealed measures and that in each quarter of the city one or two pharmacists should be charged with the duty of examining the milk from time to time Penalties were proposed for every fraudulent alteration in quality or quantity

University Events

Cambridge —Dr A J Bradley has been appointed assistant director of research in crystallography and Dr J E Driver University demonstrator in the Department of Chemistry

The Vice Chancellor gives notice that the John Humphrey Plummer professorship of mathematical physics will be vacant on October 1 by the resignation of Prof R H Fowler Preference will be given to candidates whose work is connected with theoretical atomic physics The stipend of the professor is £1 200 a year or if he holds a fellowship with dividend £1 000 a year Candidates for the professorship are requested to communicate with the Vice Chancellor and to send him on or before July 20 ten copies of any statement or testimonial which they desire to submit to the electors If testimonials and references are sent, they should not taken together exceed four in number

Dr B C Saunders University demonstrator in chemistry has been elected to a fellowship at Magdalene College Dr Saunders was placed in the first class of the Natural Sciences Tripos Part I in 1924 and the first class in Part II of the same Tripos in 1925 in which year he was elected to the Beatson Scholarship at Pembroke College Since 1931 he has been Charles Kingsley lecturer and director of studies in natural sciences and medicine at Magdalene College

J R F Jeffreys of Downing College has been elected to the Sheepshanks Exhibition for 1938

H Davenport of Trinity College has been approved for the degree of doctor of science

London —Sir Robert Pickard has been re elected vice chancellor for the year 1938 39 Dr A M H Gray has been appointed deputy vice chancellor for the same period

Dr J D Boyd has been appointed to the University chair of anatomy tenable at the London Hospital Medical College as from the beginning of next session Since 1937 he has been University lecturer in anatomy in the University of Cambridge

It has been resolved that on the occasion of the celebration of Foundation Day 1938 the following honorary degrees among others should be conferred Sir Charles H Bressey the degree of doctor of science (engineering) Sir Robert Ludwig Mond the degree of doctor of science Prof A W Pollard the degree of doctor of literature

Prof J H Clapham has been appointed Creighton lecturer for the year 1938 39

The following doctorates have been conferred D Sc in anatomy on Prof Thomas Nicol University professor at King s College D Sc in biochemistry on Mr B C J G Knight University College D Sc in botany on Mr Hugh Dickson Imperial College—Royal College of Science

Oxford —J D Lambert has been elected to an official fellowship as lecturer in natural science at Trinity College in succession to Prof C N Hinshelwood

Sydney —At the Annual Commemoration Ceremony on May 14 the opportunity was taken of presenting to Dr W L Waterhouse acting dean of the Faculty of Agriculture of the University of Sydney the Farrer Memorial Medal This is the third occasion on which the medal in honour of the world famous wheat breeder has been awarded

Societies and Academies

Paris

Academy of Sciences, May 9 (*C R*, 206 1333 1420)

Louis Couffignal A problem of abstract mechanical analysis the theory of reduction, result of mechanical functions

R de Misès The infinitesimal element of order *n* of a skew curve

Husni Hamid *The hypercongruence of Euclidian space of* $n + 1$ dimensions

Béla de Sz Nagy Series of multiply monotone factors

Alexandre Ostrowski Some transformations of the series of Liouville Neumann

Mlle Marie Charpentier The Peano points of certain systems of differential equations

Alexandre Ghika The determination of analytical functions

Silvain Wachs Some properties of pseudo conformal transformations with an invariant frontier point

Étienne Œhmichen The teachings of natural flight and their applications to flying machines capable of hovering in the air

Jean Tilho Remarks on the heliostat

Assène Datzeff The mean distribution of the electrons in a complex atom

Benjamin de Jekhowsky A criterion for the identification of small planets A simplification of the methods of calculation of the criterion of Luc Picart

V A Nicolsky Method of calculation of plates of unequal moments of inertia

Aurelio Marques da Silva The materialization of a photon in the field of an electron

Jean Virgitti The theoretical study of a transport of ions by a current of vapour used for obtaining high potentials

Nicolas Perakis, Tryphon Karantassis and **Leandre Capatos** The measurement of the atomic (magnetic) moment of tetravalent rhenium

Yeou Ta The repetition of the whole of the *vibration spectrum of organic molecules in the neighbourhood of each of the frequencies (CH) of vibration, fundamental or harmonic*

André Guinier The diffusion of X rays under very small angles applied to the study of fine particles and to colloidal suspensions

Georges Carpéni The preparation, electrometry and ultra violet spectrography of glucohepto ascorbic acid

Pierre Bonneman and **Marc Bassière** The condensed phosphoric acids The polyphosphates

Félix Trombe The isolation of metallic europium The electrolysis of europium chloride in the eutectic mixture of potassium and sodium chlorides with a cadmium cathode gives a cadmium europium alloy from which the cadmium can be removed by heating in argon under reduced pressure at carefully controlled temperatures The final product contains 98 per cent of europium

Roger Lauffenburger and **Michel Brodsky** Study of the system $Na_2HPO_4 + 2NH_4Cl \rightleftarrows 2NaCl + (NH_4)_2HPO_4$

Jean Baron and **Paul Laffitte** The inflammation of normal propyl ether The pressure temperature of inflammation curves are analogous with those of ethyl ether, and, as was found with the latter, the addition of nitrogen to the mixtures of oxygen and ether lowers the temperature of inflammation

Gustave Vavon and **Roger Mathieu** The hydrogenation of halogen derivatives by platinum black

Victor Madsen The Caledonian chain of northern Greenland

Christian Poulsen The Ozarkian in Greenland

Georges Choubert and **Louis Neltner** The Pre Cambrian of the western Anti Atlas

Jean Feldmann and **Mlle Geneviève Mazoyer** The *ioduques* of *Asparagopsis armata*

Jean Renaud The existence of the dicaryon in a *Saccharomyces* isolated from the vine

Mlles Berthe Delaporte and **Nadia Roukhelman** The presence of thymine in the nucleic acid extracted from yeast Cytological and chemical researches

Pierre Chouard The experimental production of buds under the influence of the heteroauxins

René Souèges The embryogeny of the Illecebraceae [Scleranthaceæ] The development of the embryo in *Scleranthus perennis*

Jean Cuzin Evidence of the remarkable constancy in the regime of growth in the germination of pollen

Mme Cécile Sosa Bourdouil The comparative composition of spores and pollens of vascular plants

Raymond Cahen and **Mme Andrée Tronchon** The action of zinc on the œstrogenic effects of folliculine in the ovariectomized rat Zinc chloride increases the intensity and prolongs the duration of the œstrogenic effects of folliculine in the ovariectomized rat provided that the ratio of zinc to hormone lies between certain limits

Mme Véra Dantchakoff The mechanism of the sexual deviations resulting from (*a*) treatment with testosterone (*b*) free martinism (*c*) tumours of the suprarenal capsule (virilism)

Auguste Sartory, René Sartory and **Jacques Meyer** The influence of certain water soluble vitamins on the velocity of growth of various cocciform bacteria

André Boivin and **Mme Lydia Mesrobeanu** The chemical nature and biological properties of the *Vi* antigen of the typhoid bacillus

Moscow

Academy of Sciences (*C R* 18 No 8, 1938)

I I Privalov Different classes of subharmonic functions considered from the point of view of their analytic representation

V S Ignatovskij The Laplace transformation (10)

D Shin (1) Existence theorems for the quasi differential equation of the *n*th order (2) The solutions of the self adjoint differential equation $u[n] - lu$, $I(l) \neq 0$ in $L_2 (0, \infty)$ (3) The quasi differential transformations in Hilbert space

Loo Keng Hua Some results on Waring's problem for smaller powers

N Lusin A theorem of the theory of equations with partial derivatives

N Moisseiev (1) The convergence of the series *representing formally the simple periodic solutions* (3) The generalized Jacobian stability of a periodic trajectory

H Mandel Born's electrodynamics and cosmology

G S Landsberg and **V S Malyshev** Combination spectra of the solutions of water in dioxane and pyridine

K ALEXEEVA . Long period radioactivity in silver, cæsium and indium activated by slow neutron bombardment.

S M KATCHENKOV : Absorption spectra of praseodymium and neodymium in heavy water.

S. L MANDELSTAM The intensity of spectral rays in an arc with carbon electrodes

W STOCKMANN : Some characteristic moments of the horizontal mixing of water masses of the Caspian Sea in the system $S - f(t)$

N N MALOV Contribution to the theory of the electrical conductivity of objects liable to polarization.

P KHOMIKOVSKY and P REHBINDER Dependence of stabilization and wetting of particles suspended in oil medium on the quantity of the surface-active substance adsorbed

I I ČERNIAJEV (1) Cleve's triamine (2) The *cis*-tetramine of quadrivalent platinum

N N KURNAKOV, I I KORNILOV and G. B BOKY 'Ruby' slag from the thermite process for the production of metallic chromium

A M NEGRUL Evolution of cultivated varieties of grapes

I A KOSTIUČENKO Winter hardiness of plants as influenced by vernalization of ripening seed grains

G V ZABLUDA Action of soil drought on the formation of generative organs in spring wheats

I SUKHORUKOV, E KLING and K OVČAROV The effect of *Phytophthora infestans* de Bary on the ferments of affected plants

V T EREMENKO Intermediate period of development and anatomo-morphological characters of the light stage in wheat

M CH ČAJLACHJAN Motion of blossom hormone in girdled and grafted plants.

V G ALEXANDROV and O G ALEXANDROVA Full and meagre grain in soft wheat

Tokyo

Imperial Academy (*Proc* , 14, No. 4, April 1938)

SAEMON TARÔ NAKAMURA and YOSIO KATÔ Variations in the magnetic dip in Central Japan

HANTARO NAGAOKA and TADAO MISHIMA Some chemical actions of hydrogen excited by electrodeless discharge The action of excited hydrogen on various chemical compounds is described

EIJI OCHIAI and TOSIHARU NAKAMURA On our knowledge of the so called 2 nitrosomorphins

GAKURO IMAMURA and MASAO KOTANI Crustal blocks

YOSITIRO UMEYA Developmental characteristics of the silkworm embryo

KIN-ICHIRO HANAOKA Sex modification in a semi-differentiated salamander, *Hynobius retardus*, resulting from implantation of testis and hypophysis

TOKI O YAMAMOTO Contractile movement of the egg of a bony fish, *Salanx microdon* Contraction is shown to occur on the yolk sphere, while the blastoderm itself remains still The protoplasmic layer surrounding the yolk during early stages of development is considered responsible for this contractile movement It is suggested that the movement functions as a stirrer in order to facilitate the absorption of yolk

KIYOSHI TAKEWAKI (1) Effect of testis graft on the adrenal of the mouse (2) Note on a subcutaneously transplanted mouse testis with spermatogenetic activity.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public*]

INSTITUTE OF PHYSICS (MANCHESTER AND DISTRICT BRANCH), July 4–5 —Conference on Elasticity and Plasticity to be held in the University of Manchester *

MUSEUMS ASSOCIATION, July 4–9 —Annual Conference to be held in Belfast

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

VEGETABLE SPECIALIST in the Punjab Agricultural Service Class I—The High Commissioner for India, General Department, India House, Aldwych, London, W C 2 (July 7)

LECTURER IN PRODUCTION ENGINEERING in the Dudley and Staffordshire Technical College, The Broadway, Dudley—The Principal (July 7)

JUNIOR LECTURER IN ELECTRICAL ENGINEERING in the Military College of Science, Woolwich, S E 18—The Commandant (July 8)

LECTURER IN MECHANICAL ENGINEERING in the Central Technical College, Suffolk Street, Birmingham, 1 The Chief Education Officer (July 9)

LECTURER IN MECHANICAL ENGINEERING in the North Staffordshire Technical College—The Clerk to the Governors, Education Offices, Town Hall, Hanley, Stoke on Trent (July 9)

LECTURER IN CHEMISTRY and LECTURER IN PHARMACEUTICAL CHEMISTRY in University College, Nottingham—The Registrar (July 11)

ASSISTANT LECTURER AND DEMONSTRATOR IN CHEMISTRY in King's College for Household and Social Science, Campden Hill Road, London, W 8—The Secretary (July 11)

ASSISTANT LECTURER IN THE DEPARTMENT OF BUILDING, Huddersfield Technical College—The Principal (June 13)

HEAD OF THE BIOLOGY DEPARTMENT, Huddersfield Technical College—The Principal (July 13)

JUNIOR LECTURER IN SCIENCE in the Royal Military Academy, Woolwich, S E 18—The Under Secretary of State (C 5), The War Office, London, S W 1 (July 16)

UNIVERSITY LECTURER IN MATHEMATICS in the University of Cambridge—Dr H M Taylor, Clare College, Cambridge (July 16)

PLUMMER PROFESSOR OF MATHEMATICAL PHYSICS in the University of Cambridge—The Vice-Chancellor (July 20)

PROFESSOR OF PHYSIOLOGY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W C 1

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Report by His Majesty's Government in the United Kingdom of Great Britain and Northern Ireland to the Council of the League of Nations on the Administration of the Tanganyika Territory for the Year 1937 (Colonial No 148) Pp iv + 251 + 1 map (London H M Stationery Office) 4*s* net [176

The Insurance Man and his Trade By Harry Henry ('Fact', No 15) Pp 92 (London "Fact") 6*d* [176

Education in Nazi Germany By Two English Investigators Pp 72 (London Kulturkampf Association) 1*s* [176

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 90 The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico Part 5 Diatom Evidence from the Mammoth Pit By Ruth Patrick Pp 15 24 (Philadelphia, Pa Academy of Natural Sciences of Philadelphia) [176

Anales del Museo Argentino de Ciencias Naturales Tomo 39 Antropologia, Etnologia y Arqueologia Publicación No 80 Investigaciones arqueologicas en Sorcuyo, Puna de Jujuy Por Eduardo Casanova Pp 423–456 + 6 plates (Buenos Aires · Museo Argentino de Ciencias Naturales) [176

Memoirs of the Kyancutta Museum No 5 An Outline of "Biosophy" (Part 1) By R Bedford Pp 39–65 + 1 plate (Kyancutta, S Australia Kyancutta Museum) 1*s* 6*d* [176

Indian Forest Records (New Series) Vol 3, No 9 New Indian Curculionidæ (Col) By Sir Guy A K Marshall Pp ii + 159 184 + 1 plate 10 annas , 1*s* Vol 4, No 1 A Guide to the Insects of Dalbergia Sissoo for Forest Officers Pp ii + 42 1 rupee , 1*s* 9*d* (Delhi Manager of Publications) [176

Report of the Botanical Survey of India for 1936–37 Pp 11 (Calcutta Government of India Press) [176

Records of the Botanical Survey of India Vol. 12, No 2 (1) The Flora of the Lushai Hills, by Cecil E. C Fischer , (2) Some New North-west Himalayan Mosses, by H N Dixon and R L Badhwar Pp ii + 75–179 (Delhi Manager of Publications) 1 6 rupees , 2*s* 3*d*. [176

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International Science

FOR several years past we have been familiar with the spectacle of eminent men of learning being forced to leave their work either on racial grounds or because they do not accept particular political, religious or other limited views The list of men of science in Austria who have recently been dismissed from their posts (see NATURE, June 18, p 1101, July 2, p 32), is a pertinent reminder that this state of affairs not only persists, but is even extending, and that the work of the Society for the Protection of Science and Learning needs continued and enhanced support

Important as is the work of relieving the distress entailed by such proscriptions and establishing the victims in conditions under which they can resume their studies and benefactions to mankind, there are other insidious effects which may have even more serious consequences to the world if unchecked No unprejudiced person questions the real impoverishment of science, for example, in hose countries from which the evictions on such grounds have occurred What is less apparent, however, is that the loss is one from which the whole world of science and learning suffers

A striking example of this is to be found in the recently published review of the work of the Rockefeller Federation in 1937 From the beginning of its activities twenty-five years ago, the Foundation has been guided by the objective set forth in its charter: "The well-being of mankind throughout the world." The trustees have endeavoured to maintain the work of the Foundation on an international plan without consideration of political doctrines or creeds, believing that in a programme based on the advancement of knowledge it is imperative to disregard the geographical boundaries which arbitrarily and often unhappily divide the world into a patchwork of senseless antagonisms In its search for high talent and promising opportunities, the Foundation has assumed that national frontiers are not the forbidding barriers they purport to be

In recent years serious and increasing difficulties have been encountered in pursuing this policy As Raymond B Fosdick, president of the Foundation, points out, objective scholarship is possible only where thought is free, and freedom can exist only where there is tolerance and where there are no prohibitions on the inquisitive and questioning mind

The progressive disintegration of creative scholarship, particularly in the social sciences and the humanities, which the world has recently witnessed in several countries, has already affected the programme of the Foundation In some fields it is now profitless to go where it formerly went, and its work is stopped at some frontiers because behind them the search for truth by eager and sceptical minds has been made impossible.

It needs no profound acquaintance with the detailed activities of the Foundation and its many benefactions to mankind in all countries to realize the gravity of a situation which can draw such words from the president of the Rockefeller Foundation In the last analysis, knowledge cannot be nationalized. Successful embargoes cannot be maintained against the export or import of ideas We are all of us, under whatever national flag, the joint beneficiaries of the intellectual property of mankind Science cannot but have a single aim and language in the discovery of truth or it ceases to be science

Nowhere have the dangers of the present situation been more plainly set before scientific workers It is bad enough that the activities of such an organization as the Rockefeller Foundation should be circumscribed and certain countries deprived of the services it could render This however is not the concern of those nations alone for the whole world is impoverished by this state of affairs Scientific progress depends on co operation and anything which limits the freedom of scientific work or scientific workers because they do not accept particular political or religious views whether generally or in limited areas is detrimental to the advancement of knowledge and the progress of mankind The contact between keen and untrammelled minds of men of all races supplies one of the most indispensable stimulants to scientific progress and we hamper it at our peril

The fears concerning intellectual freedom which Prof A V Hill expressed four years ago in his Huxley Memorial Lecture on The International Status and Obligations of Science have indeed been justified and it cannot be said that scientific workers as a whole have heeded his warning Many of them still forget that freedom of thought though fairly and hardly won is not a permanent and inevitable attribute of science but has to be maintained by further struggle The coercion of scientific workers to specified political opinions has already lowered the standard of scientific honesty in those countries and if unchecked may bring science itself into contempt Nor would it be hard to find evidence of forces in the Anglo Saxon communities which are working to hinder research to destroy free thought and to strike at the root of all opinion not congenial to authority

This therefore is no time for shallow complacency for self congratulation at the comparative freedom of thought to be found in one country rather than in another Scientific workers cannot be content to concern themselves solely with the advance of a science within their own national frontiers That way lies impoverishment and ultimate stultification The advancement of science no less than the continual progress of mankind demands that the liberty lost anywhere shall be regained Science and learning must recognize that they exist not only for their own sake not only for what they can do for the material welfare of mankind but chiefly for the fact that they alone seem to be truly international and capable of transcending national follies

Among the welcome signs that scientific workers are coming to recognize the gravity of the situation are the resolutions passed at the Indianapolis meeting of the American Association for the Advancement of Science and the response they have already received The first resolution affirming the independence of science of national boundaries and races and creeds and asserting that science could only flourish where peace and intellectual freedom were found extended an invitation to the British Association for the Advancement of Science to co operate not only in advancing the interests of science but also in promoting peace among nations and intellectual freedom The same resolution also declared that an examination of the profound effects of science upon society was one of the objectives of the Association

The second resolution referred even more specifically to the inroads being made upon intellectual freedom and declared emphatically that if the existing liberties won through ages of struggle and at enormous cost were lost or seriously impaired there could be no hope of continued progress in science or even of lasting material welfare The suppression of independent thought and its free expression was denounced as a major crime against civilization and the executive secretary of the Association was requested to raise with the British Association the question of co operation so that the combined scientific forces of America and Great Britain should act as a united world intellect

From these resolutions there have already been derived a number of concrete proposals such as the formulation of a set of fundamental scientific principles of an ethical nature and of the maximum number of inviolable methods of international intercourse and co operation among scientific workers as well as the planning of machinery for giving effect to such proposals Progress in such matters however is determined largely by the extent to which individual scientific workers are prepared to contribute both interest and active support Upon them depends mainly whether or not such matters figure prominently or not at all in the proceedings of the forthcoming meeting of the British Association

If the present drift is to be arrested and science and learning are to regain everywhere the immunity from interference or persecution to which they have been regarded as entitled in all civilized communities for several centuries it will not be by the efforts of a minority of scientific workers Science will only be re established in its unique place among the interests of mankind when scientific workers everywhere recognize their responsibilities and are prepared to make fresh sacrifices in the cause of intellectual freedom They must educate their fellow citizens to the realization that science is a common interest of mankind, and that whatever may be the barriers or the difficulties or the struggles between them, civilized societies must accord a certain immunity and tolerance to those engaged in scientific discovery and learning

Besides this, there must be a widespread recognition by scientific workers of the normal conditions of tolerance and immunity for scientific pursuits in a civilized State These restraints—not to meddle with or be dominated by divinity, morals, politics or rhetoric must be clearly understood and firmly accepted by scientific workers The loyal acceptance of such a code of ethics or discipline is all the more important to-day, not only if objective research in the social sciences is to be pursued, but also if what is often termed the frustration of science is to be overcome Scientific thought can no more exert its full weight than objective research be pursued unless scientific workers maintain most scrupulously their intellectual honesty and independence of political pressure The discipline of professional ethical codes, no less than the intellectual or technical excellence of the work carried out, is an important factor in establishing confidence in the integrity and impartiality of the results obtained

Scientific workers cannot afford to be indifferent to these matters They should be willing to make the effort both as men of science and as citizens, and to accept the challenge now thrown down to them Unity in defence of full freedom of thought, formulation and acceptance for themselves of the inevitable restraints demanded in a civilized community for orderly progress, refusal to allow any external system of thought or institution to dictate their decisions or activities, and promotion by all means in their power of the international exchange of ideas and its accompanying stimulation of thought are some of the necessary steps Given these desiderata, it will not be long before fresh victories are won for intellectual freedom, before the restraints on scientific intercourse are broken down and science is able to assist all nations to deal creatively and constructively with the great problems which everywhere confront us to-day

A Chapter in the History of British Botany

Sixty Years of Botany in Britain (1875-1935): Impressions of an Eye-Witness By Prof F O Bower Pp ix+112+14 plates (London Macmillan and Co, Ltd, 1938) 10s 6d net

ALL Prof Bower's books have been characterized not only by their clearness of style but also by a power of transmitting to the reader the interest of the writer. This sense of the enjoyment which the author has experienced in the writing is specially evident in the present book, which gives in vivid outline the history of an important phase in the development of botany in Great Britain In the period of which it treats, an almost revolutionary change was effected from the preceding purely systematic work to the aspects of botany familiar in our modern universities It was well worth while having the facts recorded, but this book is much more than a historical statement The history is strung on an equally interesting thread of autobiography, for Prof Bower not only lived through the whole period of which he writes, but also took an active part in its events. As the sub-title indicates, we are throughout receiving the impressions of an eye-witness Thus the reader is led on with sustained interest, grateful for the first-hand pictures he obtains of personalities and their work and sometimes a little regretful that he does not get more This artistic reserve, together with the clarity of the writing, makes the reading of the book not only profitable but also a real pleasure

As a boy at home and at a public school, the author was interested in natural history and especially in botany When he passed hopefully in 1874 into the University of Cambridge, he found the science almost dead, although the beginning of a revival was evident before 1879 in the private teaching of Vines It was from the active botanical schools of the Continent that the new botany came belatedly to Britain and, like others who were concerned in its introduction, Bower went abroad to work in the laboratories of Sachs and De Bary Reform in university teaching of the subject, on the other hand, came through Huxley at South Kensington, and Prof Bower gives us glimpses of the life of a young botanist in London in 1880-85. He became responsible for the botanical classes instituted by Thiselton-Dyer in Huxley's department, and there was active research work in the recently established Jodrell Laboratory in Kew Gardens. In 1885 Bower was almost commanded by Sir Joseph Hooker to take on the duties of the regius chair of botany at Glasgow, which he held for forty years. Botany was by then established on the new lines in England, but the work was still in great part to be done in the Scottish universities. The progress of the department at Glasgow is a good illustration of what took place in other universities.

In the course of the historical account, we have estimates of many great figures; of Hooker, Sachs, De Bary and Huxley among the seniors, and then of the younger men chiefly concerned in the movement. The brief accounts are accompanied by good portraits. It will be a revelation to many how much vital stimulus botany owed to men of whom one tends to think chiefly as administrators. This is particularly true of Thiselton-Dyer's part in the movement, but also holds for Vines and Balfour. The story of the foundation of the *Annals of Botany* by the latter is told in full. In connexion with the progress of fossil botany, we have personal impressions of Williamson, Scott and Kidston. This subject is taken as one illustration of the progress of branches of botany in Britain. It is balanced by a short consideration of the emergence of pure physiology in the botanical departments of the country, headed by Cambridge, where Francis Darwin and Gardiner were the initiators. Space will not allow of adequate comment on a chapter entitled 'The Morphological Kaleidoscope", which, as the author points out, is written in somewhat more technical style than the rest of the book. Here also the changes in point of view, the discoveries which "jogged the morphological kaleidoscope" and brought out new patterns in the study of the evolutionary morphology of land-plants, are made significant by being taken from Bower's own scientific experience.

A concluding chapter sums up the story sketched in the book, estimates the present state of botany in Great Britain, frankly recognizing the decline of interest in morphology, and looks with breadth of view and hopefulness to future progress both in pure botany and in its practical applications.

Prof. Bower has given us a valuable book which may interest many in addition to professional botanists. It should be available for the students in every botanical department. In proportion to their youth, readers will be removed from any personal contacts with the small body of pioneers who laid the foundation of the differentiated, perhaps over specialized, science as it is now found in our universities. Prof. Bower has been able to write as an eye-witness of these men and their work and has done this so vividly that we can realize how the botanical departments in which we work and the conditions we take for granted have come about. This is the book's immediate value; but the data it contains may prove invaluable to some future botanical historian. Those who introduced what was then called the 'new botany' were united in enthusiasm and in a sense of adventure, the thrill of which persists in these pages. What may be read between the lines, but is worth while making explicit, is the great part played by Prof. Bower himself, not only in the early stages of the movement, but also in carrying its spirit on to a later period. The reviewer can speak gratefully of the stimulating atmosphere which radiated from the professor in the still primitive department at Glasgow in the early 'nineties. As he can now realize, this was the direct outcome of the new spirit in investigation and teaching which came into botany in Great Britain in the 'seventies, and the history of which is the theme of this book.

W. H. L.

Research in the Antarctic

South Latitude

By F. D. Ommanney. Pp. xi + 308 + 16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 9s. 6d. net.

EVER since Dr. Stanley Kemp, as director of research to the Discovery Committee, began in 1924 to get his staff together, the Natural History Museum at South Kensington has seen the coming and going of a group of young scientific men, for the most part biologists, collected from the universities of England, Scotland, Wales and Ireland. They would spend a few months at the Museum and then disappear for a year or two, to return, looking somewhat weather-beaten, accompanied by piles of packing-cases and casks (not always odourless) to arrange and study their collections in an iron shed at the back of the Museum, and to produce the long series of "Discovery Reports" which have been noticed from time to time in the pages of NATURE. Thanks to these reports, the Antarctic Ocean is becoming the best-known, from a scientific point of view, of all the Seven Seas. About their work these young men were always ready to talk to us, about the Antarctic Convergence, or the corpora lutea of whales, or the migrations of krill, but of their personal experiences we could hear but little. Yet, sometimes, over a pipe, one did get the impression that scientific research in the Antarctic was a man's job. Now, however, they have found a worthy spokesman.

Dr. Ommanney has the gift of arresting and vivid description; he has looked upon men and beasts and things with an observant and sympathetic eye; and he has the sense of humour to perceive the ridiculous in himself as well as in his companions. He does not dwell too long or too exclusively on the discomforts and hardships, but he does make us feel in some measure what it meant to step from teaching biology to first-year medical students to the gigantic horrors of flensing. Some of his pages are not for the squeamish, but if he is a realist, he is not of the type that is blind to the beauty beside the ugliness in Nature or to the nobility that lies behind the meanness in the spirit of man. Ommanney was one of the survey party of six men who were lost for ten days on King George Island in the South Shetlands, and tragedy was only missed by a hair's breadth. The story of their experiences is as moving as anything that has been told us from the Antarctic, and none the less so because they were not out to make a sporting 'record' but were doing a bit of sober and humdrum scientific research.

Although this book touches only incidentally on the scientific work that the author and his colleagues were doing, it does preserve many details that may be missed in more formal reports. The choking stench and deafening clamour of the penguin rookeries, the loathsome slumbers of the sea-elephants on the beaches, the dignified albatrosses on their nests—the ecologist must not forget these in his picture of antarctic life, while the student of animal behaviour will note the apparent inability of seals and penguins to concentrate attention for more than a few moments on anything lying outside the daily routine of their lives. It may be true that "the elephant never forgets", but the sea-elephant seems unable to remember for five minutes that he has watched one of his companions being butchered within a few yards of him.

The Colonial Office has at its disposal to-day not only the finest ship ever built for oceanographical research, but also a team of some of the most experienced oceanographers in the world; just how experienced, Ommanney has made clear to us in this book. It is much to be hoped that good use will be found for both when the present programme of research is brought to an end.

Psychiatry from the Behaviourist Point of View

A Biological Approach to the Problem of Abnormal Behavior

By Dr. Milton Harrington. Pp. 459. (Lancaster, Pa.: The Science Press Printing Co., 1938.) n.p.

THE disadvantages of the psychological approach to mental illness, the difficulty in proving facts, the prolonged treatment during which the patient is under the influence of the physician and the unpalatable theories of the psycho-analysts, have driven many to seek a basis for psychiatry elsewhere. It is inevitable that those who turn away from psychological theories should return to the obviously firm facts of physiology, and to such the investigations of Pavlov and the behaviourists are a gift from the gods.

Dr. Milton Harrington has already written a book in which he criticized the structure and theory of psycho-analysis ("Wish-hunting in the Unconscious", Macmillan, 1934) and in his present book we have the second of a triology. Here his efforts have "not been to present new evidence bearing on the problem of abnormal behaviour, but to bring together into the form of a theory, the important facts at present known to us, thus consolidating the gains already made and preparing the way for further progress". (The third book which will complete his triology is to be on treatment.)

It is obvious that with such an intention nothing new or strange will be found in his book. Moreover, the author does not take an entirely behaviourist point of view, but is willing to recognize consciousness and to use what he thinks is good in the old psychology. He thus obtains the best of both possible worlds, and by utilizing familiar physiological and psychological facts, he describes a psychophysiology upon which he constructs his psychopathology. Two thirds of the book are devoted to the psychophysiology and a third to the psychopathology. It is described in an interesting way with a facile style, and the whole is logically developed. One feels, however, a certain poverty of material and indeed the behaviourist's explanations are so obvious that any attempt to expand them makes a book rather laboured Dr Harrington makes the most of his material and his description of the Law of Confluence by which it is possible to explain conditioning reinforcement inhibition and the production of symptoms all by one principle is most interesting and valuable

When we come to the psychopathology we cannot help feeling unsatisfied Nor does it offer as all pathology should any fresh basis upon which to construct treatment It is doubtful whether we can explain for example the appearance of claustrophobia simply by conditioning The claustrophobic seldom give a history of repeatedly being shut in closed spaces and even if one or two terrifying instances will suffice to condition the child (as recent work suggests) the innumerable instances of harmless enclosure in daily life should neutralize them In fact one can scarcely live without going into lifts and so on every day and yet someone who has done this without difficulty for years may suddenly become frightened of them The author's explanations of paranoid delusions given on page 422 are not very satisfactory and merely echo the old traditional views If delusions could arise so easily they would be a great deal more common than they are to day

In spite of these criticisms the book is sound and no one can do other than profit from reading it There are very few mistakes—the most obvious is on page 343 where the writer mentions an innate sense of modesty and one wonders if he really believes that modesty is inborn and not acquired

Dr Harrington is to be congratulated on attempting to found a behaviourist psychiatry and if it is far from complete it is because he is bound by limitations of his own seeking No doubt he feels it is better to build a small safe structure than a towering construction of doubtful theory CLIFFORD ALLEN

The Universities Yearbook

The Yearbook of the Universities of the Empire 1938
Pp xlv + 1154 (London G Bell and Sons Ltd 1938) 15s net

THE first Congress of the Universities of the British Empire held in London in 1912 resolved that the time had come for establishing a permanent centre of information to carry on the good work begun by the Congress of weaving a fabric of mutual knowledge and understanding Thus originated the Universities Bureau of the British Empire and the Yearbook the compilation of which is one of its most important tasks In addition to being a who's who and a what's what for the universities a shop window for the wares they have to offer and a summary record of their annals it brings together in a series of appendixes a heterogeneous mass of data relevant to the interests of their members actual and prospective

Such a compendium has a tendency to become unwieldy and this year the appendixes now covering 240 pages have been rearranged in a more logical sequence than heretofore facilitating quick reference They deal with such matters as admission to universities students from abroad open post graduate scholarships admission to professional careers associations of students of teachers and of other people interested in higher education and research centres of scientific research and information libraries universities of the United States Anglo American professorships international organizations

Lastly there is a bibliography admission to which is jealously restricted Perhaps a little more latitude might be allowed for new publications for as long as they are new for example the publications of the International Institute Examinations Enquiry Committee (only one of which is mentioned) the N U S congress report entitled Graduate Employment and Prof Ginsberg's address to the British Association last year

In this year's issue appears for the first time the annual report of the executive council of the Universities Bureau The publicity thus given to the Bureau's proceedings is doubly acceptable by reason of the fact that the report includes a summary of the proceedings of the Committee of Vice Chancellors and Principals of the Universities of Great Britain and Ireland lineal descendant of the committee constituted twenty years ago in response to Lord Balfour's appeal to the universities to establish a body which should not only represent them vis à vis the Government and in their relations with the universities of other nations but also should be an organ of expression to voice their desires and aspirations The list of subjects discussed by the Committee (p xxxi and again on pp 17 18) is a long one, most of the items being of minor importance It does not appear whether any of them were matters referred to the Committee by Government departments, as contemplated in Lord Balfour's appeal

Contemporary Indian Philosophy

By M K Gandhi, Rabindranath Tagore, Swâmi Abhedananda, K C Bhattacharyya, G C Chatterji Ananda K Coomaraswamy, Bhagavan Das, Surendranath Dasgupta, Hiralal Haldar M Hiriyanna S Radhakrishnan, R D Ranade, V Subrahmanya Iyer, A R Wadia Edited by Dr S Radhakrishnan and Prof J H Muirhead (Library of Philosophy) Pp 375 (London George Allen and Unwin Ltd , 1936) 16s net

IT is for the mutual benefit of Eastern and Western philosophers that such books as the present are published A clarification of Indian thought is just as important to Indians themselves as to the growing number of European scholars who make a technical study of Indian thought Of the fourteen thinkers who contributed to the present volume Gandhi and Tagore belong to Indian national life, and their messages are incorporated more for their moral influence than for their export value But the essays of the other writers provide much food for reflection

Meditating On the Pertinence of Philosophy , Dr Coomaraswamy suggests that the highest wisdom is obtainable by finding what is common to different religions and by constructing a rational metaphysics on these common elements An example of the method proposed is given in a comparative study of the idea of immortality Discussing ' The Spirit in Man ', Sir S Radhakrishnan reconciles theism and absolutism But both are rejected by Prof Wadia, as giving no explanation of evil, in favour of pragmatic idealism The suggestive study of Prof Dasgupta on The Philosophy of Dependent Emergence ' and Prof Hiriyanna's essay on The Problem of Truth" will be read with much interest, while Prof Ranade's contribution, in which he proposes to reach truth by a critical interpretation of the great philosophers, is perhaps the most original of the series An excellent study of Vedantic philosophy is given by Subrahmanya Iyer, who discusses *maya* (illusion) and the three states of the soul (waking, dreaming and sleeping)

On the whole, the essays contained in this book deal mainly with personal philosophy and religious problems , and they show, with the exception of those of Prof Dasgupta and Prof Chatterji, that absolutism is in great favour in contemporary Indian thought This is an indication of the strong influence of religion on philosophy, which will continue to be an outstanding characteristic of the Hindu mind

T G

The Structure and Development of the Fungi

By Dame H C I Gwynne Vaughan and Dr B Barnes Second edition. Pp xvi+449 (Cambridge At the University Press, 1937) 18s net

TEACHERS and students of botany and mycology will warmly welcome the second edition of this well known book During the decade which has elapsed since the book was first published, research on the fungi has been ardently pursued , much additional knowledge has therefore been incorporated in the present edition, illustrated by figures of the same excellence as characterized the book originally Among many new features one is glad to see the inclusion of a section on the interesting group of the Blastocladiales, an account of the recently discovered function of the spermatia of the rusts, and a much fuller discussion of the phenomena of heterothallism and variation in the fungi than was possible in 1927 Some new methods are described in the chapter on technique and the references to literature have, in general been brought up to date

As indicated by the title the book deals primarily with the morphology of the fungi and only in a subsidiary manner is their mode of life discussed In a few instances reference to the latter has not incorporated recent work for example, some authorities consider that the primary cause of larch canker is frost and not *Dasyscypha Willkommii*, and fresh light has been thrown on the parasitism of *Epichloe typhina* and *Armillaria mellea* It is now scarcely true to say that the Ustilaginales are obligate parasites, for several species have been cultivated on artificial media *Ustilago Carbo* treated as a single species, is really a complex of species with diverse life histories These however, are but minor imperfections in a book of generally supreme excellence In fact the authors have described the structure and development of the fungi so well that an urgent appeal can be made to them either to include a fuller account of the general biology of these organisms in the next edition or to write a companion volume on this theme

Physik fur Studierende an Technischen Hochschulen und Universitaten

Von Dr Paul Wessel Herausgegeben von Dr V Riederer von Paar Pp xii + 550 (Munchen Ernst Reinhardt, 1938) 4 90 gold marks

THIS text book of physics for engineers and technical college students is a kind of pocket edition of an intermediate course in physics with certain elaborations and unusual features While the fundamentals are surveyed, in an effective and extremely compact manner, in two main divisions of the work extending over some 350 pages in which special reference is made to X rays and crystal structure and to atomic physics, the whole of the foregoing material is later re surveyed in a more condensed fashion as a revision course occupying some 50 pages This is followed by another 50 pages containing a series of questions and answers, the latter usually taking the form of a reference to the appropriate page on which the relevant information necessary for a correct answer is to be found Finally are given a goodly collection of mathematical and physical tables, where in addition to much useful data normally required by engineers and physicists and to be expected in a book of this nature, are given tables such as those of the isotopes of xenon, the families of radioactive elements and the wave lengths of the K series of the X ray spectra of various elements, the usefulness of which is not obvious

The work is well illustrated and indexed, and should be most helpful to English speaking students who wish to acquire a knowledge of scientific German.

L F B

A Monograph on Veins

By Kenneth J Franklin Pp xvii+410 London Baillière Tindall and Cox 1937) *27s*

IF anyone supposes that little is known about veins his opinion will be altered when he reads this scholarly but interesting monograph which covers the whole literature from the sixth century B C to 1936 from the points of view of the anatomist embryologist pharmacologist histologist clinician historian and photographer—in fact from the point of view of the physiologist

Veins have been Dr Franklin s principal interest since 1924 and he has published many papers describing skilful work carried out with careful accuracy Fleisch and Gollwitzer Meier have simultaneously concentrated on the same problem Few people have known enough about veins to appreciate the significance of this work but Dr Franklin has now fitted the pieces together He was himself surprised at how well they fitted and many of his readers will share his emotion It must not be imagined however that the picture is complete for many fundamental problems are still a matter of controversy For example John Hunter suggested that the pulsations in arteries acted on veins like the movements of a piston in a pump forcing the blood past the valves This theory has been accepted by some and rejected by others, but the propulsive effect has never been demonstrated though compression of veins by the pulse has been observed by X rays in men and dogs

The subjects discussed include the blood depots the peculiar vascular anatomy of diving animals the effects of muscular contraction and respiration on the venous return the pharmacological and nervous control of veins venous pressure arterio venous anastomoses varicose veins and the history of intra venous injections and venesection

The book is attractively produced with excellent photographs diagrams and historical portraits About 1 200 references are given in the bibliography

J H C

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1937 New Series Edited by Dr M Epstein Pp xiv +488 (London Longmans Green and Co Ltd 1938) 30*s* net

WITH unfailing punctuality this concise review of world history and achievement makes its appearance A calm review of the stormy year of 1937 can have been no easy task but it has been achieved without bias yet with enough spirit and vivacity to make it readable from beginning to end As usual British and foreign history each occupy about one third of the book Particular praise may be given to the survey of internal affairs in Great Britain and to the accounts of Germany and the Soviet Union Spain China Japan and the United States also occupy many pages The writer of the survey of the literature of the year comments on the deterioration in standards of human justice and the discouragement of free speech which he believes have tended to slacken creative effort Unfortunately it is impossible to deny this belief The survey of science however records advances in several directions although the condensation of the account no doubt on the grounds of space is almost excessive There are also the usual surveys of art drama law and finance Among the public documents printed in full are the Constitution of Ireland and the United States Neutrality Act The obituaries of the year give admirable biographies of eminent men and women of all countries

Théorie Cinétique des Liquids

1 Fluctuations en Densité *2* La propagation et la Diffusion de la Lumière Par Prof J Yvon (Actualités scientifique et industrielles Nos 542 and 543) Pp 133 together 18 francs each

THE author develops a theory of the propagation and diffusion of plane polarized light without change of wave length by a monatomic liquid for example argon the molecules of which are assumed to be spherical and isotropic The first part deals with the density distribution and the effect on it of gravity and thermal agitation the second with the dielectric constant refractive index and diffusion of such a liquid the statistical method of Gibbs being used throughout An expression for the ratio of the strength of the source of diffused light furnished by a volume of the liquid per unit intensity of the incident light (Rayleigh s ratio) is obtained which agrees satisfactorily with experimental results for benzene but not for water As neither is monatomic observations on monatomic liquids are required before attempts are made to extend the theory to complex molecules Each part contains nearly 100 references

The Statesman s Year Book

Statistical and Historical Annual of the States of the World for the Year 1938 Edited by Dr M Epstein Seventy fifth Annual Publication revised after Official Returns Pp xxvi + 1497 (London Macmillan and Co Ltd 1938) 20*s* net

THIS annual has effected a significant change this year The first part of the book is no longer entitled The British Empire but has become The British Commonwealth of Nations Within this embracing title comes first of all the British Empire including Great Britain and Northern Ireland the Colonies Protectorates, India and Burma and secondly the Dominions concluding with Ireland The remaining sections of the book have undergone no change in arrangement but the usual careful revision in detail Abyssinia and Austria linger in their alphabetical places but all effective and other changes in their Governments are noted The section on the States of Germany has disappeared As usual corrections and additions are made up to the end of March or even later Of the two coloured maps one illustrates the strategic position of Singapore and the second shows the distribution of steel production and associated ores, iron, manganese chromite etc , throughout the world

James Gregory (1638-1675)*

By Prof. H. W. Turnbull, F.R.S.

IN the early seventeenth century, two brothers, Alexander and David Anderson of Aberdeen, rose to mathematical distinction Alexander, who went to Paris as professor of mathematics, became the friend and expositor of Vieta, while David, commonly called 'Davie-do-a'-thing', became the Archimedes of Aberdeen, constructed the spire of St Nicholas Church, and removed 'Knock Maitland', a dangerous submerged rock, from the harbour by harnessing it to the tide His daughter Janet married the Rev John Gregory, of Drumoak on Deeside, twelve miles from Aberdeen, and thereafter for two hundred years their descendants occupied the chairs of either mathematics, medicine or philosophy in an unbroken sequence at Scottish universities, always with vitality and distinction

The greatest of this remarkable family was James, the third son of John and Janet Gregory, who gained renown for the invention of the reflecting telescope, but was also a mathematician whose genius is outstanding even among the giants of the age of Newton James was born in 1638, the year when Descartes gave analytical geometry to the world and Galileo his laws of motion , he died prematurely in 1675, of a sudden illness accompanied by blindness which befell him as he was observing the planet Jupiter in company with his students at Edinburgh He received his first lessons in mathematics from his mother , he eagerly mastered Euclid's 'Elements" given to him by his elder brother David at the age of thirteen or fourteen , he went to the Grammar School and later to Marischal College at Aberdeen, where he graduated

By the age of twenty-four years, James Gregory had written his "Optica Promota", which contains an elegant and geometrically accurate account of mirrors and lenses, beginning with the re-discovery of the sine law (of Snellius and Descartes), dealing with elliptical and hyperbolic surfaces and ending with a description of a reflecting telescope An astronomical appendix also suggests the importance of observing the transits of Venus and Mercury for calculating parallax In 1663, Gregory went to London and the book was published He met Collins and Hooke, who put him in touch with the celebrated optician Reive; Reive tried to make such a telescope, but the resulting mirrors were a failure and the attempt was abandoned. But Hooke, that prince of experimenters, persevered, and in February 1674 presented the first Gregorian telescope to the Royal Society, and the same form was universally employed in the eighteenth century

Gregory spent the next three years in Italy, chiefly at Padua, where the great Galileo had taught There Gregory printed, in 1667, his 'Vera Circuli et Hyperbolæ Quadratura", wherein he showed how to find the area of the sector of a conic by means of convergent polygons, and actually attempted to prove the transcendence of the ratios nowadays denoted by π and e (He considered π and also the number 2 3025850929940456 which is $\log_e 10$, this he calculated correctly to seventeen figures) The book lays the foundations of hyperbolic sines and cosines, as well as the concepts of convergence and algebraic invariance under transformations

In 1668, Gregory returned to England with a third book, the 'Geometriæ Pars Universalis", which gives a systematic *geometrical* account of the calculus, based on the work of Cavalieri and Fermat It contains the earliest proof of the fundamental theorem—that the method of tangents (differentiation) and of quadratures (integration) are converses of each other It also shows how to transform $\int y\,dx$ to $\int z\,dy$, where $z\,dy/dx = y$ This book profoundly influenced Barrow, who published his "Geometriæ Lectiones" in 1670

Gregory remained in London until the autumn of 1668 with Collins, who egged him on to solve the unproved theorems of the day As a result he produced a booklet, the "Exercitationes", containing a remarkable method of reversing a power series $f(x)$ in the form $x = \Sigma c_n f(x/2_n)$, together with rigid proof of Mercator's theorem on the expansion of $\log(1+x)$ By integrating sec x and tan x Gregory cleared up the mystery of the rumb spiral, explaining why Wright's "Nautical Tables" of 1599 actually presented a set of logarithms, of which the author was unaware

In 1668 Gregory was appointed first professor of mathematics in St Andrews, where he resided until 1674 Partly owing to a conflict with Huygens over the "Vera Quadratura" and partly through hearing of Newton's success in the "Analytics", Gregory never again published his mathematical work, beyond adding one short note to a vehement little book on the "New Art of Weighing Vanity", written by a colleague, William Sanders, a regent at St Leonard's College, St. Andrews , this book was directed against George Sinclair, a retired professor of natural philosophy at Glasgow, who had quarrelled with Sanders. The note contains the expansion of an elliptic integral in a doubly infinite series and solves the finite motion of a circular pendulum. In 1674 Gregory was appointed to the chair of mathematics in Edinburgh, which he only held for a year before he died. He married in 1669 Mary, daughter of George Jamesone the painter, and widow of Peter Burnet, of Aberdeen, and they had two daughters and a son, James, afterwards professor of physic in King's College, Aberdeen (d. 1731).

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* Substance of a paper presented on Monday, July 4, 1938, at the Royal Society, Edinburgh, and also of an address on Tuesday, July 5, at the Tercentenary Graduation, University of St Andrews.

A long correspondence (1668–1675) between Gregory and Collins has happily been preserved. Gregory's letters were printed in Rigaud's "Correspondence of Scientific Men of the 17th Century". Collins's letters, which are now in the University Library at St. Andrews, have never yet been published, but the present tercentenary year affords an appropriate opportunity for doing so, particularly as they contain—on the blank spaces of the letters—some fifty mathematical notes of James Gregory in his own hand, revealing either the methods employed in such results as he sent to Collins by letter, or in still newer work which never saw the light. Careful scrutiny, begun in 1932, has unravelled their contents, and shows that Gregory actually anticipated Taylor, by forty-five years, in his famous expansion theorem, that Gregory could integrate $\sin^n \theta$, and had gone deeply into the theory of rational right-angled triangles and Diophantine quadratic equations. It is now possible to judge how slight was his mathematical contact with Newton; also how Barrow and Gregory influenced one another. It is noteworthy that Gregory probably never even heard of the name of Leibniz. These discoveries among the old letters go far to explain the fact that in his day Gregory was held to be second only to Newton.

Vaccination of Cattle against Foot-and-Mouth Disease

THE devastating epizootic of foot-and-mouth disease which has raged over Western and Central Europe amongst cattle, sheep and pigs since last autumn has by no means come to an end, though there have been some signs of local or temporary abatement in those areas first invaded in Holland, Belgium and parts of France and Germany. Sweden, Norway and Denmark have suffered little, and are always ready to stop early invasion by slaughter. In Great Britain there have been exceptionally severe and numerous outbreaks, but the number of farms affected and of animals infected or lost by slaughter has not approached that of the Continental calamity. On June 1 last, the number of farms infected in Germany was officially reported as 42,306.

Persistent research work in Germany has been carried out for forty years almost continuously, and since the Great War by Waldmann on the island of Riems; in France much valuable work was also done by Vallée at Alfort. In Great Britain research has been in progress since 1924, but though knowledge of the disease has increased, it has only been possible to increase the means of control in special circumstances and to reduce the spread of infection. Experimental stations have also been set up in recent years in Holland and Denmark.

The chief aim of investigation has been to find a method of protective vaccination, and many attempts have been made to devise a safe vaccine made from the virus, attenuated by biological, chemical or physical treatment, or made safe by the manner of its administration.

Inactivation of the virus by formalin has until recently appeared to be the most hopeful method, and has perhaps never been tried in the field with sufficient care and persistence. During the last few years, a technique of adsorption of virus with aluminium hydroxide has been very carefully worked out with great detail by Schmidt and his colleagues in Denmark on guinea pigs, and very promising results have been published. He attached great importance to the administration of the adsorbate-vaccine subcutaneously, for by other routes it was capable of producing infection. The results of vaccination given by Schmidt closely resemble those obtained with formalinized vaccine, but the adsorbate appears to be less safe and to give a somewhat higher degree of protection, as might be expected from a less completely inactivated virus. Waldmann maintains that Schmidt's vaccine is too dangerous, and he does not accept the suggestion that the active virus can only be released so slowly from the adsorbate as to be safe though still capable of giving active immunity.

A modification of Schmidt's vaccine has recently been used by Waldmann in Germany with additional safeguards to ensure its inability to produce the disease and spread infection. It was first tested on cattle at the Riems station with good results. The accessory chemical or physical means of attenuation devised by Waldmann have not yet been published, though an account of the vaccination of more than 40,000 cattle with this preparation has appeared in the *Berliner tierarztlicher Wochenschrift*, Nos. 22 and 24 (1938).

The initial difficulty in vaccination so as to prevent an invasion of the disease has always been that the vaccine must be prepared from active virus, and only relatively small quantities of virus can be obtained from one infected cow

The immense number of infected animals in Germany at the present time, and the high degree of organization in the collection of material in outbreaks in separated districts, and in the preparation of the vaccine from the virus, have enabled this relatively large trial to be made in that country The hope expressed that it will be possible to cultivate *in vitro* large quantities of suitable virus has so far not been realized The results of the campaign reported from the areas dealt with appear to be good Vaccine has been given to more than 40,000 cattle with apparently no spread of infection from the vaccinated animals It is claimed that almost 100 per cent of the vaccinated animals have developed immunity within fourteen days and some degree of resistance in five days There is also some evidence that the immunity lasted two to three months at least Sheep, goats and pigs were not vaccinated as they were considered much less susceptible than cattle, and few outbreaks in these animals are mentioned in the areas where cattle were vaccinated Three different groups of animals were vaccinated

The first group of 9,582 normal cattle were in an uninfected district and were isolated for ten days to test the inability of the vaccine to infect normal cattle The cattle were in thirty-three villages (950 farms) and were vaccinated between March 8 and April 9 No instances of the vaccine producing the disease were observed, only six cases of infection occurred, and there appeared to be good reason to attribute these to other sources The animals also presumably developed a good immunity, as they remained free from the disease in the neighbourhood of an advancing epizootic

The second group consisted of 19,486 normal cattle in districts where already a single outbreak had occurred, in this group, though a number of infections occurred in the first fortnight after vaccination, fresh cases then ceased and the animals appeared to have become immune

The third group of 11,608 cattle was in districts where several outbreaks had already occurred and many of the animals had received an anti-serum The number of cases after vaccination here was large, but fresh cases did not appear after the twelfth to fourteenth day, and this immunity was attributed to the vaccine The districts for vaccination were selected because they were in the line of advance of the epizootic It is stated that even eight days after vaccination the cases of disease appearing were fewer and less severe, and after fourteen days the immunity was almost complete

In this field experiment there were no exact 'controls', and the course which the epizootic would have taken in the absence of vaccination could be inferred only from the events in the early days after vaccination and records of its course in other unvaccinated farms, the latter details are not included in the published account It is possible that the synchronous and parallel outbreaks in other herds afforded sufficient 'controls', but the evidence has not appeared

The Scophony Television Receiver

By H. W. Lee, Scophony Laboratories

THE Scophony television receiver is an optico-mechanical system and possesses the advantages over the purely electric systems employing a cathode ray tube that (1) larger pictures are possible without great expense, (2) high voltages are not necessary—the voltage of a radio set is sufficient, (3) there is lower power consumption for a given picture size It is scarcely necessary to 'add that the Scophony receiver works on the B B C transmission

The essential parts of an optico-mechanical television receiver are (1) optical elements for producing an illuminated area on the screen, (2) means for moving the illuminated area over the screen; this is at present done by giving it two components of uniform motion in two directions at right angles, one horizontally and one vertically, (3) means for modulating the intensity of the illumination in accordance with that of corresponding areas of the picture to be reproduced. The modulated signals are received in the form of electro-magnetic waves and are converted into variations in voltage in an electrically tuned circuit, these have to be converted into variations in light intensity The difficulty of this conversion arises from the high frequency of the signals, which is 5×10^6 (The picture is divided up into approximately 500×400 elements and scanned 25 times a second) In sound recording, the highest frequency is of the order of 10^4 television has then an increase of 500 times It is thus easily understandable that mechanical light valves are out of the question nor is it possible to apply the electrical variations directly to a lighting circuit because a sufficiently brilliant source cannot be extinguished from its condition of maximum illumination in one five millionth of a second The Kerr effect was formerly employed and is still used in the telegraphic transmission of pictures but the light flux that the Kerr cell can handle is too small for high definition television (It has other disadvantages such as high capacity causing time lag)

The Scophony Light Control invented by J H Jeffree employs a cell which may be 10 cm × 2 cm in area and allowing ample light flux its action is based on the diffraction of light by compressional waves generated in liquid which act as a grating Electrodes connected to the electric circuit excited by the radio waves are attached to a quartz plate of which the thickness is such that the natural period of vibration under electric oscillations is 10 megacycles A parallel beam of light is sent through the cell and (in order to separate the diffracted from the undiffracted light) brought to a focus by means of a lens An opaque shield cuts off the light of zero order (undiffracted light) and the diffracted light (three orders of spectrum are used) passes to the screen The amplitude of the oscillation in the crystal and of the compressional waves produced in the liquid at any time is proportional to that of the electrical oscillations which in turn is proportional to the light received at the instant from the element of the picture which is being scanned As the supersonic wave travels along the cell it is followed by a rotating mirror of a mirror drum so that the small beam of diffracted light from it to the mirror is reflected in a fixed direction in space (compare the action of the heliostat mirror in following the sun s motion) A lens forms an image of the cell on the screen so that the amount of light reaching a point on the screen is proportional to that of the corresponding point on the picture but—and this explains the increased optical efficiency of this light control—the point is illuminated not for one five millionth of a second but for the time the wave takes to travel along the cell If we take the cell as 10 cm long this time since the average speed of the waves at the frequency specified is about 1 000 m per sec amounts to one thousandth of a second—a 500 fold increase

We have been considering the line scan' The number of traverses the illuminated area makes per picture is called the number of lines (the B B C standard is 405) and so the illuminated area which in one direction may be equal to the width of the picture must be limited in a perpendicular direction to a line width or 1/405 part of the picture height This means that the image of the light cell on the screen must be compressed to do this cylindrical lenses are required Moreover to reduce the length of the scanning drum so as to keep its inertia small in order that the power required to drive and synchronize it may not be excessive the light beam is still further compressed in this direction This is the principal of the split focus invented by G W Walton[2] it is only by this reduction in size that it is possible to drive and synchronize the high speed drum at 30 000 r p m The drum is driven by an asynchronous motor and synchronized by means of a phonic wheel to which the synchronizing pulses of the transmission are applied At the high speed used glass would fly to pieces so stainless steel is used which metal is necessary in order to obtain optically polished mirror faces The amount of steel is kept at a minimum and the drum is in fact a steel annulus with an aluminium core The inertia can thus be brought down to 137 gram cm^2 The slow speed drum to provide the scanning in the other direction has to change the picture (or frame) 50 times a second and moves only 1/202 5 times as fast as the high speed drum for the same number of faces and there does not arise the same need to reduce size

Fig 1 shows the lay out of the system but in order to show the optical arrangement conventional sections made in two planes at right angles through the axis are shown (Fig 2) Here the scanners are only indicated and for the sake of clearness the rays are shown undeviated by reflection at the scanners

The lenses B_1 and C have a two fold function Inasmuch as C images the supersonic waves in the cell on to the screen B_1 may be regarded as a field lens to C reducing its size On the other hand the lenses B_1 and C have to form a well defined image (of the light source) on the opaque shield and furthermore they have to fulfil a condition which is peculiar to the Scophony optical system A ray parallel to the axis impinging on the supersonic wave field at P at a distance h from the axis is brought to a focus at the shield at an angle θ to the axis Now P travels with uniform linear speed along the cell and the mirror drum rotates with uniform angular velocity it is therefore seen that the condition $h/\theta =$ constant must be fulfilled[3] (Compare the aplanatic or sine condition $h/\sin\theta =$ constant)

The above condition being satisfied the following relationship must hold

Equivalent focal length of B_1 and C is equal to the ratio of velocity of the supersonic waves to rotation speed of scanner Putting the velocity of the supersonic waves at 1 000 m sec = 10^5 cm sec and speed of rotation of drum at 500 r p m we get equivalent focal length = $50/\pi$ = 16 cm approximately Now as there are 405 lines to the picture and 25 pictures per second (or 50 pictures of 202 5 lines in the interlaced system) there are 10 125 line changes per second Therefore the supersonic waves must travel along the cell in 1/10 125 sec so that the size of the cell is

$$\frac{100\ 000}{10\ 125} = 10 \text{ cm}$$

approximately

The aperture ratio of the two lenses B and C is therefore $\frac{10}{16}$ or 1 1 6

For a cell 10 cm long holding 500 elements of the picture (an element being equal to the line width) each element occupies a space 0 02 cm The wave length of the supersonic waves is $\frac{10}{10}$ (frequency 10) 10 cm so that an element of the picture is carried by two complete waves Nomoto has shown that a width of two waves produces the diffraction phenomena

The equivalent focal length of B_2 and C being 16 cm and the angle of diffraction being equal to (wave length of light) (wave length of supersonic waves) = 0 55 × 10^{-4} 10^{-2} = 0 0055 radians for light for which the eye has maximum sensitivity the centre of the first order diffraction spectrum is displaced 16 × 0 0055 = 0 09 cm from the axis the centre of the second order diffraction spectrum is displaced 32 × 0 0055 = 0 18 cm from the axis and that of the third order spectrum 48 × 0 0055 = 0 27 cm from the axis It has been found experimentally that approximately 45 per cent of the light is diverted into the first order (at maximum modulation) 37 per cent into the second and 8 per cent into the third (with negligible amounts in the higher orders so that about 10 per cent is lost) Now the amount of light in the zero order is directly proportional to the area of the zero order that is the image of the light source formed by undiffracted light but the amount of light in the diffracted spectra is not proportional to the area unless this is very small because as the area is increased some of the diffracted light is cut off by the opaque shield, which must be equal in width to the zero order It can be shown on the basis of the above measurements that the amount of light increases rapidly as the size of zero order is increased to 1 8 mm

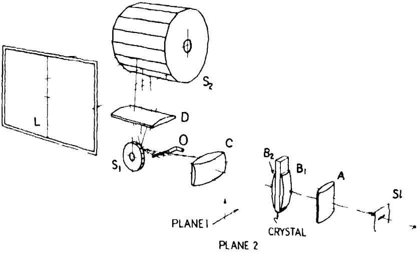


Fig 1

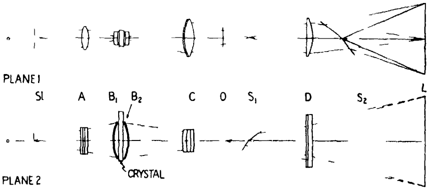


Fig 2

Sl is an illuminated slit

A is a cylindrical condenser focusing the slit in the cell in Plane 1

B₁ collimates the light from Sl to pass through the cell as a parallel beam

B₂ focuses it with the aid of C on the opaque shield O

C forms an image of the cell on the screen L in Plane 2 and an image of the light source on the scanner S₁ in Plane 1

S₁ and S₂ are the two scanners

D forms the line image

less rapidly for an increase to 2 6 mm and thereafter very slowly These calculations cannot be very accurate as no account is taken of light of different wave-lengths, but experiment is in agreement that a size of 2 5–3 mm gives optimum results It is preferable to interchange slit and shield, placing the shield in front of the light source and the slit in front of the scanner[4], this arrangement gives a solid beam of light, instead of one having a hollow centre, taking up less room on the scanner The diffracted light from this source can be dealt with very efficiently by a scanner of 5 cm diameter

A larger light source could be used by increasing the angle of diffraction by reducing the wave-length of the supersonic waves To this there are several objections shorter waves are more rapidly absorbed by the liquid (Nomoto states that no diffraction spectra can be obtained at frequencies of 30 megacycles, so that no great increase of frequency is possible), a larger light source would require a larger scanner, which would increase the difficulties of synchronization and driving, and finally, more power would be required to 'drive' the crystal (this is at present about 6 watts)

A rough idea of the accuracy required in the scanner can be obtained by considering that in the Scophony system a picture line of 500 elements is scanned by a rotation of 18° by the scanner One element therefore corresponds to about 2 minutes of arc Each surface of the scanner must therefore be placed accurately to a fraction of a minute of arc

The present Scophony receivers, although operating by no means at the limit of optical efficiency, give the satisfactory screen brightness of 15 lux The home receiver gives a picture 2 ft wide, using a mercury vapour lamp The public hall receiver gives a picture 6 ft wide, using a standard cinema arc consuming 100 amperes

[1] British Patent 430 236

[2] British Patents 328 286 and 451 132

[3] Patent applied for lenses fulfilling this condition

[4] Patent applied for

Obituary Notices

Prof. W. A. Bone, F.R.S.

THE death of Prof William Arthur Bone on June 11 has removed from the field of fuel science one of its most prominent figures and distinguished research workers So ended a career which has been remarkably effective in linking up achievements in the realm of theory with their applications to industrial progress over a long term of years.

Bone left the Friends' School at Ackworth and the Leys School, Cambridge, for chemical training at the University of Manchester at a time when a study of the properties of gases in explosion and combustion was already coming into prominence there, thanks very largely to the work of H B Dixon, and this course of training at home was supplemented by a period abroad with Victor Meyer His promise as a student was indicated by the award of the Mercer Scholarship, Leblanc Medal and the Berkeley Fellowship at Manchester, and the Ph D at Heidelberg In 1896, he became head of the Chemical Department at Battersea Polytechnic for two years, and then returned to Manchester as lecturer in fuel and metallurgy

In the following years he began to make his mark as an investigator in the subject which, in one form or other, was to engage his attention during the whole of his working life It was the work Bone did at that time which was largely responsible for a revision of the current ideas respecting the mechanism of the combustion of hydrocarbons and similar phenomena The notion of the preferential combustion of carbon on one hand or hydrogen on the other in these compounds, which had been the subject of much discussion and many claims, gave place in the light of his researches to the more rational hydroxylation theory, in which the preliminary association of the oxygen with the hydrocarbon was not simply assumed to be probable, but demonstrated experimentally to occur The successful outcome of this work was brought about by a combination of clear thinking and first class experimental technique, which was to be a distinguishing mark of Bone's work throughout life as an investigator

Meanwhile, at the sister University of Leeds, Prof Arthur Smithells had also turned his attention to combustion phenomena and study of flame, and in 1907 he had so far impressed the Council at Leeds with the importance of fuel as a proper subject of university study, that the first chair in the subject was founded there, and Bone was invited to become its first occupant During this time, Bone had been turning his attention to other phenomena of gaseous combustion which depended on the enormous influence exercised by hot solid surfaces on the rate of combustion of gaseous mixtures in contact with them This 'surface-combustion' lent itself to striking experimental demonstrations and was made the subject of various industrial applications which, in one form or another, have been taking their place in gas-burning apparatus from that time onwards The Bonecourt boiler is perhaps the best known example in which a very high rate of combustion and evaporation are obtained by burning a gas-air mixture in close contact with a solid packing of the boiler tubes.

In this part of his work Bone collaborated with McCourt and with the Leeds firm of Wilson and Mathieson.

In 1910 the association of the Fuel Department at the University of Leeds and the gas industry was cemented by the endowment of a chair of coal gas and fuel industries as a memorial to the recently deceased leader of the gas industry, Sir George Livesey, and Bone was made the first Livesey professor, a post which he occupied until 1912. As Livesey professor, apart from his more personal research work, he was occupied with that of a Joint Gas Heating Research Committee of the University of Leeds and the Institution of Gas Engineers which carried out the first systematic investigation of the radiant efficiency of the gas fire. It may be mentioned here that Bone's interest in fuel matters had a wide range, and that partly no doubt on account of a family connexion with the iron works at Skinningrove he was always specially interested in the fuel problems of the iron and steel industry. That was brought into prominence later in his life by an investigation which he carried out on the mechanism of iron ore reduction in the blast furnace, but as early as 1907 the same interest was manifested by the reading of a paper before the Iron and Steel Institute entitled "An Investigation on the Use of Steam in Gas Producer Practice". In this work, his collaborator was R V Wheeler, who later became professor of fuel at Sheffield, and it was carried out at the works of Messrs Monks Hall and Company of Warrington. It was not original in the sense of disclosing any new chemical phenomena but was a systematic and thorough examination of a prominent feature of gas producer practice on which very necessary information had been lacking, and its results have been freely utilized since that time.

In 1912, Bone transferred the scene of his activities to London. The *Imperial College* had awakened to the importance of the study of fuel, and invited Prof Bone to take over that and allied subjects in London. The headship of that Department was his official position for the rest of his life. The teaching there was post graduate, and he was enabled to devote most of his energies to the work of research. So early as 1905 he had been elected a fellow of the Royal Society, and in its *Transactions* and *Proceedings* were published most of his contributions to science.

The most striking development in Bone's work on gases was an extension of the study of the phenomena accompanying their oxidation and decomposition under high pressures in ranges including and far surpassing those used in internal combustion engines. In the elucidation of these phenomena, the principles which he accepted and applied were those which had already served him well, and he was very unwilling to depart from them in any way.

Another branch of work which occupied Bone in later years was the investigation of the constitution of coal and other natural fuels by pressure extraction with benzene and oxidation with permanganate. This work proved fruitful in his hands, and was supported by the Department of Scientific and Industrial Research. The distinguishing feature of this investigation, in my opinion, was the thoroughness of the survey undertaken, particularly on the quantitative side. By the establishment of carbon balances Bone was able to show that the products of permanganate oxidation not only contained such substances as benzene carboxylic acids, but also that these were derived in such quantities from even the less matured coals as made it legitimate to conclude that coal was essentially benzenoid in constitution. The value of this and his other research work was so far appreciated that after his retirement from the chair at the Imperial College on reaching the age limit in 1936 arrangements were made for placing at his disposal a laboratory and assistants for the continuation of his work.

Apart from his many published papers and the numerous lectures which he delivered to representative gatherings, Prof Bone wrote several books on the subjects in which he was specially interested, including "Coal and its Scientific Uses", "Gaseous Combustion at High Pressures", "Coal, its Constitution and Uses", and "Flame and Combustion in Gases". The last named work was written in collaboration with his assistant Dr D T A Townend, and in the last letter which I received from him, Bone expressed his gratification in learning that Townend had just been appointed to the Livesey professorship, of which he had been the first holder. The number of scientific and technical societies, national and other committees, with which Bone had been connected gives some indication of the reputation which he had established, but it is probably as a research worker that he will be best remembered.

JOHN W COBB

Mr J G Hides

THE death is reported of Mr J G Hides, explorer in Papua, which took place in Sydney at the age of thirty two years. Mr Hides was born at Port Moresby, Papua, and educated in Australia. He joined the Papuan Government service in 1925, and served successively as patrol officer and assistant resident magistrate. He showed an exceptional understanding of native mentality. In 1935 he carried out a patrol lasting eight months, in which he discovered in previously unexplored plateau country an unknown, and as he maintained, new race of light skinned people. The origin and identity of these people, whose culture displayed a number of features new to Papua, have been the subject of much discussion. Hides, who resigned from the service to take up gold prospecting in 1936, described his experiences and explorations in "Through Wildest Papua" (1935) and "Papuan Wonderland".

WE regret to announce the following deaths:

Dr A Galt, keeper of the Technological Department, Royal Scottish Museum, Edinburgh, in 1901–20, on June 26, aged eighty three years.

Mr W M Mordey, known for his work on the development of electro magnetic machinery and on alternating current magnetism, on July 1, aged eighty two years.

News and Views

Royal Society of Edinburgh Awards

The following have been elected honorary fellows of the Royal Society of Edinburgh *British* Sir Thomas Lewis, physician in charge of the Department of Clinical Research, University College Hospital, London, Prof G I Taylor, Yarrow research professor of the Royal Society, fellow of Trinity College, Cambridge *Foreign* Prof F Enriques, professor of mathematics, Royal University, Rome, Dr H N Russell, chairman of the Department of Astronomy and director of the Observatory, Princeton University, U S A, and Karl Freiherr von Tubeuf, professor of botany, University of Munich The joint committee of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society has awarded the Bruce Memorial Prize (1938) to Mr Alexander R Glen for his work in Spitsbergen, including survey in New Friesland and the completion of the map of North East Land The Council of the Royal Society of Edinburgh has awarded the David Anderson Berry Prize (1938) to Miss Mary A C Cowell, of the Holt Radium Institute, Manchester for her essay entitled 'An Investigation into some of the Factors affecting the Response of Human Skin and Human Skin Tumours to Radiation" The portrait of the president of the Society, Sir D'Arcy Thompson, by Mr David S Ewart, was presented by Prof F A E Crew, on behalf of the subscribers, at the meeting held on July 4

Tercentenary of James Gregory

The tercentenary celebrations of the birth of James Gregory began at the Royal Society, Edinburgh, on Monday, July 4, when papers by Profs H W Turnbull, F Enriques, M Dehn, E Hellinger and Dr O Prag were presented on the mathematical work of Gregory On Tuesday, July 5, a special graduation at the University of St Andrews was held in the Upper Library Hall, where Gregory had worked and made astronomical observations Honorary degrees were conferred on Profs G D Birkhoff of Harvard, A W Conway of University College, Dublin, O Neugebauer of Copenhagen, R Weitzenböck of Amsterdam, and (*in absentia*) V Volterra of Rome Addresses were received from the Royal Societies of London and Edinburgh, the London Mathematical Society, the Edinburgh Mathematical Society, and the Universities of Edinburgh, Cambridge, Paris, and from others An exhibition of books and scientific instruments associated with James Gregory was arranged in the Parliament Hall, Library Buildings, South Street, St Andrews

Prof. Sigmund Freud, For. Mem. R.S.

Among the distinguished scientific men of science who have left Vienna since the *Anschluss* is Prof Sigmund Freud, who has taken refuge in London Prof Freud celebrated his eighty second birthday on May 6 last His name will always be associated with the development of psycho analysis, and the significance of his contributions to psychology was acknowledged by his election in 1936 to foreign membership of the Royal Society, but Prof Freud had not hitherto been able to sign the roll of membership Although now resident in London Prof Freud was prevented by infirmity from attending the Society's rooms for this purpose and although the charter book is rarely removed from Burlington House except when it is taken to Buckingham Palace for the signature of the King as patron of the Society, it was decided to extend the privilege to Prof Freud Accordingly on June 23 Sir Albert Seward, foreign secretary and Prof A V Hill one of the secretaries accompanied Mr J D Griffith Davies, who as assistant secretary has custody of the charter book, to Prof Freud's residence, where the roll was duly signed by Prof Freud in the presence of his daughter, Dr Anna Freud, and Princess Marie of Greece, who was a pupil of his and received him when he left Austria On behalf of the Royal Society Sir Albert Seward presented to Prof Freud an inscribed copy of a facsimile of the Society's charter book

University of Birmingham. Physics Department

In April last the Council of the University of Birmingham, in considering a request from Prof M L Oliphant for an extension of the Physics Department, regretted that the demands made by the New Medical School would make such an extension impossible unless some private benefactor came forward to provide the necessary money At the meeting of the Council on June 29, it was announced that Lord Nuffield has offered to give the necessary amount of £60,000 Of this, a sum of £40,000 is to be used for the building, the remainder being reserved for equipment and maintenance and for the foundation of a research scholarship The plans for the new block provide for a professor's room and secretary's office, a staff room and library The central part is a large and lofty research hall for high-voltage work, this being flanked by eight small research rooms, each about 16 ft by 14 ft There are to be also a machine room and workshop, two dark rooms, and a basement room for high energy X ray work The general design of the laboratory is such as to lend itself to modification to provide for new developments which may from time to time become desirable The provision thus made for research will enable the existing physics block (with slight alteration) to be used for teaching purposes for which it was originally intended, and the unsightly temporary huts which since the Great War have been used as an extension of the Department will disappear

Birmingham Hospitals Centre

THE annual degree congregation at the University of Birmingham on July 2 marked the completion of the new medical school and the Birmingham Hospitals Centre by the conferment of honorary degrees on three laymen whose benefactions and services have been outstanding Sir Bertram Ford Viscount Nuffield and Mr Harry Vincent and three representatives of the medical profession Dr Robert Hutchison Sir Edward Mellanby and Sir Cuthbert Wallace At a luncheon afterwards the Guild of Graduates entertained the honorary graduates The chancellor, Viscount Cecil in proposing the toast of the new graduates referring to Lord Nuffield said that he was the successor of a very long line of splendid citizens They knew he stood for progress not only physically but also intellectually and morally When he made his splendid gifts he considered most carefully how they would be for the greatest advantage of the people he was anxious to benefit In the case of his gift to our department of Physics I think he felt that he was not only helping the University of Birmingham or the science of physics but indirectly in a most important degree giving assistance to the industry and intellectual advance of the whole country

DR ROBERT HUTCHISON congratulated the City and the University on the great work that had been carried out in forming the Hospitals Centre and expressed his belief that the example set by Birmingham in the concentration of medical resources in one quarter will be widely followed in other cities Sir Edward Mellanby said that the fight against disease has as its limiting factor lack of knowledge The present year has been a particularly good one from the point of view of discovery One of the greatest discoveries of the time has come from a Birmingham hospital Dudley Road namely the curative properties of the new drug M and B 693, which gives us considerable control over that terrible disease pneumonia The greatest part of research is the prevention of disease This is going on side by side with these other discoveries This other type of work the clearing out of disease, is becoming more and more powerful and I have no hesitation in saying that in fifty years your great hospital here will be put to other uses than it is to day It may, of course be full of motor accidents, or it may be full of very old people whiling away their last years of life in peace and happiness, or it may be occupied by the University for ordinary teaching At any rate it is going to be quite different, because the rate of progress is so rapid

National Museum for Southern Rhodesia

IT is reported that a national museum for Southern Rhodesia is to be instituted in the neighbourhood of the Zimbabwe ruins The trustees of the Southern Rhodesia Sweepstake Lotteries are to be asked to bear the cost of the building, but in the event of their being unable to provide the amount required, the sum necessary will be raised by the Government from its funds It is to be presumed from the location of the site that the museum though general in character as a national museum should be, will devote special attention to the antiquities of the adjacent Zimbabwe area and the culture of its native inhabitants past and present in which the Governments of South Africa have already evinced their interest by the assistance they have given to the archæological investigations undertaken by the joint universities committee for archæological research Although the situation of the museum may seem somewhat remote from any academic centre, this will scarcely prove a deterrent to the serious student who will appreciate the advantage of studying the culture of the Zimbabwe in its natural setting, more especially if it should prove possible to get together a really representative selection of the antiquities which have been found in the ruins from time to time The proximity of the museum to the Victoria Falls as well as to the ruins, should ensure that it does not suffer from lack of visitors As an illustration of the most remarkable feature in South Africa s cultural history such a collection should have the highest educational value

Prehistoric Research in Great Britain

THE Prehistoric Society (formerly the Prehistoric Society of East Anglia), has recently established a research fund with the object of undertaking the excavation of a series of key sites in Britain in order to develop our knowledge of the prehistory of the country Of the competence of the Society to undertake the direction and administration of such a fund there can be no question Its membership of seven hundred includes most of those prominent in the study of prehistoric archæology both in Great Britain and abroad, and among them are those who have been mainly responsible for recent rapid advances in our systematized knowledge of the mesolithic neolithic and iron age periods in Britain The advantages which will accrue from a research fund under the control of the Society are patent The facility for systematic planning of research, combined with flexibility in the application of effort both of man power and of financial resources, will make it possible to add effectively to the sum of organized knowledge in those periods and departments of British prehistory where it may be needed most from time to time A beginning is to be made in this season, when it is proposed to excavate an iron age village site near Britford, one mile south of Salisbury Cathedral This site is believed to belong to the earlier part of the period 500-100 B C The village enclosure was dug out of the chalk by its inhabitants and its form is known in some detail but only from photographs taken at a height of 2 000 ft in air survey, which revealed the existence of the site The object of the excavation will not be to lay bare the site as such, so much as to throw light on the mode of life and organization of a settlement of small farmers and stock raisers of the period The Society appeals for contributions to the research fund, which should be addressed to the Honorary Secretary, Mr C W Phillips, Selwyn College, Cambridge

Flint Implements of the Bronze Age

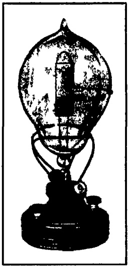
WHAT would appear to be a remarkable collection of flint implements of Bronze Age date unusually numerous for the period is reported (*The Times* June 28) to have been found on Lightlands Farm belonging to Mr George Lawrence of Frant Sussex It includes arrow heads tanged and barbed scrapers knives and flakes Apparently the implements belong to a pygmy flint industry The site is half a mile north east of the camp of Saxonbury It is on clay soil which has been ploughed for orchards The flints in consequence have been widely scattered It is pointed out that such sites are not common in the mid Weald to which the raw flint had to be carried either sixteen miles from the North Downs or eighteen miles from the South Downs Pygmy implements are more commonly found on the sandy sites fringing the Weald

The Attempt on Mount Everest

ONCE more the attempt to reach the summit of Mount Everest has failed *The Times* announces that Captain Oliver a member of the expedition has returned to Kalimpong and that the other members may shortly be expected there This year's party was a small one, but included men of great experience Mr H W Tilman the leader Mr N E Odell Captain P R Oliver Mr E E Shipton Mr F S Smythe and Dr C B Warren had all had experience on Mount Everest and elsewhere and Mr P Lloyd had distinguished himself on Nanda Devi A message from Mr Tilman to *The Times* confirms the news that the attempt has been abandoned for this year Some details are given Camp IV on the North Col was reached on May 26 but owing to bad conditions was abandoned five days later It was reoccupied on June 5 and on the following day Camp V at 25 300 ft was established Conditions were not promising although the weather was good at the time There was an exceptionally early monsoon with heavy snowfalls Avalanches were unusually numerous and several times endangered the expedition On June 8 Messrs Shipton and Smythe established Camp VI at 27 000 ft where they were joined by Messrs Tilman and Lloyd but beyond 27 300 ft the snow made progress impossible and the attempt was abandoned Two of the porters are seriously ill but the rest of the party is well

The First Radio Valve

SIR FELIX POLE recently made a presentation to Mr Charles Corbett who has completed fifty years unbroken service with the Edison Swan Electrical Co, Ltd Sir Felix pointed out that the company is the oldest electric lamp concern in Great Britain, and is the Company to whom Sir Ambrose Fleming was consultant when he produced the first radio valve In 1878 Sir Joseph Swan exhibited at Newcastle on Tyne the first electric lamp, and in 1881 formed the Swan Electric Light Co, Ltd, to manufacture and market electric lamps Two years later the names of Thomas Alva Edison and Joseph Swan were coupled by the amalgamation of their interests and patents in the formation of the Edison and Swan United Electric Light Co Ltd The factory became established at Ponders End In 1916 the Company's name was changed to the Edison Swan Electric Co Ltd About the time of the amalgamation Edison noted the irregular blackening of the inside of the lamp bulb during life Later this Edison effect was investigated in the laboratory by Sir Ambrose Fleming (then Prof J A Fleming) and a number of special carbon filament lamps were made for him for experimental purposes The result was in 1904 the Fleming thermionic valve Although this valve was no more than a simple carbon lamp of the period with a metal plate placed between the legs of a hairpin shaped filament it could detect wireless signals without the disadvantages common to the old coherers and other mechanical detectors Much remained to be done before the valve could be brought to that stage of comparative efficiency which was reached with the advent of broadcasting but something of the physics of the valve had been learned



University of London Observatory

ON July 1 in spite of a severe thunderstorm during which the roof of Mr Will Hay's house was set on fire by lightning, one hundred and sixty people attended the opening, by the Astronomer Royal of the new building of the University of London Observatory at Mill Hill in which the 24 in Radcliffe photographic refractor from Oxford and a library have been installed The Astronomer Royal was introduced to the guests (among whom were the Mayor and Mayoress of Hendon) in a short speech by Sir Frank Dyson chairman of the University Observatory Committee of Management, and gave an account of some of the circumstances which led to the founding of the Observatory in 1929 This had been largely due, he said, to the enthusiasm of the late Prof L N G Filon, who was made honorary director, and to Mr C C L Gregory, who was given the title of Wilson Observer Mention was made of the Wilson 24 in reflecting telescope which was presented to the University by Mr J G Wilson, and also of the gift by Mr. Fry of a smaller instrument, an 8 in. refractor by Cooke. The Astronomer Royal described the Radcliffe telescope as a sister telescope to the one now being used at Greenwich for parallax determinations, and hoped that much useful work along similar lines would be done in the future at Mill Hill, in keeping with the past traditions of the Radcliffe Observatory. The Radcliffe Observatory has now been removed to Pretoria, where the largest telescope in the southern hemisphere is being erected. The Vice-Chancellor, Sir Robert Pickard, thanked the Astronomer Royal on behalf of the University for performing the opening ceremony.

Museums and Rural Life

IN supporting the appeal for a further £5,000 for the endowment fund which was launched at the jubilee celebrations of the Haslemere Educational Museum, Dr. John Ramsbottom, president of the Linnean Society, stressed the great importance of teaching people of all classes how best to spend their leisure. The Haslemere Museum, he said, is worthy of unreserved praise, for it is part of the communal life of the district. Children and adults bring specimens of all kinds to the Museum for identification and are assured of receiving information, whether it be a matter of local history or natural history. He also referred to the magnificent display of British wild flowers with their names and such information as is sure to appeal, that is maintained in the Museum throughout the year. Lord Winterton suggested that research into the origin of the old wage-earning families in the neighbourhood of Haslemere would prove most interesting, for many of them are descended from migrants from France or Flanders in the fourteenth and fifteenth centuries. During that time there was a big trade between the Sussex and Hampshire ports with France and considerable migration between the two countries; also large numbers of workers came over for the extensive glass industry then existing in the south of England. In those days when anyone made any money it was put into land, and many of the place names—such as those of the woods, fields and so on in the neighbourhood—give indications of the names of the worker immigrants, some of them also being of Saxon origin.

Linnæus in England

THE Year Book of the Swedish Linnean Society for 1938 (Svenska Linné Sällskapets Årsskrift, Årg. 21) opens with a dedication to the Linnean Society of London on the occasion of its sesquicentenary, in which the elder Society is greeted as "chirographorum Caroli Linnaei pia conservatrix". The volume contains a long account, illustrated by photographs and drawings, of Linnæus's house in the old Botanical Gardens at Uppsala and of the way in which it has now been skilfully restored as nearly as possible to the state in which it was when Linnæus lived in it. Of the other articles one, by the editor, Mr. A. Hj. Uggla, is of special interest to readers in Great Britain, since it deals with two recently discovered documents bearing on Linnæus's connexion with England. One is a draft of a letter intended for, and perhaps actually sent to, Dillenius at Oxford in 1733, when Linnæus was twenty-five years old, and shortly after his expedition to Lapland. It is written in Latin and ends by expressing the hope that he might one day meet Dillenius. This hope was fulfilled when Linnæus visited Oxford three years later. The other document is a letter written in August 1735 by J. F. Gronovius in Leyden to Philip Miller, superintendent of the Apothecaries' Garden at Chelsea. It is written in English and states that Linnæus, then in Leyden, "hath a mind to make a step over to England to be acquainted with you. I am sure you will be pleased with his company but it will bee troublesome for him as only speaking his own Language and Latin however I think the Swedish minister at London can procure him an interpreter".

Experimental Fire-Walks

A REPORT by Dr. G. Burniston Brown on three experimental fire-walks has recently been issued ("A Report on Three Experimental Fire-Walks by Ahmed Hussain and others". By Dr. G. Burniston Brown. Bull. 4, University of London Council for Psychical Investigation, 19 Berkeley Street, Mayfair, London, W.1. 1s. net). The experiments were made at Carshalton, where Kuda Bux had also been tested (see NATURE, 136, 468, 521; 1935) and at the Alexandra Palace. The accompanying table shows a comparison of the most successful attempts made by Ahmed Hussain, R. Adcock and Kuda Bux.

	Weight	Distance walked	Surface temp. (°C.)	No. of steps	Time	Minimum mean time of contact per step
Hussain	128 lb.	12 ft.	800	4	1.6 s.	0.40
Adcock	160	1	800	3	1.8	0.60
Kuda Bux	1[illegible]	11	430	4	2.2	0.[illegible]5

The results of the experiment showed that the fire-walk is not a trick but is performed in the normal manner with bare and chemically untreated feet. Moisture on the feet was shown to be a disadvantage, since it may cause hot particles to adhere to the skin and thus cause blisters. The sudden formation of an insulating cushion of vapour between the foot and the hot embers does not occur and no abnormal degree of callosity of the feet is required.

The "Invisible College", 1645–1662

IN the Moravian literary publication, *Miscellanea*, Dr. R. F. Young recently gave an account of the "Invisible College" which preceded the foundation of the Royal Society in 1662. The term was used to describe the periodical meetings of men of science at either London or Oxford, and Dr. Young points out that the contemporary meaning may have been derived in four possible ways. In the first place, it may be an Italian *concetto* adopted directly by Boyle from the name of a literary academy at Cremona. It may have been borrowed from the contemporary critics and opponents of the "invisible" Rosicrucians, such as J. V. Andreae (1586–1654). A third view is that it was a reminiscence of an elaborate play on the word invisible contained in Shirley's comedy The Bird in a Cage (1633) The last possibility, towards which the author leans is that it was a title devised by Theodore Haak to contain an implicit allusion to Comenius's plan of an international pansophic college for scientific research to be erected in London This plan was much to the fore during Comenius's visit to England in 1641–42 and the scheme was set out in detail in his manuscript treatise, Via Lucis (1642) Haak was a German from the Palatinate who had been one of the principal supporters of the plan to establish a scientific academy in London He regarded the informal scientific meetings as the nucleus of a future State college of science and is likely to have used the expression Invisible College in conversation with Boyle and others The Philosophical College was thus the Invisible College until it definitely became the Royal Society

Medicine and Eugenics

THE Galton Lecture to the Eugenics Society by Prof John A Ryle on medicine and eugenics is printed in the *Eugenics Review* 30 No 1 In a carefully considered address it is pointed out that the eugenic movement needs the fuller support of the medical profession and that this can only be given when medical men receive a fuller training in human genetics than is now the case The family doctor is now rarely prepared even if asked to give advice connected with eugenic prognosis, although men and women are increasingly prepared to discuss such matters Practising physicians should be able to keep pedigree records of their patients who show mental and physical defects Medical education should be altered so as to lay greater stress on animal and human genetics in place of some of the routine zoology and the more specialized biochemistry and biophysics The constitutional variations which abound should be the subject of closer genetic study Several chairs of human genetics should be instituted and associated with them should be research centres concerned with morbid inheritance in man Wider contacts of the Eugenics Society with medical societies throughout the country would be helpful The foundation of a National Council is advocated embodying an alliance between medicine, eugenics and sociology and having appropriate contacts with the Ministries of Health, Agriculture and Labour The preservation of health as a primary function with the treatment of disease as a secondary function should become the new ideal

Forestry in Nyasaland

PERHAPS the most important information contained in the annual report of the Forestry Department for the Nyasaland Protectorate (for the year ending December 31, 1936 Govt Printer, Zomba, Nyasaland, 1937) are the remarks on soil erosion and the investigation work now being undertaken in this, considered to be one of the greatest dangers facing Africa as a whole Extensive areas were examined with particular regard to overcrowding and to cultivation on steep hill slopes in parts of the southern province On the subject of forest policy it is stated that provision is to be made for the demarcation, protection and management of selected forests and woodlands by native authorities, where the objects of conservation are comparatively local These local Government forests will be supplementary to the State forests but they will in no way supersede the village forests which are managed by the village headmen solely in the interests of village needs There will thus be three types of demarcated forests in the future each managed by its own authority One of the chief dangers in many parts, owing to the improvident habits of the people is erosion Provided that each type of forest reservation may be made to serve as a protective agent against this evil, the steps now being taken appear to meet existing problems

Science and Horticulture

VOL 6 of *Scientific Horticulture* (260 pp 1938, from the Editor R I Pearl S E Agric Coll Wye Kent 4*s* net 4*s* 6*d* post paid) the journal of the Horticultural Education Association contains a very useful series of reviews upon the science and practice of horticulture A suitable introduction is provided by Mr F A Secrett who writes upon the enterprise and skill requisite for successful market gardening and the need for evolving schemes to assist Nature The article is the text of an evening address delivered at the University of Reading during the Association's revision course in horticulture in September 1937 Papers read at this course are published in the present volume they minister chiefly to the needs of flower growers with emphasis upon carnations, roses pot plants and chrysanthemums both early and late There are further papers on genetics in relation to horticulture the nature of inheritance of flower colour and on photoperiodism Papers contributed specially to the volume include a review of recent Dutch research upon the growth and flowering of tulips and daffodils by Miss O N Purvis upon hormones (M Thomas) boron deficiency (A W Greenhill) chromosomes and their importance in horticulture (F W Sansome) and the place of school gardening in elementary and secondary schools (T Ewing) The production of virus free seed potatoes is discussed by P A Murphy and the modified leader tree by T Swarbrick whilst the formation and development of cherries is described by M B Crane

The Royal Technical College, Glasgow

IN the building up of the world wide reputation of the 'Scots engineer the Royal Technical College, Glasgow, may fairly claim to have played a very large part, and much of this work has been done in its evening classes It is noteworthy that of all the colleges that come within the purview of the University Grants Committee, the R T C has far and away the largest number of evening students Its recently published annual report shows that, notwithstanding the transfer of the classes in music, with about a hundred students, at the end of the preceding session, to the Scottish National Academy, there was an increase in the evening student enrolment from 2,624 to 2,665, of whom a very large majority were engineering students Some indication of the exceptional range and standard of the evening classes is given by the fact that the enrolment included 100 graduates of universities of Scotland, England, Ireland, Canada India and China An important and seemingly long overdue event of the year was the formation of a Former Students Association with a membership of seven hundred and correspondents in many parts of the world The Association aims at enabling former students to retain an interest in the affairs of the College and as the honorary secretary is a member of the staff it may be hoped that it will help the College to retain an interest in the former students An important source of strength for the College is the scheme of affiliation of continuation classes conducted by eight county education authorities and attended by more than seven thousand students The Glasgow Careers Council (for Secondary Schools) co operates with the Ministry of Labour in promoting visits of boys and girls with their teacher to various departments of the College

University Studies at Jerusalem

A BULLETIN recently issued by the Hebrew University at Jerusalem discloses the fact that Polish students largely outnumber all others The total enrolment last year was 779 including 48 research students Of the undergraduates 433 were from Poland 150 from Palestine 49 from Germany, 35 from Lithuania and Latvia 17 from Rumania and the rest from 18 other countries The same bulletin contains an article by Dr Dushkin lecturer in educational method and administration on the various activities of his department including measures for improving and extending the teaching of Arabic In the Palestinian schools Arabic has been taught like Latin or Greek with stress upon the analysis of grammatical forms and translation of classic texts The University s policy is, on the contrary, to emphasize the conversational aspects of the language and to promote the employment of a minimum course for all Jewish children in colloquial Arabic, with simple reading and writing and instruction in Arabic folk ways and customs This is a difficult task owing to the prevalence of a snobbish contempt for the 'vulgar spoken language of the common people, which differs widely from the classic Arabic of literature and is not taught by the Arabs in their own schools The department is largely under the influence of American educational theory, the chair of the principles of education being held by Prof Kaplan of New York, for many years a professor at the Jewish Theological Seminary there and principal of its Teachers Institute, and a leader of the Society for the Advancement of Judaism and of the Reconstruction Movement in American Jewry

King Edward's Hospital Fund for London

THE fortieth annual report of King Edward's Hospital Fund for London, recently issued and covering the year 1936, gives an account of the finances of the Fund and of the grants recommended The ordinary distribution remained unchanged at £300 000, to which was added a first contribution of £2,000 in respect of work done for hospital out patients by district nursing associations Grants were made to 146 hospitals and 56 convalescent homes The contributions to the Fund included a capital gift of £20 000 from His late Majesty King George V The Fund has acquired an additional 7 grains of radium, thus bringing the amount under the Fund s control up to a total of 17 grams An account is given of the work of the Propaganda Committee which includes the production of a new film on hospital progress, specially suited to school audiences

Eradication of Bovine Tuberculosis

THE Register of Attested Herds in Great Britain, under the Tuberculosis (Attested Herds) Schemes which has been recently published gives particulars of the herds on the Register on December 31 At that date there were 812 attested herds with 37 000 cattle in England and Wales, and 640 herds in Scotland with 50 500 cattle a considerable increase over the previous year The Register gives the names and addresses of the owners and the breeds of cattle and can be obtained on application to the Ministry of Agriculture and Fisheries 7 Whitehall Place, London S W 1, or, for Scotland, 15 Moray Place Edinburgh, 3 The issue of a certificate of attestation is evidence that the owner of the herd has taken steps to eradicate tuberculosis from the herd, and that as a result of an official tuberculin test the herd has been found to be free from tuberculosis

Air borne Traffic and Infectious Diseases

THE Minister of Health has made regulations, similar to the Port Sanitary Regulations 1933 designed to prevent the introduction of infectious diseases into Great Britain through the medium of air borne traffic which came into force on July 1 The authorities responsible for the administration of these Aircraft Regulations are the port health authorities for aerodromes at ports and elsewhere the local authorities of the districts in which the aerodromes are situated The regulations authorize if necessary, temporary detention of aircraft medical inspection of passengers and crews, cleansing, disinfection, etc The issue of these regulations marks a further advance in the policy for the provision of health services suitable for modern conditions

The Vale of Neath

THE National Museum of Wales has initiated a series of studies of the origin of Welsh scenery with a small pamphlet on the River Scenery at the Head of the Vale of Neath , by Dr F J North The area covered is about sixty square miles and is one of great scenic charm The studies do not necessarily embody original work , but they aim at giving popular descriptions of the origin of the land forms with as little use of technical terms as possible Where technicalities are unavoidable they are fully explained The present study is a good example of intelligent popularization both in its wording and its diagrams and illustrations

Old Science and Medicine

E. P. GOLDSCHMIDT AND CO., of 45 Old Bond Street, W.1, have recently issued an illustrated and annotated catalogue of works of old science and medicine, comprising important books in the history of the mathematical and physical sciences, biology and medicine. The most valuable works figuring in the catalogue are the complete manuscript of the 'Chirurgia Magna' of Bruno de Longoburgo (1250), Pierre Franco's treatise on hernia (1561), the Aldine *editio princeps* of Galen's works in five volumes (1525), Robert Hooke's Cutlerian Lectures on physics, mechanics, geography and astronomy (1674–1678), Claude Perrault's memoirs on the natural history of animals in two volumes (1671–76) and theses by pupils of Linnæus (1749–1769) and Purkinje (1824–1840). The catalogue also contains first editions of works by Tycho Brahe, Euclid, Fracastor, Goethe, Laennec, Lamarck, Lavoisier, Napier, Röntgen, Schwann, Sirturus, Steno, Tartaglia and Willis. Modern literature is further illustrated by works by Edison, Freud, Casimir Funk, Metchnikoff, and Hugo de Vries.

Royal Anthropological Institute

THE annual meeting of the Royal Anthropological Institute was held on June 28 when Mr. H. J. Braunholtz delivered his presidential address entitled 'Ethnographical Museums and the Collector: Aims and Methods'. Two Rivers Memorial Medals for 1938 were presented, to Prof. A. R. Radcliffe-Brown for anthropological research in the fields of the Andaman Islands and Australia, and to Miss D. A. E. Garrod for work in Gibraltar, Southern Kurdistan and Palestine. The Wellcome Gold Medal for 1937 for anthropological research was awarded to Dr. Meyer Fortes for a thesis on 'Marriage Law among the Tallensi'.

World Power Conference: Vienna Meeting

THE Vienna Sectional Meeting of the World Power Conference will take place on August 25–September 2. A programme has been issued giving details of the sessions and sectional meetings, the social events planned for the participants, the sight-seeing tours and the Conference journeys. The official opening meeting in the Vienna Concert House is at 10 a.m. on Thursday, August 25, and allowing Saturday and Sunday for sight-seeing, the meeting goes on until Friday, September 2, when a second week begins devoted to tours of exceptional interest. Messrs. Thos. Cook and Son have been officially authorized to act as travel agents. Payment of all fees, which are most reasonable, can be made in English currency. The railway administrations grant substantial reductions in fares to all the participants at the Vienna meeting. Among other excursions on Monday, September 5, there will be one over the Gross Glockner Pass. This road has an almost perfect surface and owing to the wonderful road building technique, the gradient is never more than 12 per cent. It is a marvellous piece of engineering. The excursion goes to the Franz Josefs Hohe (7,370 ft.) where there is a wonderful view of the Pasterze Glacier, the longest glacier of the Eastern Alps. Full particulars of the fortnight's programme, charges, accommodation, etc., can be obtained from the Secretary, British National Committee, World Power Conference, 36 Kingsway, London, W.C.2.

Announcements

MR. H. N. SAVOURY, of St. Edmund's Hall, Oxford, and MacIver Research Student of Queen's College, has been elected by the Faculty of Archæology, History and Letters of the British School of Archæology at Rome to the Rome Scholarship for 1938. Mr. Savoury will devote the period of his tenure of the scholarship to research on certain aspects of the neolithic, bronze and early iron ages in Italy, and the influence of Italy on the lands north-west of the Alps and on Iberia during the early Bronze age.

THE Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk who lost his life in 1914 while flying an experimental aeroplane, has been awarded for 1938–39 to G. O. Jones, Emmanuel College, Cambridge.

DR. ADALBERT CZERNY, formerly professor of children's diseases in the University of Berlin, has been awarded the shield of nobility of the German Reich on the occasion of his seventy-fifth birthday.

A MONUMENT to Dr. Albert Calmette, the well-known authority on tuberculosis, has recently been unveiled at Nice.

THE Public Health Services (Engineering and Equipment) Exhibition and Congress, formerly the Public Health Exhibition and Congress, will be held at the Royal Agricultural Hall, London, on November 14–19.

THE International Congress of Light will be held at Davos, Switzerland, on July 29–30 under the presidency of Dr. Morikofer. The subjects for discussion will be light and climatology, action of natural and artificial light on healthy and diseased organs, and physiological and physical study of the therapeutic sources of light. Further information can be obtained from Dr. Schreiber, Robert Koch Platz 1, Berlin.

THE Child Welfare Information Centre of the League of Nations has published a useful "Summary of the Legislative and Administrative Series of Documents of the Child Welfare Information Centre to December 31st, 1937" (Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1. 1*s*.). It contains brief details of enactments in various countries between February 1936 and December 1937 dealing with matters of child welfare.

ERRATUM. In the issue of July 2, p. 31, line 5, for "Pinex" read "Pinax".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 78.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Tides in the Upper Atmosphere

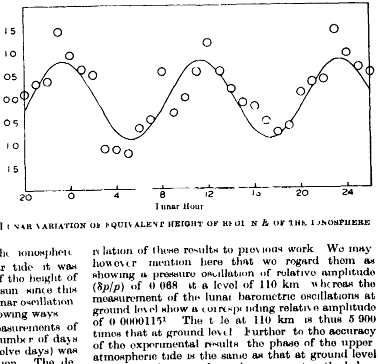
THE exploration of the physical state of the upper atmosphere by radio waves has so far been principally concerned with the investigation of the distribution of ionization and with the regularities and irregularities in this distribution due to solar control. In a series of measurements made during the past year we have endeavoured to extend the employment of radio waves to the investigation of upper atmospheric oscillations. Such oscillations would include tides produced by the gravitational influence of the sun and the moon, and would result in both vertical movements of individual air particles and also in variations of the atmospheric pressure at a given level. The influence of the moon has been examined first, since, the effect being purely gravitational, there is no need to unravel, as in the solar case, the simultaneous effects of tidal motion and varying height of ion production. Further, for various theoretical and experimental reasons attention has been confined to the level of Region *E* of the ionosphere.

For the investigation of the lunar tide it was necessary to eliminate the variation of the height of the reflecting layer with angle of the sun, since this variation is many times the expected lunar oscillation. This was accomplished in the two following ways.

(*a*) A series of quarter hourly measurements of equivalent height of reflection for a number of days (usually six to eight in a period of twelve days) was plotted to exhibit the diurnal variation. The departures from the smooth mean curve were then plotted as a function of lunar hour.

(*b*) A series of noon values of equivalent height were plotted to exhibit the seasonal variation, and the daily departures from the smooth curve were plotted as a function of lunar hour.

The accompanying diagram shows the hourly mean departure as a function of lunar hour, the full curve giving the semi-diurnal lunar variation of equivalent height as deduced from the points by harmonic analysis. The curve is derived from quarter hourly measurements made during different groups of days, throughout a period of eight months. A seasonal set of measurements has indicated a tide of the same magnitude and phase, the maxima being about ¾ hour before the lunar transits.



LUNAR VARIATION OF EQUIVALENT HEIGHT OF REGION *E* OF THE IONOSPHERE.

We hope to publish elsewhere a full account of the evidence which leads us to regard this tidal amplitude as significant, together with a discussion of the relation of these results to previous work. We may, however, mention here that we regard them as showing a pressure oscillation of relative amplitude $(\delta p/p)$ of 0.068 at a level of 110 km., whereas the measurement of the lunar barometric oscillations at ground level show a corresponding relative amplitude of 0.0000115[1]. The tide at 110 km. is thus 5 900 times that at ground level. Further, to the accuracy of the experimental results, the phase of the upper atmospheric tide is the same as that at ground level at Greenwich, a result in disagreement with deductions made from the lunar magnetic variations, assuming such variations to arise from currents flowing in Region *E*.

These experiments have been conducted as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
K. WEEKES.
Cavendish Laboratory,
Cambridge.
June 17.

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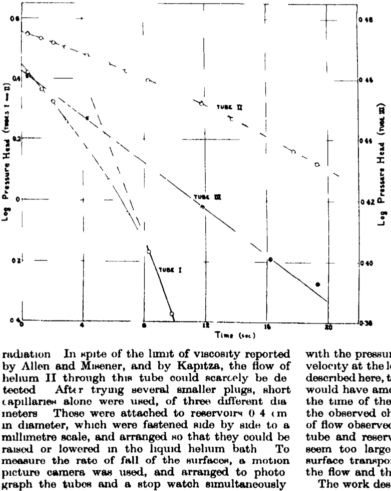
[1] Chapman, *Quart. J. Royal Meteor. Soc.*, **44**, 271 (1918).

Viscosity of Liquid Helium II

IN recent experiments on the flow of liquid helium II through very small openings, carried out by Allen and Misener[1], and by Kapitza[2], an upper limit to the viscosity was placed at 10^{-9} c g s units, in definite disagreement with previous results obtained in this laboratory by Wilhelm, Misener and Clark[3] by means of an oscillating cylinder However, in none of these experiments were conditions such as to ensure laminar flow

In view of this apparent extremely rapid flow of helium II, we thought that a study of the flow as the liquid passed through the λ point would give some information concerning the rate of transformation from helium II to helium I For this purpose, a capillary tube 0 02 cm in diameter was filled to a length of 3 cm with washed emery powder, and connected to a reservoir In order to prevent the fountain effect observed by Allen and Jones[4] with a similar device, the emery plug was protected from radiation In spite of the limit of viscosity reported by Allen and Misener, and by Kapitza, the flow of helium II through this tube could scarcely be detected After trying several smaller plugs, short capillaries alone were used, of three different diameters These were attached to reservoirs 0 4 cm in diameter, which were fastened side by side to a millimetre scale, and arranged so that they could be raised or lowered in the liquid helium bath To measure the rate of fall of the surfaces, a motion picture camera was used, and arranged to photograph the tubes and a stop watch simultaneously In the first experiments the tubes were lowered into helium II at a temperature a little below the λ point, and the flow into the tubes was observed as the temperature was slowly raised through the transformation to helium I However, the change in the rate of flow on passing through the λ point was not greatly marked, and so measurements at fixed temperatures in helium II were made



In no case did the results suggest that the liquid helium II was behaving as a super fluid In the accompanying diagram the logarithm of the pressure head is plotted against the time, for a series of measurements at 2 16° K It will be seen that, for the slower rates of flow, the relation is linear, showing that the rate was nearly proportional to the pressure The viscosity has been calculated from these results, and is given in the accompanying table The values quoted are correct in order of magnitude only, since the tubes were not very uniform, and no end corrections were made Using this estimate of the viscosity, the Reynolds number has been calculated, and in all three cases is less than 1,000 for the smallest velocity measured We hope, by using more uniform tubes, to obtain more accurate values for the viscosity

Tube	Diameter (cm)	Length (cm)	Viscosity (c g s units)	Velocity for small pressure heads (cm /sec)	Reynolds number
I	0 035	1 8	$7\ 9 \times 10^{-6}$	21	750
II	0 024	1 9	$7\ 8 \times 10^{-6}$	28	670
III	0 013	1 7	$5\ 4 \times 10^{-6}$	13	170

These results are not compatible with those of Allen and Misener, or of Kapitza, but agree in order of magnitude with the earlier work of Wilhelm Misener and Clark We suggest that in the case of the long fine capillary used by Allen and Misener, the observations can be explained by the transport phenomenon studied by Daunt and Mendelssohn[5] According to the results reported by the latter the level in the reservoir used by Allen and Misener would have fallen at a rate of about 0 02 mm per second at 2 17° K due to transport over the surface of the tube This would account for the observed drop, and it seems probable that the actual flow through the long capillary was negligible This would also account for the fact that the velocity did not vary greatly with the pressure head, and for the large increase in velocity at the lower temperature In the experiments described here, the change in level due to this transport would have amounted to only about 0 1 mm during the time of the experiment less than 1 per cent of the observed change On the other hand, the rates of flow observed by Allen and Misener with a larger tube and reservoir, and that observed by Kapitza, seem too large to be fully accounted for by the surface transport, and further experiments on both the flow and the transport are highly desirable

The work described above was carried out by H E. Johns, J O Wilhelm, and Dr H Grayson Smith

McLennan Laboratory, University of Toronto
E F BURTON (Director)

[1] Allen J F, and Misener A D NATURE 141 75 (1938)
[2] Kapitza P NATURE 141 74 (1938)
[3] Burton, E F NATURE 135 265 (1935) Wilhelm J O Misener A D and Clark A R *Proc Roy Soc*, A 151 342 (1935)
[4] Allen, J F and Jones H, NATURE 141, 243 (1938)
Daunt J G and Mendelssohn K NATURE 141 911 (1938)

Production of Secondary Electrons by Cosmic Ray Particles

SOME early measurements of Anderson and Neddermeyer[1] show that the number of single secondary electrons ejected by cosmic ray particles from a metal plate is in reasonable agreement with that to be expected from direct elastic collisions In a series of photographs we have observed the traversal of a 2 cm plate of gold by about 900 particles all of which may be assigned to the penetrating group With this gold plate, which has a thickness of 8 5 in the units of the cascade theory the behaviour of electrons can be immediately distinguished from that of the penetrating particles, and so the behaviour of the penetrating rays can be examined separately On the assumption that these penetrating rays have a mass greater than that of electrons Bhabha[2] has calculated the number of ordinary secondary electrons knocked on by collision and the subsequent cascade showers that the latter produce The particles are considered in two energy groups above and below 3×10^9 e volts previous measurements of the energy spectrum for the magnetic field and counter arrangement used having shown that 44 per cent of the observed rays have an energy greater than 3×10^9 e volts For convenience of the comparison with theory, the secondary electrons have been classified into those with energy greater and less than the critical energy of the cascade theory for gold 10^7 e volts

In the group of particles with energy greater than 3×10^9 e volts, the total number of secondaries observed with energy greater than 10^7 e volts was 4 4 per cent of the number of primary particles The corresponding number of secondaries for the energy range below 3×10^9 e volts was 0 4 per cent

The table below shows the frequency of occurrence as a percentage of the penetrating particles of (*a*) single secondary, (*b*) two secondaries (*c*) three or more secondaries

	Energy of Primary (e v)	(*a*)	(*b*)	(*c*)
		1	2	>
All observable secondaries	$> 3 \times 10^9$	3 3	0 3	0 3
	$< 3 \times 10^9$	0 8		
Secondaries of energy $> 10^7$ e volts	$> 3 \times 10^9$	2 8	0 3	0 3
	$< 3 \times 10^9$	0 4		

We observe relatively few slow secondaries, with energy loss than 10^7 e volts but this is due at least in part, to the strong scattering of these particles

The measurements give a rough indication of the mass of the main penetrating component of the rays In Fig 1 the total number of secondary particles of energy greater than 10^7 e volts to be expected from the calculations of Bhabha[2] for penetrating particles of 10 and 100 times the electron mass and for protons is shown, and the measured values for the two groups of particles are plotted These values are probably low, in comparison with the theoretical curves, since the theory does not take account of scattering, but they are sufficient to indicate a mass of the penetrating particles at least 100 m_0 and probably greater

Thus these results show that the observed number of secondary electrons can be explained by the elastic collisions of the penetrating rays with electrons, assuming that the former have a mass rather greater than 100 m_e The energy loss corresponding to this process can be seen from Bhabha's calculation to be of the order of one third of the ionization loss alone

Now for energies between 10^8 and 2×10^9 e volts, direct measurement[3, 4] has shown a much larger energy loss, of the order of ten times the ionization loss It follows that the main part of this energy loss must occur without producing observable secondaries

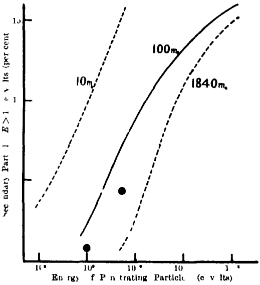


Fig 1

Fig 2 shows the production of a small shower of four electrons by a penetrating particle of high energy The fastest electron has an energy of about 3×10^7 e volts A similar photograph has been reported by Ehrenfest[5]

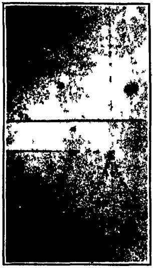


Fig 2

Physical Laboratories, J G WILSON.
University of Manchester
June 3

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[1] Anderson and Neddermeyer *Int Conf Phys Lond* 182 (1934)

[2] Bhabha *Proc Roy Soc* A **164**, 257 (1938)

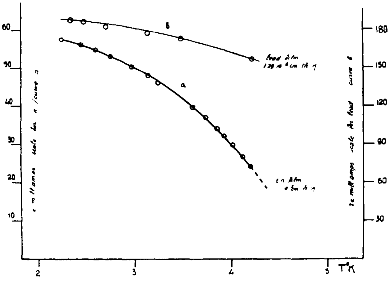
[3] Blackett and Wilson *Proc Roy Soc* A **160** 304 (1937)

[4] Wilson *Proc Roy Soc* A (in the Press)

[5] Ehrenfest *Comptes rendus* **206** 428 (1938)

Superconducting Thin Films

We wish to report some preliminary results on the superconductive properties of lead and tin films between 5×10^{-7} cm and 2×10^{-6} cm thick, obtained by condensation from the vapour. The films were deposited on a glass surface at 4·2° K which carried four platinum electrodes, the conductivity measurements being made by means of a compensation apparatus; the film thicknesses were determined from the difference in mass of the source before and after evaporation. In order to ensure the cleanest possible conditions, the condensation and measurements were made in a sealed off high vacuum apparatus.



Even the thinnest films investigated showed superconductivity. The resistance was restored in a single abrupt jump if the measuring current was increased beyond a critical value i_c characteristic of the particular film and temperature; further increase of current produced no appreciable change of resistance. On again reducing the current, the resistance disappeared in a single jump but at a lower value of current than i_c; the whole resistance current curve could be reproduced any number of times. The value of i_c at a given temperature decreased with the thickness of the film, and was in general of the order of magnitude of some milliamperes; in all cases this was very much smaller than could be expected from Silsbee's hypothesis, supposing the critical field to be the same as for the bulk metal.

Actually, however, the magnetic fields required to restore the resistance were not lower, but much higher than for the bulk metal: thus a magnetic field even as high as several thousand gauss, applied parallel to the current, reduces the value of the critical current, but this influence is only slight (especially for the thinner films). With increase of the film thickness the magnetic field required to destroy superconductivity decreases.

The critical current decreases with increase of temperature, and in the case of tin, it was possible to estimate the transition temperature by extrapolation of the accompanying $i_c - T$ curve (Curve *a*) to zero i_c. This suggested a transition temperature of about 4·7° K for all the tin films, which is about 1° higher than for tin in bulk. For lead this extrapolation is not possible, owing to the flat course of the $i_c - T$ curve (Curve *b*), but the curve suggests that here also the transition temperature may be higher than for lead in bulk (7·2° K).

A significant feature of the results is that the superconductive properties underwent a marked change if, after deposition the films were warmed to room temperature (probably causing recrystallization), and then recooled. Thus in the case of tin the transition temperature dropped to about 3·7° K (the value for bulk tin), for a temperature equally far below the transition temperature the magnetic fields required to restore resistance became rather smaller, and i_c became rather greater.

Since all the properties (except the sharpness of the transition between super- and normal conductivity) are very reminiscent of those of superconductive alloys, it seemed that the anomalously high transition temperature of freshly deposited tin might be connected with the presence of impurities; variation of cleanliness of the condensation conditions however caused no change of the high transition temperature, so it is likely that this is genuinely characteristic of the *structure* of films deposited at 4·2° K. How far the other anomalous properties are connected with the structure and how far with the thinness of the films must remain a question for further investigation, but the results so far, suggest that the structure can scarcely be responsible alone.

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April 27.

Melting and Structure of Long-Chain Ketones

A number of isomeric long-chain ketones have been prepared and specially purified in the course of investigations on the solid liquid transition in long chain compounds[1]. As will be clear from the diagram for the ketones $C_nH_{2n+1}COC_{(16-n)}H_{33-2n}$ the setting points depend in a remarkable way on the position of the CO dipole in the long chain molecule. The maximum difference (between $C_8H_{17}COC_8H_{17}$ and $C_5H_{11}COC_{11}H_{23}$) of 9·2° may be compared with the difference in setting points between $C_5H_{11}COC_{11}H_{23}$ (s.p. 40·8°) and the corresponding paraffin $C_{17}H_{36}$ (s.p. 21·6°).

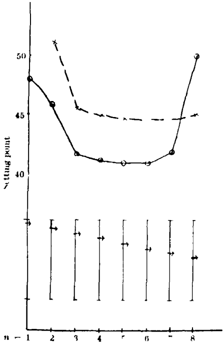
In order to verify that this behaviour is not confined to chains with an odd number of carbon atoms, ketones of the series $C_nH_{2n+1}COC_{(17-n)}H_{35-2n}$ have also been prepared, and show a corresponding behaviour. A survey of published melting points of other ketones suggests that this effect is quite general.

In view of the comparatively simple crystal structure of long chain compounds[2,3], these observations are of interest for theories and mechanical models of the melting of crystal lattices. A detailed analysis of the crystal structure of a long chain ketone has not yet been achieved partly owing to the lack of suitable single crystals The comparison of X ray powder photographs of ketones with the corresponding paraffins shows however, that the introduction of the CO dipole only leads to small changes in the side spacing of the chains, when these are sufficiently long For compounds of the series $C_{17}H_{36}$ the lattice dimensions are

	a	*b*	*c*
$C_{17}H_{36}$	7·63	4·91	23·26
$C_{17}H_{34}O$	7·55 ± 0·01	4·79 ± 0·06	23·26

and any differences between the isomeric ketones are within the errors of measurement In view of the intensity determinations on X ray powder photographs of ketones due to Shearer it may be assumed that the chief difference between the lattice of a paraffin and a ketone is the presence of layers of dipoles in the latter Except in the methyl ketones, the potential energy of dipoles in a layer is apparently without influence on the potential energy in other layers A check on this assumption is obtained from the measurement of the latent heats of fusion obtained from cryoscopic data The latent heats of fusion are

$C_{17}H_{36}$ 10·0 k cal /mole
$C_{17}H_{34}O$ 13·5 ± 0·4 k cal /mole



DATA FOR $C_{18}H_{36}O$ CROSSES $C_{17}H_{34}O$, CIRCLES

In the case of the isomeric ketones, deviations from the mean value do not seem to be connected in any systematic way with the position of the dipole, and are probably due to experimental errors The results merely show the additional heat of fusion required to break up the dipole layers

Since the dynamical properties of the paraffin and ketone lattices must be closely similar, a possible explanation of the variation in setting point in isomeric ketones may perhaps be given on purely mechanical grounds On melting, the thermal motion of the chains has not only to overcome the orientation energy due to van der Waals forces, which will be similar to those in the paraffin but has also to overcome the orientation energy in the dipole layers If the long chain molecules are compared with an assemblage of rods undergoing torsional vibrations and clamped to one another at a position along the rod corresponding with the position of the dipole it seems likely on account of the properties of stationary vibrations that the minimum interaction on the clamping will be found when this is situated either symmetrically in the middle or at one end In other words the thermal motion of the molecules required to overcome the orienting forces in the dipole layer must be bigger when the layer is situated at a point in the chain where torsional vibrations are less efficient in leading to motion

This interpretation of the experimental results in terms of a mechanical model can only be regarded as provisional Obvious limitations arise from the fact that electrical[4] and thermal[1] properties of long chain compounds indicate extensive premelting and at least a partial freedom of orientation of the molecules below the melting point Nevertheless the latent heats of fusion indicate that considerable orientation of the dipoles must persist in the solid A further limitation may arise owing to differences in details of the structure of isomeric ketones not evident from powder photographs, though the structural and thermodynamic evidence does not leave much scope for uncertainty Experiments are being made with other compounds in order to test more fully the various factors which determine a transition from solid to liquid

A R UBBELOHDE
J W H OLDHAM

Davy Faraday Laboratory
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June 1

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[1] Ubbelohde A R Trans Far Soc 34 282 (1938)
[2] Shearer G Pr Roy Soc A 108 655 (1925)
[3] Muller A Helv Phys Acta 9 626 (1936)
[4] Müller A Proc Roy S A 158 403 (1937)

A Heat-Labile Isomer of Vitamin A in Cod Liver Oils

IT was observed during experiments involving the keeping properties of an individual cod liver oil that the value of $E^{1\%}_{1\,cm}$ 328 mμ determined on the unsaponifiable fraction spontaneously increased, on keeping to a maximum after several weeks, but the total absorption determined directly on the oil did not increase The oil had an initial $E^{1\%}_{1\,cm}$ 328 mμ value of 0·60 when determined on the unsaponifiable matter, and 0·60, 0·62, 0·63, 0·65 and 0·54 after 1 4, 5, 8 and 14 weeks respectively, whereas the determination on the original oil of 0·70 gave figures of 0·70, 0·69 and 0·67 after 1, 8 and 14 weeks With tests performed on the oil itself, both by spectrographic means and colour reaction, spontaneous increase in the apparent vitamin A has been noted by others[1] and has been assumed due to extraneous substances such as free fatty acids[2,3]

From the observation that the $E^{1\%}_{1\,cm}$ 328 mμ value increases spontaneously, it follows that either there is a chromogen present transparent at 328 mμ which is being converted to the normal vitamin A or there is a factor present giving absorption at about 328 mμ which is sensitive to heat and is destroyed during saponification. The former supposition cannot be correct since the gross absorption does not increase simultaneously but, in fact, remains practically constant. In the latter event isomerism would most likely account for the increase of the vitamin A with time. Smith, Stern and Young[4] have suggested the possibility of an isomeric factor of the *cis-trans* type being present in concentrates.

Experiments appear to confirm the presence of a heat-labile factor; when using cold saponification followed by cold evaporation of the ethereal solution of the extracted unsaponifiable matter, higher values for $E^{1\%}_{1\,\mathrm{cm}}$ 328 mμ are obtained. Tests have been made on genuine cod liver oils examined as soon as possible after extraction; some of the results, typical of the whole, are given in the accompanying table.

		A	B	C	D
Direct on oil	Day received	0·94	0·[illegible]8	1·0[illegible]	0·[illegible]2
	After 1 week			1·08	
	2 weeks	0·93	0·60		
	4 "	0·89	0·62		0·[illegible]6
Via hot unsap.	Day received	0·81	0·53	0·8[illegible]	1·47
	After 1 week	—		0·84	
	2 weeks	0·86	0·[illegible]8	—	
	4 "	0·[illegible]1	0·[illegible]8		1·49
Via cold unsap.	Day received	0·96	0·[illegible]8	0·9[illegible]	[illegible]
	After 1 week			1·06	
	2 weeks	1·03	0·60		
	4 "	0·[illegible]8	0[illegible]		0·[illegible]4

Deterioration set in fairly rapidly under the particular conditions of storage, namely, full bottles at room temperature in the dark, but the figures for cold saponification generally remained above those for the hot saponification method.

Heat evaporation of the solution of extracted cold saponification unsaponifiable matter and also boiling the oil with alcohol lowered the figure for the value of $E^{1\%}_{1\,\mathrm{cm}}$ 328 mμ in comparison with that obtained by cold saponification and cold evaporation.

The possibility of an enhanced 328 mμ absorption in the cold saponification method being due to extracted impurities difficult of volatilization at low temperatures was eliminated by experiment.

If the isomeric chromogen should prove biologically active, it follows that the value for $E^{1\%}_{1\,\mathrm{cm}}$ 328 mμ obtained directly on the oil would be, at least for fresh oils, a more correct indication of the vitamin content, although after general deterioration of the oil impurities take effect and the test on the unsaponifiable matter obtained by cold saponification would have to be used.

It is hoped that full details of the experiments and further work nearing completion on this problem, including the effect of accelerators, light and temperature, will shortly be published elsewhere.

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June 9.

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[2] See also Medical Research Council Special Report No. 202.

[3] Gillam, A. E., and Morton, R. A., *Biochem. J.*, **25**, 1346 (1931).

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Mechanism of Fructose Resorption in Intestine and Kidney

As demonstrated by Cori[1], fructose is absorbed from the intestine definitely more slowly than galactose and glucose. If an intermediary formation of hexose phosphoric acid is an essential factor in the active absorption of sugars[2] it must be assumed that either the phosphorylation of fructose or the dephosphorylation of fructosephosphoric acid (or both reactions) proceeds with a definitely lower velocity than the corresponding reactions of glucose and galactose. The phosphorylation of fructose in kidney extract takes place at precisely the same rate as the phosphorylation of glucose[2]. The question now is whether fructosephosphate is dephosphorylated at a slower rate than glucosephosphate?

In an interesting paper of Goda[3] it is demonstrated that the complete conversion of fructose into glucose in the liver tissue depends on a peculiar selective dephosphorylation of the glucose component in the Embden ester; in other words, fructosephosphoric acid is not directly dephosphorylated, but only through conversion into glucosephosphoric acid.

It is suggestive to suppose that this indirect dephosphorylation of fructosephosphoric acid is the reason for the relative slowness of fructose resorption in the intestine.

I have tried to demonstrate the Goda effect in extracts of intestinal mucosa and kidney cortex.

CHANGES IN CONTENT OF ALDOSE AND KETOSE DURING ENZYMIC DEPHOSPHORYLATION OF EMBDEN ESTER

	Min.	Per cent dephosphoryl.	Aldoses	Ketoses
Intest. mucosa	60	7[illegible]	3·[illegible]8	3·[illegible]
Intest. mucosa	3[illegible]	67	2·24	3·04
Intest. mucosa	60	80	3·0[illegible]	3·34
Kidney extract	60	7[illegible]	+ 2·30	1·[illegible]

In the kidney extract no fructose at all was liberated whereas in the mucosa extracts a part of the phosphorylated fructose was liberated.

The selective dephosphorylation was not demonstrable in concentrates of intestinal and kidney phosphatases (Albers and Albers preparations[4]) but is evidently a characteristic of the fresh tissue. That the intestinal mucosa really converts glucose into fructose appears from the data of Oppel[5]. According to Verzar[6] fructose when given in high concentrations is partly actively absorbed into the blood through a conversion into glucose, partly diffuses passively.

The cause of the slowness of absorption of fructose in the intestine seems therefore to be not a slow phosphorylation of fructose but a slow dephosphorylation of the fructose 6 phosphate.

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[2] Kalckar, *Enzymol.*, **2**, 47 (1937). *Skand. Arch. Physiol.*, **77**, V. Nord. Kongr., 193.

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Nicotinic Acid and the Fermentation of Dextrose by the Colon-Typhoid Group of Bacteria

NICOTINIC acid has recently assumed special importance as a vitamin for certain bacteria, animals and man. Knight[1] has shown that nicotinic acid is an essential factor for the growth of *Staphylococcus* *aureus* During the same year it was demonstrated that this substance cures black tongue in dogs and pellagra in man[2,3]

The object of our studies was to ascertain whether nicotinic acid is essential for the growth of the pathogenic members of the colon typhoid group The results show that although *Shigella dysenteriae* (Shiga and Flexner) and *S Paratyphosus* A can grow in the simple peptone medium described below the addition of nicotinic acid is essential for their active utilization of dextrose

The basic medium was made up as follows

(*a*) Salt solution

NaCl	0 [illegible] per cent
Na_2HPO_4 $2H_2O$	0 2
KH_2PO_4	0 03
$MgCl_2$ $6H_2O$	0 03
Traces of iron and manganese	

These salts were dissolved in distilled water and filtered through a Seitz filter

(*b*) To this salt solution were added sterile solutions of peptone dextrose and nicotinic acid as desired

In one type of experiment 0 25 per cent peptone and 0 1 per cent dextrose were added to the salt solution To one set of tubes 10 γ nicotinic acid was added for each c c of medium while another set of the same lot served as controls The two sets of tubes were inoculated with the same number of organisms and incubated for twenty four hours at 37 C Growth occurred in both sets of media The dextrose content was examined by the Ellmann Maquenne method The uninoculated control contained 8 37 mgm the culture without nicotinic acid 6 29 *mgm and that with nicotinic acid* 0 93 *mgm* of dextrose per 9 c c of media

In another type of experiment we varied the amount of peptone To one set of tubes was added 10 γ of nicotinic acid per c c while to the other set no nicotinic acid was added The sugar content of the various tubes after 48 hours incubation was as follows

Per cent peptone	With nicotinic acid mgm dext 9 c c	Without nicotinic acid mgm dext 9 c c
1	3 99	[illegible]
2	0 [illegible]	[illegible]
3	0 [illegible]	[illegible]

These and other data show that although the dysentery bacilli and paratyphoid A grow in the peptone glucose medium to which no nicotinic acid has been added, the glucose content is only slightly diminished even after forty eight hours incubation The addition of nicotinic acid stimulates the prompt and active utilization of the glucose with the formation of acid The nicotinic acid apparently acts as a cozymase It should be noted that even in media containing nicotinic acid paratyphoid *A* ferments glucose with the production of acid but fails to produce gas Paratyphoid *B* on the other hand ferments glucose with gas production in the medium without nicotinic acid (behaving in this respect like *B coli*) The enzymic systems of the two species of paratyphoid are thus fundamentally different

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[1] Knight B C J G NATURE 139 628 (1937) *Biochem J* 31 731 (1937)

[2] Elvehjem C A Madden R J, Strong F M and Woolley D W *J Amer Chem Soc* 59 1767 (1937)

[3] Fouts P J Helmer O M Lepkovsky S and Jukes T H *Proc Soc Exp Biol and Med* 37 405 (1937)

Phytohormones and Seed Disinfection

THE formaldehyde method of disinfecting cereal seeds for smuts often results in substantial reduction in germination and in retarded growth It has been found that the addition of 1/100 10 ppm of phytohormone chemical to the treating solution greatly reduces or entirely prevents formaldehyde damage This effect is obtained with 3 indolylacetic *l* naphthyl acetic and phenylacetic acids and with a number of other physiologically active chemicals Certain plant extracts and vitamin B_1 also reduce this type of seed injury The accompanying photograph illustrates the effect of adding phytohormones to formaldehyde solution of standard concentration (1 part 40 per cent formaldehyde to 320 parts water)

Rewari wheat planted in soil 1 day after formaldehyde treatment Plants washed out and photographed 19 days after planting Each group represents the total number of plants grown from [illegible]0 seeds Left to right control (untreated) formaldehyde formaldehyde with 1 10 ppm 1 naphthylacetic acid formaldehyde with 1 ppm 3 indolylacetic acid

The damage caused by disinfecting seed with copper sulphate and mercuric chloride is also reduced by the addition of a small amount of phytohormone By a similar method marked improvement is produced in the germination and growth of seed treated with hot water for smut control The use of these active chemicals as an accessory to seed disinfection may thus be of value in agricultural practice It has also been found that these responses of seed to physiologically active chemicals may be used to indicate the activity of new chemicals and extracts

A more detailed account of this work will appear shortly in the *Canadian Journal of Research*

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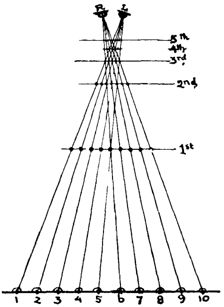
A Binocular Illusion

THE following may be added to Dr R S Creed's letter in NATURE of May 28 p 977

In the case of a well defined pattern for example, alternate squares of black and white, the distance between centres of the pattern being about equal to that between the observer's eyes it is easy to make the 'suspended' pattern appear at any one of five different distances. With the original pattern about 90 cm. distant, the nearest suspension (in my own case) is at about 9 cm. from the eyes—the others being at about 11·5, 15·5, 22 and 42 cm. respectively.



The distance of the suspension depends on the degree of convergence of the eyes and is most easily adjusted by fixing the eyes on, say, the observer's own thumb nail and moving it to and fro in front of the patterned surface. At about the distances mentioned the observer's thumb suddenly seems to be floating on the suspended surface. The apparent size of the pattern decreases in proportion to its apparent distance from the eyes.

The principle involved is shown in the accompanying drawing. At the first suspension the right eye R is looking at element 6 of the pattern while the left eye L is looking at 5, while the observer's mind assumes that both eyes are looking at the *same* element: the pattern is therefore seen suspended at the distance at which the two lines of sight converge. In the 5th suspension, R is looking at element 10 while L is looking at element 1.

It seems clear that in these experiments the angle of convergence of the eyes is the determining factor in producing the illusion of distance.

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Points from Foregoing Letters

Prof. E. V. Appleton and K. Weekes have shown the existence of a lunar tide in the Kennelly-Heaviside layer which is accompanied by a relative pressure oscillation 6,900 times as large as the corresponding lunar pressure oscillation at ground level.

A table and graphs showing the rate of flow of liquid helium II through capillary tubes, as determined by H. E. Johns and J. O. Wilhelm and Dr. H. Grayson Smith, are submitted by Prof. E. F. Burton. The results differ from those of Allen and Misener and of Kapitza in showing a normal rate of flow without any tendency to super-fluidity.

From the number and energy of secondary electrons produced by the more penetrating cosmic ray particles traversing a 2 cm. plate of gold, J. G. Wilson, using Bhabha's calculations, concludes that the observed number of secondary electrons can be explained by the elastic collisions of the penetrating rays with electrons, assuming that the former have a mass rather greater than a hundred times that of the electron.

Dr. A. Shalnikov reports anomalous properties of superconducting lead and tin films condensed on to glass at 4·2° K. The transition temperatures were higher than for the bulk metals, the currents required to restore resistance were much lower than those predicted by Silsbee's hypothesis, and the magnetic fields required to restore the resistance were much higher than for the bulk metal. All these anomalies were modified if the film was warmed to room temperatures and re-cooled, and for tin the transition temperature became about the same as for the bulk metal, so it is probable that the anomalies are partly connected with the structure of the films.

Experimental values are given by Dr. A. R. Ubbelohde and J. W. H. Oldham for the setting points of isomeric ketones of the general formulæ $C_{17}H_{34}O$ and $C_{18}H_{36}O$. The setting points are considerably higher when the carbonyl group is at one end or symmetrically in the middle of the chain. A possible interpretation of these observations, in terms of a mechanical model, is considered in the light of the structural and thermodynamic evidence.

From the observation that in a cod liver oil the absorption at 328 mμ determined on the unsaponifiable fraction increases spontaneously with age, whereas the gross absorption of the oil does not increase simultaneously, Dr. D. C. Garratt infers the presence of an isomer of vitamin A which is being converted to the normal form but is destroyed by saponification. Cold saponification experiments tend to confirm this supposition.

Experiments by H. Kalckar on the rate of dephosphorylation of Emden ester by fresh tissue of intestinal mucosa and kidney extract indicate that the cause of the slowness of absorption of fructose in the intestine is not a slow phosphorylation of fructose but a slow dephosphorylation of the fructose-6-phosphate.

I. J. Kligler and N. Grosowitch find that although the dysentery and paratyphoid bacilli can grow in peptone-glucose media in the absence of nicotinic acid they cannot in those circumstances utilize glucose. Paratyphoid *B*, on the other hand, needs no nicotinic acid in order to utilize glucose.

Photographs are submitted by N. H. Grace showing that the addition of very small amounts of plant hormones (3-indolylacetic acid, *l*-naphthylacetic acid and phenylacetic acid) to wheat grains which have been disinfected with formaldehyde, reduces or prevents the slowing down of germination and growth which otherwise follows disinfection.

Research Items

Tokelau Islands

THE culture and ethnology of the Tokelau Islands, a group of four islands south of Samoa and east of the Ellice Islands, was studied during a two months visit by Mr. Gordon Macgregor from October until December 1932 (Bernice P. Bishop Museum Honolulu *Bull.*, **146**, 1937). Study of the culture shows that in its linguistic, social, religious, mythological and material phases many features are common to cultures of eastern Polynesia, but have no further distribution in western Polynesia, except in the neighbouring Ellice Islands. Of the material traits in particular many with eastern affinities are found in western Polynesia, in contradiction to the theoretical western material culture complexes put forward by previous writers. Hiroa, who has made the latest grouping of Polynesian material, has shown that a fundamental culture is common to both eastern and western islands. The analysis of Tokelau culture is summarized as follows. A migration of people moving through Micronesia passed through the Tokelau Islands and into the eastern Polynesian area. This people left a small number of their group in the Tokelau Islands where they were the first settlers and the bearers of the so called eastern Polynesian culture traits now found in the Tokelau culture. A movement of people from Samoa to the islands of the north west, through which their ancestors had probably come to settle Samoa, reached Fakaofu, introducing Samoan culture, and ultimately conquering the whole group. During the whole period of settlement of the Tokelau Islands there was a small but constant drift of Polynesians brought by the trade winds from the eastern area who introduced locally developed eastern cultural traits and reinforced the early culture. There developed in the Tokelau Islands, and the Ellice Islands as well, a culture based on the early forms of eastern culture, later influenced by Samoan, or western Polynesian culture, and perhaps slightly by Micronesian cultures, which took on a form unique in Polynesia, and which must be considered a sub culture in the western area, and in the future distinguished from the phrase "western Polynesian culture".

Anthropometry of Racial Hybrids

AN anthropometric study of certain hybrid populations has been made by Mr. J. C. Trevor (*Eugenics Rev.*, **30**, No. 1). The nine populations chosen for analysis included 113 Norfolk Islanders, descendants of the *Bounty* mutineers, half blood Sioux, Ojibwa whites, 880 Yucatecans, Jamaican 'browns', American Negroes, Boer Hottentot crosses, East Indian Mestizos and Anglo Indian mixtures. Difficulty was found in obtaining comparable statistics of the parent races, and in no case could the F_1 be directly compared with the parents. Nevertheless certain significant results emerge. Comparative analysis shows that where the parental types differ markedly in any quantitative feature, such as head length or nasal breadth, the mean of the hybrids is generally intermediate, although sometimes almost coinciding with one parent. The variabilities of the hybrid population follow approximately the normal curve and appear to be unimodal. They are not, on the whole, peculiarly high or low. These results are not perhaps genetically surprising if the parent populations are themselves highly heterozygous and variable. A study of F_1 individuals from some racial cross in direct comparison with their parents would throw light on some of these questions.

Cell Size

A SERIES of careful measurements of the sizes of human lymphocytes under different conditions is utilized by Donald Mainland and Basil K. Cody (*J. Anat.*, April 1938) as a basis for a useful discussion of the significance of cell measurements. This is important since subsequent to the large amount of work done on this subject at the beginning of the present century scepticism has been expressed as to the value of such measurements. The blood was obtained from two healthy young men, and the measurements of about a hundred examples from each preparation were taken. The specimens were prepared in various ways, the ordinary control method followed by Wright's stain, mixing before drying with isotonic saline, hypotonic saline and isotonic formaldehyde. Spreading the film between cover glasses it was found that those on the lower cover glass were on the average $0\cdot56\mu$ greater in diameter than those on the upper. This the authors attribute to the more rapid falling of the larger lymphocytes. The noteworthy variation in size between the lymphocytes obtained in twenty nine films from the same individual cannot be due to controllable differences in technique. In comparing the differences obtained by the film method and mounting in isotonic saline, it was found that there was much greater variability within and between the films than in the saline preparations so that the latter furnish a more satisfactory basis for comparative observations.

Water-Absorbing Area in the Grasshopper Egg

MANY insect eggs appear to require for development an intake of additional water and oxygen from the medium surrounding them, and Bodine, in 1929, demonstrated that the increase in weight of the egg of the grasshopper, *Melanoplus differentialis*, as it develops is due to an actual increase in water content. The chitinous cuticle of the grasshopper's egg is, however, resistant to wetting and impermeable to fluids, though gases may diffuse through it, so that some special mechanism must exist for the absorption of water. Eleanor H. Slifer finds that at the posterior end of the egg a small circular area is present in the cuticle which, in contrast with the rest of the cuticle, becomes excessively thin and transparent on treatment with caustic potash solution (*Quart. J. Micro. Sci.*, **80**, Part 3, 437, 1938). In this area, termed the 'hydropyle', there is a number of large cells, different from those elsewhere, and evidently constituting a secretory organ by means of which water is taken into the egg. If at an early stage of development the hydropyle is covered with water impermeable material, development is stopped. During the twenty five days' development at 25° C., the weight of the egg nearly doubles.

Fertilization in the Onychophora

IN some species belonging to the family Peripatidæ, the males form large spermatophores which are supposed to be deposited in the female genital opening In *Peripatopsis* however the spermatophores are deposited anywhere upon the body of the female and their route thence to the ovaries has remained problematical, though the subject of ingenious speculation Dr S M Manton has solved the problem and the solution is different from the speculations (*Phil Trans Roy Soc London* B, **228**, No 556) After a spermatophore has been deposited upon the skin of a female leucocytes invade the ectoderm and the cuticle of the body and the lower wall of the spermatophore rupture Through this breach, the spermatozoa swim and so reach the vascular spaces By their own activity they pass through the hæmocœl and reach the ovary through the wall of which they force their way to the ovarian lumen where oogonia are lying freely Sperm heads invade the cytoplasm of the oogonia which divide to form ova and these absorb the sperm heads and grow In the meantime the spermatophore wall remains attached to the cuticle and closes the wound caused by the entry of the spermatozoa In the ovary the spermatozoa apart from fertilizing ova provide the early ova with food needed for their growth, and they may also supply the animal itself with nourishment or other special substances

Mycorrhiza in Garden Plants

THE mycotrophic habit has been shown to be of wide occurrence in many families of plants and now M A Mostafa has shown that *Tropæolum majus* L *Phlox Drummondii*, *Verbena officinalis* L and *Clerodendron inerme* Gaertn Hook show well developed endotrophic mycorrhiza when growing in a soil which is alkaline and of a low humus content Detailed observations of *Tropæolum* and *Phlox* have recently been published by the author (*Ann Bot* New Series **2** No 6 481 April 1938) The mycotrophic habit of both these species was shown to be very similar In neither case was the fungus found in the aerial portions of the plant From *Tropæolum* two species of *Aspergillus* three of *Penicillium* and single species of four other genera of fungi were isolated , from *Phlox*, two species of *Penicillium* one of *Fusarium* and one of *Alternaria* were obtained The fungus, outside the piliferous layer, was septate , it became septate and showed an increase in diameter of hypha after penetrating the root Aseptic seedlings (obtained by treatment of seeds with mercuric chloride) of *Tropæolum* raised either in sand or agar cultures produced a well developed root system but no fungus

Variation in Keeping Quality of Apples

AT a meeting of the Industrial and Agricultural Research Section of the Royal Statistical Society on Thursday, May 26, Mr T N Hoblyn read a paper entitled A Study of the Variation in Keeping Quality of Apples in Store as illustrated by the Behaviour of the Variety McIntosh Red from an Ontario Apple Orchard ' Keeping quality is markedly influenced by cultural treatment, but even in an orchard receiving uniform treatment considerable variability occurs Mr Hoblyn described an attempt to evaluate such variability and to elucidate the factors affecting keeping quality Samples of fruit were taken from similar trees in different positions in the orchard from trees showing varying degrees of winter injury and from trees showing inherent variability Samples from the same trees were further divided into categories according to colour and size The fruit was kept for eight months in two similar storage chambers, one at 36° F and the other at 32° F , the effect of position in the store being allowed for in the experimental design 11 520 individual apples were examined with particular reference to two forms of low-temperature breakdown, namely core flush and superficial scald' Analysis of the data showed that samples from the same tree may be extremely variable but that samples from different trees vary even more Inherent differences between trees were more important than those due to position or degree of winter injury Core flush in apples from the same tree varied with size and colour, small red apples showing least Scald, on the other hand was associated most with green apples irrespective of size The variability was discussed, and possible methods of sampling for use in different types of storage experiment were suggested

Major Spiral of the Chromonema

BY comparing normal, desynaptic and asynaptic *Trillium*, C L Huskins and G B Wilson in 1937 showed that the three following factors play a part in causing changes in direction of the major spiral of chromonema (1) chiasmata (2) the attachment (3) random changes which may be expected to be proportional to the number of gyres which the chromonema forms The authors have now published the data in detail (Probable Causes of the Changes in Direction of the Major Spiral in *Trillium erectum* L *Ann Bot* New Series **2** No 6, 281 , April 1938) From the analysis of these data it appears that (*a*) chiasmata may cause a number of changes equal to the chiasma frequency , (*b*) the direction of coiling is random on either side of the attachment, and this will cause half as many changes in direction as there are chromatid attachments, (*c*) the remaining number of changes is proportional to the number of gyres

Protective Insecticides and Fungicides

E Fajans and H Martin (*J Pom and Hort Sci* , **16**, 14 , 1938), in continuation of their work on the physico chemical properties which determine the retention of spray fluids and the tenacity of spray deposits, have examined sprays consisting of emulsions (liquid/liquid systems) and of added suspensions (liquid/liquid/solid systems) The initial retention of emulsions was found to be determined by the properties of the aqueous phase and intermediate between that of the emulsifier solution alone and that of water Preferential retention of the oil phase increases as the emulsifier concentration is reduced, and is dependent on the character of the latter Retention of emulsion suspension systems is markedly affected by the extent of interaction between the emulsifier and the solid phase, which results in partial or complete adsorption of the oil phase by the solid, which is flocculated to large agglomerates The stability of the emulsion is thus reduced with consequent increase in the extent of preferential retention of the oil phase followed by preferential retention of the solid phase The tenacity of deposits from emulsion suspension sprays is favourably affected by the presence of oil but may be reduced by the emulsifier for example, sulphite lye Owing to the necessity for using sprays of high stability, only emulsion suspension systems showing little or no interaction between emulsifier and solid can be recommended for practical use Sulphite lye is the most suitable from this point of view, and its unfavourable effect on tenacity may be reduced by reducing its concentration

Lunar Periodicity of Earthquakes

In a recent paper (*Union Geol Geoph Intern Publ*, Ser A, fasc 15, 241 257 1937) H T Stetson has studied the frequency of earthquakes in connexion with the hour angle of the moon During the years 1918 29 2 569 earthquakes were recorded at stations more than 80 from the origin Arranging these according to the hour angle of the moon referred to the meridian of the epicentre of each earthquake, he finds two maxima of frequency at 7 and 18 hours For the smaller district consisting of the Philippines and Japan the maxima occurred at 6 and 21 hours Again for 113 deep focus earthquakes, with depths of 100 km or more below the surface the maxima were at about 5 and 16 hours and the curve representing the means of the numbers of earthquakes for lunar hourly intervals corresponds closely with the curve of the east and west component of the lunar tidal force

Thermometry below 1° K

It is known that magnetic susceptibility is not appreciably useful for the purpose of denoting temperatures in the presence of any considerable magnetic field and in many cases it is undesirable to remove the field even for short intervals in very low temperature work W F Giauque J W Stout and C W Clark (*J Amer Chem Soc* **60** 1053 1938) have investigated the possibility of using the electrical resistance of finely divided amorphous carbon and their results show that this method will be very useful at temperatures below 1° K At 1 63 K a carbon ink film on glass had an electrical resistance 13 700 times that at 293° K, and the rate of increase with lowering temperature was accelerating so rapidly at 1 63 that a form of carbon with a smaller temperature coefficient of resistance was desirable The construction of amorphous carbon thermometer heaters from lampblack is described and the resistance of a carbon thermometer from 293° to 0 129° K was measured at these temperatures it was 28 062 and 58 640 ohms, respectively One thermometer was studied over a year and its resistance was found to be constant to one per cent after initial stabilization had occurred The increase of resistance in a magnetic field was measured at 4 2° and 1 5° K It was found to be larger at the lower temperature and proportional to the square of the applied field at both temperatures

Absolute Configuration of Optically Active Substances

A USEFUL review of the methods of determining the absolute configuration of optically active substances, and of progress made within recent years, has recently been given by W Kuhn (*Naturwiss*, **26**, 289, 305, 1938) The methods are discussed in connexion with inorganic compounds, potassium cobaltic oxalate $K_3Co(C_2O_4)_3$ being taken as an example The Cotton effect in the neighbourhood of the absorption bands and the oscillations of the various atoms and groups in the molecule are considered and it is shown how the configuration is arrived at Organic compounds are then dealt with starting with methyl ethyl carbinol and proceeding to compounds which can be derived structurally from this compound

Specific Ionization of Cosmic Ray Particles

D R Corson and R B Brode (*Phys Rev* **53** 773 1938) have examined a number of cloud chamber tracks of cosmic ray particles in which the ions were spread sufficiently to enable them to be counted In spite of this spreading of the tracks the energy of each particle could be measured with reasonable accuracy by its curvature in a magnetic field The particles examined were in the energy range 0 2 40 Mev they were therefore slow on a cosmic ray scale The theory of Bethe gives in this region a minimum ionization at about 2 Mev followed by a slow rise at higher energies This rise has now been found experimentally for the first time It amounts to between 10 per cent and 20 per cent for the fastest electrons studied The paper also contains an examination of the more heavily ionizing cosmic ray tracks observed by the authors themselves and by others There is a relation between the mass of the particle the curvature of the track the density of ionization, the residual range and the rate of change of velocity with distance such that any two of these quantities determine the others This is expressed in a nomogram and it is shown that nearly all the published data on heavy tracks agree with a mass 200 50 times the mass of an electron

Direct Evidence for the Neutrino

For many years the existence of a neutral particle of electronic mass has been invoked to explain the continuous energy spectrum of β rays from radioactive nuclei On this view the energy of all β disintegrations is the same and when a low energy β particle is emitted the excess energy is given to the neutrino H R Crane and J Halpern (*Phys Rev* **53** 789 1938) have investigated the recoil of the radioactive nucleus in β disintegrations and have shown that momentum relations indicate the participation of a third body A radioactive gas (a compound of radio chlorine) was introduced into a cloud chamber The track of the recoiling nucleus was too short to be measured but the expansion chamber conditions were adjusted so that the ions produced by the recoil particle formed a cluster of droplets which could be counted The number of droplets counted was examined as a function of the electron energy and it is found that where a low energy electron is emitted the momentum carried off by the *recoiling nucleus is much larger than required to* balance the momentum of the electron Control experiments were carried out with a compound of radio phosphorus, which has a much lower upper limit to its β spectrum, and very few of the tracks had detectable clusters at their origin This is held to confirm the identification of the cluster with the track of the recoil nucleus

The National Physical Laboratory

Inspection by the General Board

THIS annual event was held on June 28, when a large number of visitors representative of numerous academic, technical and commercial institutions throughout the country were received by Sir William Bragg, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Dr W L Bragg, director of the Laboratory The Laboratory was thrown open to the visitors and special exhibits demonstrating the work in progress were staged in its various Departments The time available does not permit the visitor to see all the exhibits, but amongst those of more recent or important the following were noted

PHYSICS DEPARTMENT

The section of the Physics Department concerned with the thermal properties of materials covers a wide range both of materials and temperatures, some of the extreme examples being typified by apparatus for measuring the thermal conductivity and latent heat of fusion of refrigerants, and another for measuring the thermal properties of steels and other alloys up to temperatures of the order of 1000° C The value and convenience of electrical methods of heat production and temperature measurement were well appreciated by a glance through the exhibits in this section

The Acoustics Section is tackling a number of problems which will eventually contribute to the comfort of a large proportion of the population by the elimination of unnecessary noise A thorough analysis of the noise emitted by a motor-cycle engine when running under various loads and silencing conditions has begun in a small laboratory which has just been built for these tests The work on architectural acoustics has largely centred of late on methods of avoiding the transmission of sounds throughout large buildings such as blocks of flats or offices. In one exhibit, a slab of acoustically insulating material such as might be built into the walls of a building was clamped between two plane surfaces one of which was driven at any desired frequency or amplitude The ratio of the amplitudes of vibration of the driver and driven surfaces was determined for various frequencies and clamping pressures

The work which has been in progress for several years in the Radiology Section on tooth structure has employed micrographic, radiographic, and X-ray analytical methods of investigation Tooth enamel has been found to possess a prismatic cell structure, and X-ray analysis has shown that these prisms contain preferentially oriented crystallites of an apatite (probably hydroxy-apatite) the hexagonal axes of which bear a definite angular relation to the axis of the prism in which they lie. The radiographic examination of sections of teeth has also revealed the distribution of their calcium content, and the changes in this distribution consequent on injury or attrition of the enamel at any point have been studied.

A new A C. bridge circuit has been developed in the Electrical Standards Section, by which capacitance and power factor can be determined in terms of the fundamental standards of mutual inductance and resistance A completely screened variable sub standard mutual inductance incorporating a compensating circuit, which ensures perfect quadrature of secondary E M F and primary current, forms an essential part of the apparatus The equipment is designed for measurements on capacitances ranging from 500 μμ F to 4 μ F, and the limits of error at 1,000 cycles per second are of the order of ± 3 parts in 10^5

The Electrotechnics Section still has a considerable amount of work in hand in connexion with the testing of substandard apparatus for supply authorities throughout Great Britain, and reflecting dynamometer wattmeters have been installed to facilitate the progress of the A C instrument testing, which has hitherto been carried out entirely with electrostatic instruments In the High Voltage Laboratory a new battery of condensers for the generation of transient currents of the order of 100,000 amperes was shown in operation

A portable telephotometer which has been in use for some years for the measurement of atmospheric transmission over distances up to about a mile was exhibited in the Photometry Section This instrument is based upon the Maxwellian view principle, and by means of a Lummer Brodhun prism the intensity of the light received from the distant source is matched by that from a lamp in the instrument The matching has been found to depend on the size of the image which is formed in the plane of the eye-ring For reliable measurements, the dimensions of this image should not exceed about ½ mm.

RADIO DEPARTMENT

Much of the work in the Radio Department is devoted to the higher frequency transmissions which have assumed increasing importance of late An instrument for the measurement of field-strengths at frequencies of 30 Mc. per sec and upwards consisted of a supersonic-heterodyne receiver, the amplification of which could be adjusted to a reproducible value by operating with a constant 'thermal noise' in the output circuit. By means of a radiator (also exhibited) giving a calculable field, the receiver could then be calibrated at this setting and adjusted to any desired lower sensitivity by the incorporation of calibrated attenuators or voltage dividers in the amplifier. A direction-finding receiver used in conjunction with a cathode ray oscillograph for giving visual indications of bearing was also shown. This incorporated two separate amplifiers of closely identical characteristics—a condition on which the whole success of the apparatus depends.

Another interesting exhibit in this department was a very light-weight short-wave transmitter which has been developed for meteorological work This apparatus transmits a wave with two modulations, the frequencies of which depend on the atmospheric pressure and temperature respectively, and hence when flown with a sounding balloon this transmitter gives continuous information of changes of these factors on its journey. The complete transmitter weighs only 4½ lb and has reached heights up to 9 miles and distances of more than 100 miles with good reception throughout

METROLOGY DEPARTMENT

A well designed and recently completed air tight chamber for testing mercury barometers was seen in the Metrology Department This provides accommodation for six barometers including a standard and the necessary adjustments for setting each one can be made from outside The pressure can be varied over a wide range and held constant at any value to within ±0 01 mm of mercury by a barostat control

A determination of g by a reversible pendulum has just been completed The pendulum carries two plane parallel surfaces on which it is swung from a fixed knife edge on the supporting pillar an arrangement with which the effective length of the pendulum may be measured with considerably greater accuracy than one in which the pendulum carries knife edges The effect of the elasticity of the pendulum rod and the finite radius of curvature of the knife edge have been investigated in the course of this work

In the Gauge Testing Section a new self contained vertical type of projector for the examination of plaster casts of ring gauges or of plug gauges up to 3 inches in diameter was shown This apparatus is transportable and can be used in a normally lighted room

ENGINEERING DEPARTMENT

The results of an interesting investigation on frettage corrosion that is the corrosion which occurs between two metal surfaces which are generally regarded as being in non rubbing contact were shown in the Engineering Department It has been shown that the phenomenon only occurs when an alternating and microscopically small relative movement between the two surfaces occurs Certain combinations of soft and hard metals especially when lubricated appear to reduce the corrosion effect but so far no combination of surfaces has been found to be immune In the section devoted to the study of lubrication problems the use of ball ball and ball plane contacts has enabled reliable measurements to be made under boundary layer conditions This has been of particular value in the testing of extreme pressure lubricants Tests on water lubricated rubber bearings have shown that the coefficient of friction of a plane cylindrical bearing is considerably lower than that of the more usual fluted type

A new apparatus for studying the load relaxation of model pipe flanges at high temperatures was also seen in this Department This consists of a very rigid frame in which a series assembly of four flanges is compressed by a hydraulic ram The two centre flanges are thus loaded exactly as in practice, and an extensometer fitted to them measures their total compression The whole assembly was surrounded by a furnace which could be heated up to 600° C

METALLURGY DEPARTMENT

The accurate investigation of the iron carbon, iron sulphur and iron nickel systems which is contemplated in the Metallurgy Department has necessitated the production of a regular supply of very pure iron This is now prepared on a routine basis by chemical methods using electrolytic iron as the raw material The chloride is first produced and this is decomposed by steam at a carefully regulated temperature the oxide so formed being washed free from the chlorides of other metals by water The dry oxide is reduced in hydrogen and the metal melted first under slightly oxidizing conditions then in hydrogen, and finally *in vacuo* The final product contains not more than 0 01 per cent of total impurities The melting of iron without contamination has been made possible by the use of the high frequency furnace and the production of crucibles of alumina and magnesia

In this Department there were also two exhibits one showing the automatic control of the rate of temperature change of a furnace and the other showing the automatic plotting of cooling (or heating) curves by the combined use of which the tedium usually associated with the accurate determination of transformation points can be avoided entirely A new gas fired furnace with an improved design of burner was seen in the foundry This will attain temperatures up to 1900 C and has been used for the firing of the refractory vessels mentioned above and also for testing Seger cones as used in the ceramic industry

AERODYNAMICS DEPARTMENT

In the compressed air tunnel of the Aerodynamics Department a large amount of data upon aerodynamic effects at high Reynolds members has been accumulated Measurements which are in progress on model wing sections include determinations of drag of the position of the point of transition from laminar to turbulent flow on the surface and of pressure distribution over the surface It will thus be possible to separate skin friction drag from form drag and with a knowledge of the transition point to compare the results with predictions from modern boundary layer theory

A model of a small airscrew in front of a thick wing was shown in the duplex tunnel This has been used to investigate the point at which the airscrew becomes so small with respect to the wing that its efficiency begins to fall The data so obtained will be of value in the design of large aircraft in which these conditions are most likely to occur The extensive use now being made of kite balloons has stimulated further interest in their stability and a model of a balloon was seen undergoing tests on the whirling arm

FROUDE LABORATORY

In the Yarrow Tank of the Froude Laboratory a tug propelled by twin paddle wheels, towing two barges, was under test Power and speed measurements were automatically recorded and the method of reduction to ship dimensions was explained A model of a high speed hull was demonstrated in the new tank This type of work is of growing importance owing to the increasing use of small speed boats for naval and commercial purposes

In conclusion, a tribute might well be made here to the garden staff, which has created and maintained the pleasant surroundings in which the Laboratory is set and which help to make a visit on such an occasion as this a delight as well as an interest

Field Days at the Rothamsted Experimental Station

TWO important meetings took place at Rothamsted on June 28 and 29. The first was a gathering of Empire agricultural officers on leave in England who were visiting Rothamsted by the joint invitation of the Station and the Imperial Bureau of Soil Science. This has now become a yearly function, and serves the double purpose of enabling Empire agriculturists to meet each other and acquaint themselves with recent work of the Station and the Soil Bureau. There was a full gathering, and no less than fifteen Empire countries were represented. The programme included a tour of the laboratories and field plots and a brief summary of the work of the Station and the Soil Bureau was given by the Director.

The annual field inspection at Rothamsted was held on June 29, when the Right Hon. the Earl of Radnor, chairman of the Lawes Agricultural Trust, presided over a large gathering of friends and supporters of the Station. The guest of honour was the Right Hon. the Earl of Feversham, Parliamentary Secretary to the Ministry of Agriculture and Fisheries.

The morning was devoted to a visit to the famous field experiments: the Park grass plots showing the effects of fertilizers on meadow hay, and Broadbalk with its striking series of wheat plots. Broadbalk, now carrying its ninety-fifth successive crop of wheat, was in first-class order and showed splendid standing crops where complete manuring had been given. Attention was not confined to the classical fields, and this year the guests were conducted over a modern grazing experiment on High Field carried out in co-operation with the Royal Agricultural Society of England. The purpose of this experiment is to evaluate the fertilizing effect of the residues left behind when concentrated feeding stuffs are fed to cattle at pasture. Tenant right valuers at present use the old and well-known tables of Hall and Voelcker in estimating the compensation due to an outgoing tenant arising from the consumption of concentrated foods on grass, and the present experiment will show whether in present conditions they still remain the most suitable basis, and if not, what should be done to replace them.

In his chairman's address, Lord Radnor stressed the importance of the work on soil fertility in which Rothamsted was engaged. With our shrinking cultivated area and the progressive exhaustion of virgin soils overseas a time would soon come when food production from our home soils would be a vital problem. Knowledge gained now and put in a form that farmers could readily use would serve to meet the demands that sooner or later would be made upon our agriculture. To make full use of its opportunities the Station equipment had to be brought completely up to date, and it was hoped to raise a sufficient sum to have this completed by the centenary, which would be celebrated in 1943.

Speaking of the contribution of Rothamsted to agriculture, Lord Feversham acknowledged the assistance that the Ministry of Agriculture had received from the Station in connexion with the Land Fertility Scheme. The recent work carried out in pasture problems had been of great value in this connexion. He had pleasure in announcing that the Government had granted £14,500 to meet half the cost of the new wing to accommodate the Departments of Chemistry and Biology, while plant physiology was to be housed in a separate building. This money was well spent and would undoubtedly give a good return for the outlay. The taxpayer had frequently been called upon in recent years to make contributions to the agricultural industry. There should be no appearance of subsidizing obsolete methods. One of the functions of agricultural research was to ensure that farmers should have at their disposal trustworthy information on which to base efficient production.

Sir John Russell than gave a brief outline of the work of the Station. Agriculture was at present passing through a period of depression; some people were turning to politics and others to economics as a remedy for the present situation, but these fields were outside the scope of the Station's activities. The purpose of the Rothamsted work was to provide sound technical knowledge and put it out to farmers in such a way that costs could be lowered or output increased. The resources of the Station were amplified in two directions. In pure science the Rothamsted work was linked up with investigations in highly specialized fields, with Prof. V. H. Blackman for example in plant physiology, and with Sir William Bragg at the Royal Institution. On the other side, the Station owed much to the co-operation of expert users of agricultural produce. Thus the Institute of Brewing gave valuable help in the study of barley problems, and the experts of the Sugar Commission in the study of the production of sugar beet. Progressive farmers all over Great Britain allowed the Station staff to carry out experiments on their land under conditions of actual agricultural practice.

Processes of Urine Formation*

THE controversies which in the past have characterized the experimental literature on the nature of renal function have resulted in large part from lack of information concerning the composition of urine at different stages of its elaboration within the structural units of the kidney. The discovery that the kidneys of amphibians and of reptiles can be subjected to direct microscopic observation during life indicated that a way of obtaining such information might be found.

Microdissection methods, as developed by Barber, Kite and Chambers, applied to the kidneys of these animals, have made possible the collection of minute specimens of fluid from Bowman's capsule and from various levels of the uriniferous tubules. Quantitative analyses of these specimens show that with

*Substance of the Croonian Lecture delivered by Prof. A. N. Richards, University of Pennsylvania, before the Royal Society on June 30.

respect to every constituent for which an analytical method could be devised, the fluid as separated from blood plasma in the glomerulus has the composition of a protein free plasma filtrate The blood pressure in the capillaries of individual glomeruli has been measured and found to be significantly higher than the colloid osmotic pressure of the plasma Hence the conclusion seems inescapable that the glomerular process in these animals is physical filtration

Analyses of fluid collected from the tubules have shown that the glucose of the glomerular filtrate is restored to the blood during passage through the proximal convolutions that chloride is reabsorbed and reaction is changed from alkaline to acid by the cells of the distal convolutions Reabsorption of water takes place in both sections of the tubule to a greater degree in the distal than in the proximal segment

Reasons for thinking that the conclusions drawn from these experiments with reference to glomerular function in amphibia are applicable to the mammalian kidney have been derived from study of the excretion of the polysaccharide inulin by dogs and rabbits The results show that this substance which after intravenous injection is excreted rapidly and in high concentration in the urine finds access into the urine solely through the glomerulus From the amount of inulin excreted in unit time and its concentration in plasma a minimal rate of glomerular filtration can be calculated Such calculations show that in non diuretic dogs the volume of glomerular filtrate is more than a hundred times as great as the volume of urine elaborated from it and is sufficient to contain all the constituents of urine normally excreted with the exception of those which are formed within the kidney (ammonia and hippuric acid)

The experiments support the view that the excretory function of the kidney is accomplished at the expense of energy derived from the heart that the work which the cells of the kidney perform consists in the selective restoration to the blood against osmotic gradients of those substances loss of which would disturb that constancy of composition of the fluid environment of tissue cells which is essential for survival

Science News a Century Ago

Freshwater Fishes of Great Britain

THE *Athenæum* of July 14 1838 said We must call the attention of our readers to the completion of a very extraordinary publication In No 16 of this journal (published ten years ago) our predecessors announced the commencement of Mrs R Lee's (then Mrs Bowdich) work on *The Freshwater Fishes of Great Britain*, in which the illustrations are not engraved but are coloured facsimiles of the original drawings all executed by the unassisted hand of the biographer of Cuvier all executed too without the slightest relaxation of pains and finish The fish have been in the first place drawn from life immediately on the specimens being taken out of the water This process may account for a greater gaiety and delicacy of colouring in some of the specimens, than are familiar to the eyes of those who may have been used to examine fish some time after their capture A review of the whole work is here impossible , but now that it is completed we ought to commend it to the notice of all who are interested in the subject were it only as a remarkable we believe in England unique evidence of female energy and perseverance

Mrs Sarah Lee nee Wallis was born in 1791 and in 1813 married the African explorer Thomas Edward Bowdich (1791 1824) Five years after his death she married Robert Lee With her first husband she had studied in Paris and at one time been an inmate of Cuvier's house and in 1833 she published her Memoirs of Baron Cuvier In 1854 she received a Civil List pension of £50 She died at Cork in September 1856

Magnetism of Iron Ships

ON July 14 1838 Captain (afterwards Rear Admiral Sir) Francis Beaufort (1774 1857) then hydrographer to the Navy wrote to the Astronomer Royal Airy that the Admiralty wished him to make experiments on compasses in the iron steam vessel *Rainbow* and a week later the Admiralty gave Airy full powers to proceed The experiments were carried out in the basin at Deptford Dockyard during the course of the summer Among his notes on the work Airy recorded On Aug 17th and 18th I measured the intensity of some magnets to be used in the ship for correction It is to be remarked that beside the effect of polar magnetism there was no doubt of the existence of an effect of induced magnetism requiring correction by other induced magnetism and experiments for this were made in the Magnetical Observatory All was ready for trial and on Aug 20th I carried my magnets and iron correctors to Deptford mounted them in their proper places tried the ship and the compass which had been disturbed 50 degrees to the right and 50 degrees to the left was now sensibly correct On Aug 21st I reported this to the Admiralty and on Aug 24th I tried the ship to Gravesend The results of Airy's experiments were published in the *Philosophical Transactions* on April 25 1839 under the title Account of Experiments on Iron built Ships instituted for the purpose of discovering a correction for the deviation of the Compass produced by the iron of the Ships

Sir James Anderson and Steam Waggons

AMONG the many pioneers of steam road carriages was the Scottish baronet Sir James Caleb Anderson (1792 1861) He took out several patents and his water tube boiler for steam carriages was described in the *Mechanics Magazine* of June 16 1838 A month later on July 14 the Editor published a letter from Anderson in the course of which he said I have spent nearly two *apprenticeships* to this undertaking and have unaided by any company expended about £30 000 on my experiments These have never been brought before the public for I did not consider my carriage until the present time equal to the difficulties to be overcome And I now give the measure into the hands of a company *because it is of paramount importance to the country, that locomotion on common roads should be introduced as widely and expeditiously as possible*, which cannot be done individually, otherwise my partner and myself would have worked it for our own benefit

If the public find my steam drag answer, it will but prepare the way for those of greater talent to introduce them Capital can never be wanted for what is really good , and the public are now awakening to the necessity for locomotion on common roads '

University Events

Birmingham —It is announced that the General Electric Co wishes to give £10 000 to endow two scholarships in celebration of the jubilee of the Company In the letter offering the gift, Lord Hirst, chairman of the Company says 'Bearing in mind our intimate connexion with Birmingham which goes back some 40 years as well as the close interest we have always taken in the development of the University of Birmingham we have decided to put at the disposal of your Council a sum of £10 000 for founding two post graduate scholarships in electrical engineering We sincerely hope that this gift may still further strengthen the bonds existing between industry and our Universities in general and between the General Electric Co the City of Birmingham and the University of Birmingham in particular

The Brewers Society has guaranteed funds to provide scholarships of £100 per annum for training graduates who wish to take a course leading to the degree of B Sc in industrial fermentation and a post graduate course in malting and brewing

The Anglo Iranian Oil Co the Asiatic Petroleum Co and the Burmah Oil Co have guaranteed a fund for providing scholarships, of value more than £100 per annum, for students entering the oil industry tenable at the Oil Engineering and Refining Department of the University

The following lecturers have recently been appointed Miss L Phillip in hygiene and physical training, Dr Thelma Mouat in bacteriology, and Dr R W Pohl in electrical engineering

Cambridge The Frank Smart Prizes awarded in connexion with the Natural Sciences Tripos have been gained by J L Crosby, Magdalene (botany) R G Goode Gonville and Caius (zoology), and Miss M R Osborn, Newnham (zoology)

The Harkness scholarship for proficiency in geology including palæontology value £150, has been awarded to W B Harland, Gonville and Caius College who was placed in the first class of Part II, Natural Sciences Tripos

Edinburgh —At a graduation ceremonial on July 1 the degree of D Sc was conferred on the following for the theses indicated Dr B N Desai Importance of Dialysis in the Study of Colloids , Dr A Haddow, 'Studies in the Biology of Cancer', A G MacGregor, The Volcanic History and Petrology of Montserrat, with Observations on Mt Pelé in Martinique', Dr E G V Percival, Studies in the Carbohydrate Field , I A Galloway, Studies on Certain Viruses Pathogenic for Man and Animals"

London —The Earl of Athlone chancellor of the University, will open the new arts building of Queen Mary College on October 12 This new wing, which is being completed at a cost of £50 000, will be available for teaching and research when the new session opens on October 4 next The top floor will be used for the teaching of zoology Queen Mary College is being largely rebuilt and modernized at a total estimated cost of £200,000

St Andrews —For the triennial period 1935–38 the Senatus has awarded two Sykes Gold Medals for D Sc theses of unusual merit The theses are by Dr G J Robertson on 'Walden Inversion in the Sugar Group' (1936), and by Dr Ian Sandeman on "The Mathematical Representation of the Energy Levels of the Spectrum of Hydrogen (1938)

Societies and Academies

Paris

Academy of Sciences, May 16 (*C R*, 206, 1421 1516)

Jules Drach The differential equation of the third order of the elliptic ϑ functions

Henri Deslandres The universal constant of band spectra Attribution of the lines of the band to other causes than the rotation of the molecule

Ernest Esclangon The aurora borealis of May 12 1938 Description of the effects seen in the Paris region the phenomenon was less intense than that observed in England and Germany

Georges Denigès A new reaction of cystine applicable to its estimation and to its detection in urinary calculi and concretions The reaction is based on the liberation of iodine from a solution of iodic acid acidified with hydrochloric acid It is claimed that no other constituents of urinary calculi liberate iodine in this way

Hwa Chung Lee The transformations of Hamiltonian congruences

Charles Ehresmann The analytical arcs of a Cartan space

Léon Pontrjagin The classification of an $(n+1)$ dimensional complex quantity in an n dimensional sphere

Aryeh Dvoretzky The singularities of analytical functions represented by Dirichlet s series

Kyrille Popoff An extension of the idea of the derivative

Vladimir A Kostitzin Natural selection and the transformation of species from the analytical, statistical and biological points of view

Henri Pailloux The equilibrium of membranes

Léopold Escande Indeterminations and multiple solutions in flow through a submerged valve gate Alternating phenomenon

Svetopolk Pivko The interactions of a helix working at a fixed point with a supporting wing

Henri Mémery An index of stability of the solar activity The ratio of the number of sun spots to the frequency is approximately constant varying only between 5 7 and 6 1 over a period of 56 years

Bohuslav Hostinsky The solution of a general problem of the theory of diffusion

Gérard Petiau The proper function of the fundamental operators of Dirac s theory of the electron

Jean Roubaud Valette The nature of the electromagnetic field in limited relativity

Émile Elchardus Study of the surface tension of fused mixtures containing cryolite

Mlle Nine Choucroun and Maurice Arditi The measurement of superficial electric moments in the midst of a liquid

Ouang Te Tchao and Mlle Anne Marie Moulin The state of equilibrium between large ions and the ions produced by X rays in a gas

Mlle Jeanne Brigando The comparative study of some complex bases

Raymond Chevallier and Mlle Suzanne Mathieu The magnetic properties of ferric hydroxide

Louis Néel The paramagnetism of electrons in a rectangular band

Hugo Steinhaus The localization of objects by means of X rays

Jacques Duclaux and **Miguel Amat** Ultra filters of graduated porosity A method based on the solubility of cellulose acetate in aqueous solutions of magnesium perchlorate These solutions coagulate instantaneously in contact with water and give a porous film The concentration of the cellulose acetate determines the porosity

R Gregoire The mass numbers of the stable isotopes of the elements 43 61 85 and 87

Mlle Marie Falinski A basic zirconium sulphate obtained by hydrolysis of the normal sulphates

Michel Lesbre Complex organic compounds of lead

Jean Desmaroux The action of dilute acids on the nitrocelluloses observation of steric hindrance The considerable variations in the hydrolytic action of various acids are due to the fact that the large ions penetrate the nitrocellulose structure with difficulty owing to their size

Marcel Mathieu and **Mlle Thérèse Petitpas** The solubility structure of the denitrated nitrocelluloses

Max Mousseron and **Robert Granger** The monohalogen derivatives of methylcyclohexane

Augustin Boutaric and **Maurice Engeldinger** Dilatometric researches on a synthetic resin

Alfred Silberstein The crystalline structure of some bromocupric compounds

Raymond Furon Observations on the Nummulitic of eastern Persia

Antoine Bonté Phenomena of modification in the phosphatic nodules of the Toarcian of Echelle (Ardennes)

Pierre Comte The facies of the Upper Devonian in the Cantabrian mountains

Paul Walter Study on the resistivity of the water of the Marne near its junction with the Seine

Vladimir Frolow The annual component of the maximum temperature of Morocco

Jean Feldmann A new genus of Siphonocladaceae

Fernand Obaton Measurement of the brightness of *Photobacterium* as a function of its development

André Mirimanoff and **Mlle Anne Raffy** Preparation of flavine in the crystalline condition starting with *Eremothecium Ashbyii*

Emile F Terroine and **Mlle Berthe Nataf** The role of the reticulo endothelial system in nitrogen metabolism

Dikran G Dervichian and **Michel Machebœuf** The existence of a monomolecular layer of lipoid substances at the surface of the red corpuscles of the blood

Léon Velluz Study of the comparison, in the polycyclic series between reversible oxidability and carcinogenetic power

Brussels

Royal Academy (*Bull Classe Sci*, 24, No 1, 1938)

L Godeaux Cyclic involutions belonging to an algebraic variety and possessing a united curve

Th De Donder Velocity of reaction (2)

G Lemaître and **O Godart** Generalization of Hill's method

M Florkin The cryoscopic depression of the body fluid of *Anodon* in the course of prolonged inanition

P Heirman Note on the distribution of a catecholoxidase in the tissues of vertebrates

L Lison Comparative study of the resorptive permeability of the *néphron* of the toad (*Bufo vulgaris*) for acid and basic dyes

O Rozet The cyclic involutions of order nine belonging to an algebraic surface (2)

P Vincensini Transformations of cyclic systems deduced from Laplace's equation

Vienna

Academy of Sciences, April 28

F Adler Velocity of dissociation of polonium hydride

Elisabeth Rona, **Herta Scheichenberger** and **R Stangl** Artificial radioactivity of thorium The products with half periods of 1 and 12 minutes are produced by fast neutrons, while the product with a half period of 25 minutes is produced by thermal neutrons

J Trinks Triboluminescence of rock salt irradiated by radium

H Flaschka and **F Gastinger** Degree of depolarization of the scattered radiation of binary liquid mixtures (2)

R Herzog Spreading of aliphatic hydrocarbons on solid surfaces

H Dostal Statistical theory of the elasticity of rubber (1) and (2)

N Stranski and **L Kratanov** Theory of orientated deposition of ionic crystals on one another

F V Britzke and **L Hoffmann** Molecular weight of P_2O_5 between 670° and 1100° C

H Pelzer Kinetic theory of the elasticity of rubber

K Murban Brachiopods from the Christophberg near Pischeldorf (Middle Carinthia)

A Ginzberger Supplement to Natural History of the Scoglien and Smaller Islands of South Dalmatia' (*Denkschriften d kais Akad d Wiss in Wien* 92 261, 1915) Under the above title was published the first of a series of reports on the geology botany and zoology of this region Subsequent reports are scattered among various journals and books The present note gives a complete list of these reports, together with corrections to many of them

May 5

R Inzinger Ellipses A representation is discussed which has the property of projecting any circle in a plane Π into a conic section in a plane π with its centre at a fixed point O

Th R Widorn Period of rotation of the planet Mars

May 12

E Chwalla Theory of the stability of statically indeterminate frameworks The case of a framework with axial loading is discussed by means of the author's method, which uses the strains in the various members instead of forces and moments, as unknown quantities

A Rollet and **H Gantz** Silicon as a reducing agent in organic chemistry

May 19

S Meyer Simple formula for the calculation of the atomic weight from the mass number and packing fraction

Forthcoming Events

[Meeting marked with an asterisk is open to the public]

Tuesday, July 12

SOCIETY FOR THE STUDY OF INEBRIETY (11 Chandos Street W 1) at 4 p m —Dr J D Rolleston 'Auguste Ford and his Campaign Against Alcoholism

BRITISH MEDICAL ASSOCIATION (at University College Hospital Medical School, Gower Street, W C 1) at 5 Dr Gordon Holmes F R S The Cerebral Integration of the Ocular Movements (Victor Horsley Memorial Lecture) *

Friday, July 15

INSTITUTE OF WIRELESS TECHNOLOGY, at 7 30 —S A Hurren A New System of Pianoforte Electro Acoustics

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

LECTURER IN MECHANICAL ENGINEERING in the North Staffordshire Technical College The Clerk to the Governors Education Offices Town Hall Hanley (July 9)

CHIEF LECTURER IN MECHANICAL ENGINEERING in the Leicester College of Technology and Commerce The Registrar (July 13)

HEAD OF THE BIOLOGY DEPARTMENT Huddersfield Technical College The Principal (July 13)

MECHANICAL AND ELECTRICAL ENGINEER in H M Office of Works—The Establishment Officer Room 60A Second Floor H M Office of Works Storey's Gate London S W 1 (July 16)

TWO LECTURERS IN MECHANICAL ENGINEERING in the Merchant Venturers Technical College The Principal (July 16)

ASSISTANTS III (ENGINEERS) at the Fuel Research Station East Greenwich The Establishment Officer Department of Scientific and Industrial Research 16 Old Queen Street London S W 1 (quote *J 38/8*) (July 18)

DEMONSTRATOR IN PHYSICS in the University of Leeds The Registrar (July 18)

LECTURER IN MINING in the Burnley Municipal College The Director of Education Education Offices Burnley (July 18)

PROFESSOR OF CHEMISTRY in the University of Durham—The Registrar (July 25)

ASSISTANT TO THE DIRECTOR OF THE UNIVERSITY FARM Cambridge—The Secretary School of Agriculture Cambridge (July 30)

LECTURER IN CHEMISTRY in the University of Cape Town—The Secretary Office of the High Commissioner South Africa House Trafalgar Square London W C 2 (August 19)

JUNIOR PHYSICIST to the British Rubber Producers Research Association—The Secretary 19 Fenchurch Street London E C 3

LECTURER IN ENGINEERING in Achimota College Gold Coast Mr C S Deakin 48 Copse Avenue West Wickham

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Royal Botanic Gardens Kew Bulletin of Miscellaneous Information 1937 Pp iv+600+16 plates (London H M Stationery Office) 15s net [176

British Association for Labour Legislation British Section of the International Association for Social Progress Report on Nutrition Pp 118 (London British Association for Labour Legislation) 1s 6d [206

Norman Lockyer Observatory Council's Report and Accounts and *Director's Report List of Council Staff Members etc* Pp 1 (Salcombe Norman Lockyer Observatory) [226

Transactions of the Royal Society of Edinburgh Vol 59 Part 2 No 11 The Hairs of the Monotremata with special reference to their Cuticular Scale Pattern By Dr A B Wildman and J Manby Pp 333 349+7 plates (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) 4s 9d [226

Philosophical Transactions of the Royal Society of London Series A Mathematical and Physical Sciences Vol 237 No 776 Flexure with Shear and associated Torsion in Prisms of Uni axial and Asymmetric Cross sections By A C Stevenson Pp 161 230 9s Vol 237 No 777 The Law of Error and the Combination of Observations By Harold Jeffreys Pp 231 272 5s Series B Biological Sciences Vol 229 No 558 Two New Echinoidea *Aulechinus* and *Ectinechinus* and an Adult Plated Holothurian *Eothuria* from the Upper Ordovician of Girvan Scotland By E W MacBride and W K Spencer Pp 91 136+8 plates 12s (London Cambridge University Press) [226

Imperial Bureau of Animal Health Review Series No 1 Bovine Mastitis Survey of the Literature to the end of 1935 By E Munch Petersen Pp vi+272+8 plates (Weybridge Imperial Bureau of Animal Health) 10s [226

The Doctors Cookery Book 21 Menus and 82 Recipes for Family Meals Pp 48 (London British Medical Association) 4d [226

Labour's Plan for Oil from Coal Pp 79 (London Labour Publications Department) 1s [236

Towards a National Food Policy Pp 8 (London Committee Against Malnutrition) 2d [236

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant Academic Year 1936 37 Pp 26 (London H M Stationery Office) 1s 3d net [246

Spectrochemical Abstracts 1933 1937 being a 52 page Bibliography with Abstracts of over 200 Papers on Spectrochemical Analysis By F Twyman Pp 52 (London Adam Hilger Ltd) 4s [246

British Non Ferrous Metals Research Association Research Reports Association Series No 472 Nickel Silver a Survey of Published Information By C E Pearson Pp 36 (London British Non Ferrous Metals Research Association) 3s [246

The Therapeutic Application of the B D H Sex Hormones in Gynaecology and Obstetrics Pp 64 (London British Drug Houses Ltd) [246

Other Countries

Essential Facts about the League of Nations Ninth edition (revised) Pp 319 9 plates (Geneva League of Nations London George Allen and Unwin Ltd) 1s [146

Industrial Research Bureau Bulletins of Indian Industrial Research No 11 The Manufacture of Sulphitation Sugar from Colour Canes (Purple Mauritius) By S Venkata Ramanayya Pp ix+25 5 plates *(Delhi Manager of Publications) 10 annas 1s* [176

Ceylon Sessional Paper 4 Report and Accounts of the Coconut Research Scheme for 193 Pp 21 (Colombo Government Record Office) 25 cents [226

Report of the Aeronautical Research Institute Tôkyô Imperial University No 162 Chemical Structure and Viscosity Characteristics of Lubricating Oils By Bunnosuke Yamaguchi Pp 211 235 0 40 yen No 163 On the Influence of a Resonator upon the Sound Field By Kôzi Satô and Kenti Kubo Pp 236 244 0 20 yen (Tôkyô Kôgyô Tosho Kabushiki Kaisha) [226

Smithsonian Institution Bureau of American Ethnology Bulletin 117 Historical and Ethnographical Material on the Jivaro Indians By M W Stirling Pp xi+148+38 plates (Washington D C Government Printing Office) 35 cents [226

U S Department of the Interior Office of Education Bulletin 1937 No 27 Printed Page and the Public Platform a Study of the Relation of Reading to Forums and Discussion By John Chancellor with the assistance of Chester S Williams Pp vi 100+5 plates 20 cents Bulletin 1937 No 34 Industrial Arts its Interpretation in American Schools Report of a Committee appointed by the Commissioner of Education Pp vi+125 15 cents (Washington D C Government Printing Office) [226

Queen Victoria Memorial Salisbury Annual Report for the Year ended 31st March 1938 Pp 8 (Salisbury Rhodesian Printing and Publishing Co Ltd) [226

Report for the Year 1937 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty Pp 9 (Cape of Good Hope Royal Observatory) [226

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No 182 Control of the Long horn Beetle *Stromatium fulvum* (Villers) on valuable Furniture in Egypt By Dr M Shafik Pp 9+4 plates 25 mills Bulletin No 191 A Chocolate Spot Disease of Beans (*Vicia faba*) Part 1 Studies on *Botrytis sp* as the Cause *of the Disease in Egypt* By Dr A F El Helaly Pp ii+8+2 plates 2 P T Bulletin No 197 Contribution to the Flora of Egypt New Additions to the Flora of Egypt By Jos R Shabetai Pp ii+4+5 plates 2 P T (Cairo Government Press) [226

Smithsonian Institution U S National Museum Bulletin 171 The Pleistocene Vertebrate Fauna from Cumberland Cave Maryland By James W Gidley and C Lewis Gazin Pp vi+99+10 plates (Washington D C Government Printing Office) 25 cents [236

Transactions of the Academy of Science of Saint Louis Vol 29 No 5 The Pre Cambrian Structure of Missouri By Howard B Graves Jr Pp iii 111 164 Saint Louis Mo Academy of Science) [246

Smithsonian Institution Proceedings of the U S National Museum Vol 85 No 3038 A New Genus and Two New Species of Cottoid *Fishes from the Aleutian Islands* By *Leonard P Schultz Pp* 187 191 (Washington D C Government Printing Office) [246

Proceedings of the American Philosophical Society Vol 79 No 1 Geophysical Exploration of the Ocean Bottom Symposium arranged by the American Geophysical Union held at the American Philosophical Society November 20 1937 Pp 144+4 plates (Philadelphia American Philosophical Society) [246

Catalogues, etc.

Catalog and Price List of Eastman Organic Chemicals 29th edition Pp 124 (Rochester N Y Eastman Kodak Company)

Priced Catalogue of B D H Laboratory Chemicals Pp 204 (London British Drug Houses Ltd)

The Revival of Learning European Scholarship in the XVth and XVIth Centuries Biblical Linguistic and Historical Studies the Neo Latin Poets (Catalogue 49) Pp 76 (London E P Goldschmidt and Co Ltd)

Protamine Insulin (with Zinc) Suspension—Boots in the treatment of Diabetes Mellitus Pp vii+18 (Nottingham Boots Pure Drug Co Ltd)

Catalogue of the Library of the late W J Sollas LL D, Sc D chiefly on the Subjects of Geology Anthropology, Ethnology Palæontology and kindred Sciences, including a number of works on Sponges (No 273) Pp 24 (London Dulau and Co, Ltd)

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Science and Government

A LECTURE entitled "Science and Government", recently delivered to the Royal Philosophical Society of Glasgow by Prof. J. Graham Kerr, raises questions of the widest concern. Its theme is the utilization of science in the interests of the community and the inculcation of scientific methods of thought into governance – matters outside the sphere of party politics. Prof. Graham Kerr is a believer in democracy and prefers our bureaucratic system to that of totalitarian States; the former is slow in action but flexible, while the latter, though more speedy in action, has a certain rigidity, and its dependence on the ability and principles of the individual renders it liable to a sudden collapse. He compares the bureaucratic machine to an organism. Its increase in size contains its own elements of danger in the development of a longer and longer chain of organization, which is liable to have weak links and thus to break down under strain.

It is unquestioned that the organized modern State depends on the successful applications of science, alike to the feeding, motility, health and recreation of the whole population, as well as in securing the safety of the community from foreign aggression. The development and efficiency of services in these matters are the sole concerns of several ministries. The business of their executive officers is, for the most part, the application of regulations in their different spheres, but secondarily they have to advise the ministers responsible to Parliament. As the higher departmental staffs consist of individuals generally chosen for ability by examinations in which science, being unprofitable, is a subordinate subject, ministers can scarcely rely upon their advice in major concerns; if capable of understanding, they have not the time—perchance, the inclination—to keep abreast of the advances of science. Hence the institution of advisory committees, strongly endorsed by Prof. Graham Kerr on account of their "cold-blooded, judicial consideration" of questions placed before them.

The personnel of these committees, having been properly selected, must subject the ministers to no "fussy interference", while, above all, a ministry must in its turn try neither to persuade nor to bring pressure by raising purely administrative or political difficulties. As a general principle, it is suggested that every administrative ministry, civil and military, should have its own advisory committee, and examples of the success of these committees are given. In all cases where a ministry has its own scientific department, it should help its members to discuss their scientific problems with colleagues whose activities are more concerned with the fundamentals of science. In the modern civilized State, however, all these matters depend ultimately for their success on the general educational system, which is considered by Prof. Graham Kerr to demand a thorough overhaul as a matter of national concern.

Considering the topic 'science and government' more widely, we regret that Prof. Graham Kerr did not let his thoughts wander to the Empire. The Dominions have made considerable advances in education by the evolution of new technique and the development of almost new subjects—and in most of their interests they have independent experts upon whom they can call for advice. The Colonies have practically no experts apart from those commercially and personally concerned. Colonies represent earlier stages in the evolution of civilized States and independent democracies than do Dominions Their environmental conditions are obviously immature Health is all important food has to be produced perhaps new foods introduced transport should be easy luxuries from abroad must be balanced by excess production culminating in exportation and lastly all questions concern at least two races of man in each colony Here as in the home State success depends on experts between them capable of applying each branch of science More often than not these experts are private individuals who risk their wealth in practical business an excellent arrangement provided that this business is kept duly subordinated to the interests of the colony

The executive officers of a colony have to devote their energies to keep the machinery of government smoothly running and to this end have now some training enabling them to consider the interrelationships of races living together How far are these individuals largely chosen for their informative and cultural education capable of dealing (for example) with food production and perchance the reports of specialist officers if they themselves are ignorant of the basal methods employed in such work ? Obviously governors of colonies scarcely belong to the present age but how many of their executive officers have been trained in the methods of science ? What value is placed on such knowledge in their selection ? In the probationary period before proceeding to colonies what time is devoted to training in the scientific method if the individual is chosen for other sides of learning ? In other words have the methods in the governance of the Colonies kept pace with the scientific evolution of the last decades The Colonial Office alone has the information necessary for reply In democracy colonies must be held by the consent and goodwill of the governed and the Empire demands an efficiency of management leading through prosperity to a permanency of union

Lastly from our point of view the payment and pension problem has long been a matter of concern the conditions in the scientific services being inferior to those in the administrative In a statement to Parliament* the Colonial Office appreciates the necessity of a Standardisation of Conditions which since a uniform pension rate has been laid down as suitable for officers of the unified Services can only mean a gradual rectification of a grievance of scientific workers This is a necessary step to secure the best recruits for the scientific services the training for which is long and intensive and in which only men of high ability are required The Colonial Office thereby attains a liberty of action which previously it could not exercise No longer need it transfer an officer who has made an intensive study of the scientific problems of one colony to a post in another thus promoting him while rendering his study nugatory If the Colonial Office requires he can now be called upon without injustice to identify himself with the particular colony in which his success and perhaps affection lie The old system of promotion solely by transference was often unsuited to the scientific services and made permanency in any colony a sign of ineffectiveness

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* The Colonial Empire in 1937 38 Statement to accompany the Estimates for Colonial and Middle Eastern Services 1938 (Cmd 5760) Pp 79 (London HMSO) 1s 3d net

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Principles of Factorial Experiments

The Design and Analysis of Factorial Experiments
By F Yates (Imperial Bureau of Soil Science Technical Communication No 35) Pp 96 (Harpenden Imperial Bureau of Soil Science 1937) 5s

THE publications of the various Imperial Bureaux are necessarily of very unequal scientific value and naturally also, appeal to very different bodies of scientific workers Their format and presentation are not such as to excite an expectation of material of wide interest Thus the reader who encounters first in large letters Imperial Bureau of Soil Science and then the somewhat repellent caption Technical Communication No 35 is not well prepared for the exceptional interest of the material presented by Mr Yates in the monograph under notice It should therefore be stated at once that this particular publication has been awaited eagerly by experimenters in all parts of the world and that in providing not only a much needed compendium of well established designs but also the practical solutions of a number of the problems outstanding it will more than justify the expectations that have been formed

For at least a century experimenters have felt the need, and have frequently attempted, to incorporate two or more factors in the same experiment Two of the classical fields at Rothamsted, dating from 1852, are such attempts Unfortunately, they did not know how to reap the great advantages of such arrangements, without incurring even greater drawbacks A long history, involving on one side the experimental exploration of the nature of the experimental errors , on the other, the gradual development of adequate statistical techniques , and, finally, the recognition of the conditions upon which the mathematics could be made applicable to the experimental facts, lay between the aim and its fulfilment It is the knowledge acquired in this long process, and the changes in point of view which this knowledge has induced, that have brought factorial experiments to the fore Designs formerly felt to be extravagant, or dangerously ambitious, are now known to be demonstrably more economical in time and money than any available alternatives They require, however, careful planning and foresight When high precision is aimed at, they may be very intricate Their statistical reduction will defeat the novice who has not studied the subject Only those who feel that this is too high a price to pay for efficiency and comprehensiveness will be tempted to ignore the opportunities which the work of recent years has revealed

Of the seventeen sections, the first is introductory It contains a clear brief statement of the purpose of the memoir The next two sections deal with a three-factor experiment with eight experimental combinations, this useful type serving excellently to illustrate the notation for the recognition of particular components The scheme of progressive sums and differences (p 15) is an especially valuable feature, and will save much tedious calculation

Confounding and partial confounding are introduced in Section 4 with the same example The real advantages of partial confounding, however, only appear in the following section with the discussion of general 2^n designs, that is, of the simultaneous use of n factors at two levels each The reader should note the elegantly balanced sets of confounded components for experiments with thirty-two combinations in blocks of eight, or of four (p 25) A practical example of confounding thirty-two combinations in blocks of eight, shows a gain of more than 48 per cent in the precision of the components conserved Since the loss is only one fifth in the interactions of three or of four factors, even the components partially confounded would in these circumstances have 19 per cent higher precision than without confounding

The treatment of factors at two levels only is completed in Section 8, with a highly original series of designs for confounding in Latin squares This is an idea which considerably influences the later sections In the introduction it is suggested that the loss of precision which, prior to the introduction of confounding, used to accompany the simultaneous testing of large numbers of treatment combinations, was due principally to the necessity of abandoning the Latin square It is therefore of importance that 4 × 4 and 8 × 8 squares can be used very efficiently A wide choice of designs is available, and the section will repay very careful reading

With Section 9 we come to the use of factors at more than two levels The section is excellently planned to give the reader an adequate background for the application to these more complex problems of the many devices already applied to factors tested at two levels only The most difficult sections are devoted to these Especially valuable is the notation for the interactions of a number of factors at three levels, the understanding of which greatly facilitates the appreciation of the later designs

A point of very general interest emerges in the last section The great difficulty of factorial designs, which the previous sections have shown how to overcome, lies in the large number of combinations which need to be compared The technique of confounding and partial confounding, in answering this difficulty, incidentally shows the way to deal with the typical problem of practical plant improvement, where the geneticist is faced with the testing of a host of promising segregates obtained from crossing. In the quasi-factorial designs these are treated *as if* they were the combinations of two or more 'factors , and in this way a large number n of varieties may be tested in blocks of only $n^{1/2}$ or $n^{1/3}$ plots This represents an enormous gain in practical efficiency , won, in this case, at the cost of some complexity in the statistical treatment of the data Triple lattices based on the Latin square ought to be much more widely used when their advantage is appreciated, and when high replication is available the balanced lattices or 'balanced incomplete blocks' provide a type of experiment in which all comparisons are of equal precision (whereas with the unbalanced lattice they are slightly unequal), and the computations are correspondingly simplified

The lattice square is a beautiful application of the same principle using the elimination of rows and columns (Latin square) in place of only the elimination of differences between blocks To compare forty-nine varieties with only four replications in four Latin squares of which the eight subdivisions by rows and columns form a mutually orthogonal set, is an achievement astonishing in its simple ingenuity The last section in fact is all too short and might perhaps have been given space at the expense of Section 16 devoted to split plot designs Every possessor of the monograph at least ought to examine in relation to his own problems the possibilities of this last section

The details of the arithmetical analysis are given throughout so that no experimenter need hesitate to apply even an intricate design if it appears to suit his requirements for fear that the data obtained will prove unmanageable

R A FISHER

Atomic Realism

The Renaissance of Physics
By Dr Karl K Darrow Pp viii + 306 + 17 plates (New York The Macmillan Company 1936) 12*s* 6*d* net

DR DARROW'S capacity for making rough places smooth is well known and is admirably shown in this popular exposition of modern advances in physical science For the most part he has chosen to be guided by the motto which Kamerlingh Onnes proposed for physics *Door meten tot weten* through measuring to knowing — a phrase that carries one back to the fifty year old pronouncement of Kelvin that it is not until you have measured a physical quantity that you can really begin to say you know something about it There is room for very pretty argument in both statements the shape of the earth—sphere spheroid ellipsoid and finally with a gesture of despair geoid—has become more elusive as precision of measurement has increased but that may be let pass for the nonce

It is a fact that a great many popular expositions of modern physics concern themselves more with the presentation and discussion of results than of methods and the inquiring layman thereby loses some entrancing stories of experimental technique and possibly gains some very warped notions of the manner in which the experimenter has arrived at the astonishing conclusions of the last generation Indeed some of the popular expositions leave one with the impression that the subject has just growed and give not an inkling of the experimental methods that lie behind it all Dr Darrow's book is a wholesome corrective of such views He has an eye for the essential in a physical experiment and the intelligent reader will rise from the perusal of this work with some knowledge not only of what has been done but also of how it has been done

It is needless to attempt to define the scope of the book with any fullness of detail It is sufficient to say that waves and corpuscles and the structure of the atom are topics which are discussed at length when and only when the reader has been given a sound grounding in the relevant parts of the elements of classical physics and the grounding is none the less thorough even though the work is almost entirely devoid of mathematics It is significant however that the name of Heisenberg and the terms uncertainty and indeterminacy do not appear in the index

It is with mild regret rather than surprise that one finds Dr Darrow in the ranks of the atom seeers (not *seers* which is another matter) He directs our attention to the observer who marking a luminous trail in the sky says I see a shooting star and makes a parallel between that experience and the experience of him who observing a trail on a photographic plate exclaims I see an atom—or a sub atomic particle Moreover he reminds us that as lately as 1909 a brilliant and distinguished man could print Atoms like molecules are fictions The language of chemists has become so saturated with the phraseology of the atomic and molecular hypotheses that we speak in terms of atoms and molecules as if they were objects of immediate observation It must be reiterated therefore that this language is figurative and is not to be taken literally
Strange words indeed to be published in 1909 and re read in 1936 !

Yes and they may very well be compared with the words of Lord Kelvin written but a few years earlier than 1909 in which he avers his belief in the reality and substantiality of the luminiferous ether The fate of that avowal might well give pause to the enthusiastic atom realists of the nineteen thirties

It does seem that in these matters the man of science is permitting himself to become something of a pseudo philosopher and to confuse the model with the reality Indeed much of the trouble centres on the use and the misuse of the term real If I sum up a number of sense data in the expressions This is a table and This table is *really* solid I am using words in a commonsense way to which I apprehend no metaphysician would take exception But it is a different and much more debatable matter when I proceed to say This table is *really* made up of a cloud of sub atomic particles and for the most part is *really* empty space" We are now, in our use of the word 'really' adventuring into philosophic regions of thought and, though it is perfectly true that we may advance through science into philosophy, it is also true that philosophical studies are as technical in character as physical studies and, lacking that technical knowledge, the man of science may find himself suffering a sea-change into a half-baked metaphysician

Atom, ether, quantum-mechanical model all these dwell in a conceptual world which we build up to imitate, as closely as may be, the happenings in the world of sense-data in which we move and live We perceive some such event as a column of mercury in a barometer tube, the 'slow-decaying oscillations' of a torsionally-suspended disk in air, certain groupings of the weights on a balance pan which record the results of a chemical reaction, and we find that the concept 'atom' in our model world best correlates these happenings in the world of perception The atom does not come one whit nearer reality, using that word in the way originally defined, if we add to our perceptions that of, say, a streak on a photographic plate, or a flash of light on a phosphorescent screen This is not to say that a concept can never become a reality in the perceptual world—some miraculous change in the scale and powers of our being may bring the atom into the region of direct sense-perception, but until that happens, talk of its reality is just irrelevant Moreover, when concept becomes percept, it is more than likely that some other feature will be added to the conceptual model to account for the new set of facts in the world of perception

This considerable digression must, however, not be interpreted as conveying any fundamental criticism of Dr Darrow's delightful book, which is one of the best and most stimulating of the popular reviews of modern physical science that has appeared during recent years

A F

Planning of Social Progress

The Middle Way.
a Study of the Problem of Economic and Social Progress in a Free and Democratic Society By Harold Macmillan Pp ix+382 (London Macmillan and Co, Ltd, 1938) 5s net

THOSE who weary of the puerile aspects of party politics, and think that the 'something rotten' in the State is its economic structure, will welcome this thought-compelling book with its major premise that social changes are ineluctable but amenable to human direction Fully cognizant of the value of co-operation and of public ownership or control of certain essential services, the author lays down some fundamental rules for peaceful progress along a middle road between socialism and capitalism, which should ensure the safety of democracy and lead ultimately to the highest degree of individual freedom compatible with the general good

The first rule is to mitigate poverty and to banish that great scourge of civilization—economic insecurity and the fear of it There must be a minimum standard of living, attainable through a legal minimum wage, higher unemployment benefits, and certain family allowances, and to meet the extra cost of these, industries and services must be made more efficient, a few more of them put under public control, and the whole integrated and rationalized Private enterprise and the free play of competition are desirable in young and expanding industries, but after that stage co-ordination by the industries themselves, with proper safeguards against monopolistic abuses, becomes necessary, and eventually certain key industries are best transferred to public ownership Coal, power, transport, a central bank, investments, foreign trade, and essential foodstuffs (including purchase and distribution of milk and other dairy produce, bread, sugar and potatoes) would all in time come under public control, each being managed by a special board in consultation with and supervised by a national economic council

The above represents but a *coup d'œil* over the vast field covered by this book, which is of remarkable value and free from obvious bias or error (except *grains* for *grams* on page 40). Study of it, however, leaves a doubt whether such reforms would be properly implemented, and if so, how long they would endure, in an acquisitive society ruled largely by individual self-interest Lasting success would seem to demand an enlightened outlook, which might be achieved by drastic changes in educational methods Youth must be served that health and "joy through work" be attained, not by means of mass suggestion, dogma and violence, as in the totalitarian States, but by inculcating freedom of thought and expression, reason and persuasion Economics *and* education are the two vital fronts on which the citadel of human discontents must be attacked E H T

Physical Chemistry of Textile Materials

Kolloidchemische Grundlagen der Textilveredlung
Von Dr Emmerich Valkó Pp xi+701 (Berlin Julius Springer 1937) 60 gold marks

IN this book Dr Valko gives a remarkably comprehensive account of the present position of physico chemical investigation in relation to many aspects of the manufacture of textile materials The title is perhaps not altogether fortunate since the scope of the book is wider than it suggests Moreover the author is well aware that modifications of the physical characteristics of the various textile fibres are *fundamentally* determined by the chemical nature of the sub stances composing them and he also recognizes that nothing is gained by simply labelling obscur ities in behaviour as colloidal phenomena

The first chapter consists of a very useful de scription of the chemical constitution and mole cular and crystalline structure of cellulose wool keratin and silk fibroin It includes an able critical review of the results obtained from attempts to estimate the chain length of cellulose molecules In Chapter iii an interesting account is given of the arrangement of the molecules in cotton wool and other fibres as deduced from their optical and mechanical properties and from their behaviour in the diffraction of X rays the absorption of liquids and in other respects Evidence for the existence of structural units in the form of sub microscopic molecular aggregates (micelles or more specifically crystallites) is presented in a judicious fashion In particular it is emphasized that optical and mechanical anisotropy of the fibre cannot be regarded as direct proof of the presence of crystallites Chapter iv deals with the sorption of water by the fibres and the consequent alteration in their dimensions and mechanical properties The nature of the sorption process is fully discussed in the light of the available informa tion due weight being given to the data obtained in studies of the heat of sorption sorption hysteresis and the specific volume of the fibres

Chapter v is devoted to the consideration of the chemical and physical behaviour of wool and silk when treated with solutions of acids and bases and Chapter vii deals with various aspects of the mercerization of cotton While clearly explaining how the principles of the Donnan membrane equilibrium may be operative in the swelling of wool silk and cellulose the author is careful to indicate the limitations of the osmotic theory In reviewing work on the absorption of alkali by cellulose Dr Valkó appears to have overlooked an investigation by Hibbert and co workers (1930) which provides further evidence in favour of chemical combination in equal stoichiometric proportions The degeneration and activation of cellulose and the modification of wool by the action of chlorine and other reagents are con sidered at length in Chapters viii and ix Short chapters on the morphology and histology of fibres the electrokinetic behaviour of cellulose and the felting of wool complete the first half of the book

The next three chapters which occupy about a third of the book deal with the nature of aqueous dispersions of dyes the principles underlying dye ing processes and the behaviour of dyes when fixed on the fibres They form a particularly valuable feature of the book since the need for a summary of this kind has long existed It is frequently supposed that in the direct dyeing of cotton the dye is held in virtue of its colloidal condition Dr Valko shows that while this view is not supported by the results of recent work with purified dyes there is reason for postu lating an *indirect* connexion between the colloidal character of the dyes and their dyeing properties in the sense that the forces which produce associa tion of the dye molecules in solution are also responsible for their attachment to the fibre

An excellent account is given in Chapter xiv of the properties (including surface tension) of solutions of soaps using this term in its widest sense Recent developments in this field are described in detail since they are of special interest in regard to the elucidation of the state of the soap at the concentrations employed in textile practice In the following chapter interfacial phenomena and the stabilization of emulsions and suspensions are discussed in connexion with the wetting wash ing and impregnation of the fibres The greater part of the remaining chapter is allotted to the physical chemistry of starch solutions there being in addition short sections on gum arabic methyl cellulose and the processes of sizing and printing

The author designedly excludes consideration of purely mechanical processes and processes involved in the actual formation of artificial fibres Within the limits imposed however little of importance appears to have escaped mention Certainly full justice is done to the work of British investigators

The book should facilitate collaboration between specialists in the industries concerned and prove stimulating to all interested in colloid chemistry Though packed with information it is very readable as Dr Valkó maintains a lucid and agreeable style throughout The diagrams are very numerous and the book is well produced T R BOLAM

Historic Haunts of England

By Gwen Woodcock Pp xiii+368+48 plates (London Alexander Maclehose and Co, 1938) 7s 6d net

IN the phrasing of a bygone age, Mrs Woodcock combines instruction with entertainment In this companion to her volume on Scotland she has selected more than fifty places of interest scattered throughout England and has given her readers a bird's eye view of the salient features of the history of each Topographical and architectural details are strictly subordinated to elucidating the story This is told admirably in a graphic and succinct narrative without unnecessary ornament The author's interest is catholic, and she covers not only picturesque towns, such as Dover and Rye, Burford Beverley or York, but also castles great houses, such as Knole and Hatfield, and ruins and prehistoric monuments, Kenilworth, Avebury and Stonehenge Illustration is generous and excellent

Lest a necessarily brief account of a book containing much, but not an overload of detail, should convey the impression that it is no more than an excellent 'gossiping guide, it may be pointed out that from the author's judicious selection of incident and the frequent juxtaposition of a number of distinct narratives of events drawn from identical periods in time, certain general trends in the history of the English people emerge Such are for example the forces which welded the English a people of so diverse an origin, into one, or the development in the relations of nobles and people and the cognate matter of the divergencies in form and character of the English township and the origin of these divergencies, some towns being appanages of a great house such as Arundel and Warwick, others groupings of independent burgesses arising with the early growth of trade, commerce and industry as do the towns of the Cotswolds or the Cinque Ports which base their independence on the sea

(1) Wild Flowers in Britain

By Robert Gathorne Hardy (British Nature Library) Pp 120+104 plates (London B T Batsford Ltd, 1938) 8s 6d net

(2) Everyman's Wild Flowers and Trees

Five Hundred of the British Wild Flowers, Trees, Shrubs, Grasses, and Ferns, described and illustrated, 384 in colour after Sowerby's "British Wild Flowers", and 120 from line drawings by the Author By Miles Hadfield Pp vii+184+32 plates (London J M Dent and Sons, Ltd, 1938) 6s net

DURING the past few years there has been a spate of illustrated guides (not necessarily floras) to the plant life of Great Britain, especially the flowering plants Some have been scarcely anything but vehicles for artists' impressions of attractive flowers, while others have proved very helpful not only to the amateur naturalist but also to the professional botanist Now, therefore, in any new work on British wild flowers, we may feel justified in demanding some distinguishing features to warrant its publication

(1) In Mr Gathorne Hardy's book we see such features His ultimate aim is to instruct the amateur in the pleasures rather than the science of botany and he would be a very hardened reader who does not become captivated by the author's pleasing style of description He writes with such literary prowess and enthusiasm for his subject that the book makes good armchair reading Thus it might fail in its main purpose but it would be failure along the right lines because the book is so beautifully illustrated The photographs (many of them full page) are some of the best we have seen They have clearly been chosen with care from the work of the best living Nature photographers Mr John Nash's colour lithographs make an enchanting decoration to the whole work Botanists and all other Nature lovers should welcome this book as a distinctive addition to a subject rather over burdened in books

(2) Mr Miles Hadfield's book comes under a different category since instead of putting the beauty of plant life in his book he puts the layman reader in the way of finding it in Nature for himself The illustrations are useful for identification purposes only, but that was obviously intended The author's main aim is to extend the scope of the book to deal not only with herbs but also with trees, shrubs and ferns by omitting the rarer species which only the skilled botanist is likely to recognize The book opens with descriptions of classification and naming of plants, the structure of leaves and flowers, and means of identification This is followed by illustrated descriptions of five hundred plants, grouped in families A distinctive feature of the work is the consideration of the economic value of certain plants, garden relations and the meanings of the botanical names of plants The author is to be congratulated on the production of a really useful book

Clowes and Coleman's Quantitative Chemical Analysis

an Intermediate Text Book Edited and revised by Dr D Stockdale and J Dexter Fourteenth edition Pp xiv+617 (London J and A Churchill Ltd 1938) 18s

IN this new edition of a well known text book the type has been completely reset and a large part of the text rewritten Additions include accounts of the gravimetric and volumetric determination of aluminium and magnesium by 8 hydroxyquinoline, the colorimetric determination of aluminium, the use of the chromate radical in the determination of barium, lead and sulphates, ferrous phenanthroline as an internal redox indicator, a brief introduction to the use of ceric sulphate, and the analysis of cupro nickel by salicylaldoxime The book thus includes some well tried modern methods of analysis

The sections on the analysis of water, foods, oils and fats, and gas analysis have been retained, since although these subjects are now best dealt with in special treatises, the processes included provide very useful introductions for the senior student, and also enable the teacher to set alternative exercises in special cases The book is a thoroughly sound and accurate one and its continued popularity may be predicted

Vāgbhata's Aṣṭāngahṛdayasaṃhitā

ein Altindisches Lehrbuch der Heilkunde Aus dem Sanskrit ins deutsche ubertragen mit Einleitung, Anmerkungen und Indices Von Dr Luise Hilgenberg und Prof Willibald Kirfel Lieferung 1 Pp iv+64, Lieferung 2 Pp 65–128, Lieferung 3 Pp 129 192, Lieferung 4 Pp 193 256 (Leiden E J Brill, Ltd , 1937) 3 50 guilders each part

OF the early Indian treatises on medicine, that of Vāgbhata is one of the most important The author flourished at the end of the eighth century, A D , and although translations of his works have appeared, he seems to have remained to a large extent unrecognized and unknown He divides his matter into sections In Part 1, theoretical principles are considered, based upon the conception that The chyle, blood, flesh, fat, marrow and sperm are the seven bodily elements that may become corrupted Towards the end of this section, various surgical instruments are described and pictured—forceps, bone and lion forceps, straight and curved needles, saws, and others—all much like those used at present Certain surgical procedures are also described, such as methods for the removal of foreign bodies from wounds Part 2 deals with the physiology of the body, commencing with conception, pregnancy and birth, and Part 3 with the etiology of disease, discussing fever, coughs, respiratory affections and heart disease consumption and urinary troubles, abscesses and abdominal complaints

The translation appears to be a scholarly one, an attempt is made to convey the exact meaning of the original, and in order that there shall be no doubt the Sanskrit word is frequently given in brackets after its German equivalent Further, the various plants, etc , comprised in Vāgbhata s materia medica are identified so far as possible We await with interest the completion of the work

Aristotle

Parts of Animals , with an English translation by Dr A L Peck , Movement of Animals , Progression of Animals , with an English translation by Prof E S Forster (Loeb Classical Library, No 323) Pp v+556 (London William Heinemann, Ltd , Cambridge, Mass , Harvard University Press, 1937) 10s net

HERE is the Greek text, faced by excellent translations, of the three works of Aristotle of most interest to students in animal physiology, namely, Parts of Animals , Movement of Animals and Progression of Animals Dr Marshall s Foreword" sets the right key for the reader, namely, composition leading to function, first tissues consolidated into organs Aristotle is altogether charming , his method is that of science—and students and the dilettanti, who read, will be delighted The food of plants ' is already concocted before it enters them, and in return for it they yield their fruit and seeds" Horns on the head offer the least possible hindrance to the movements of the body in general "The Progression of Animals is quite a basal treatise for research, so popular to day, on the swimming and other movements of animals

The Sturge Collection

an Illustrated Selection of Foreign Stone Implements bequeathed in 1919 by William Allen Sturge By Reginald A Smith Pp viii+131+plates12 16 (London British Museum, 1937) 21s net

THIS volume, dealing with stone implements from foreign sites, completes the publication by the British Museum of the Sturge Bequest, the vast collection of stone implements bequeathed to the nation by Dr Allen Sturge, who died on March 27, 1919 The first volume by Mr Reginald Smith dealt with implements from sites in Britain , and in the volume now issued the same authority has selected a representative sample of the remaining implements Of these the greater number come from France, but other sites represented are in the various countries of Europe Asia Minor Egypt Africa north, east west and south, Palestine, India, the Far East and Australia The American section is regarded as ethnographical, and has been omitted

As the basis of a scientific investigation, the collection suffers, according to the modern orientation of archæological studies, from lack of adequate documentation , but as a whole the assemblage of so vast a collection of specimens representative in type, is in itself of immense value Its use is facilitated by the succinct but admirable explanatory paragraphs which Mr Smith has prefixed to the descriptive notes on each group of specimens selected for illustration, these being arranged under sites on a geographical basis of distribution, taking Britain as its starting point The references to the more important literary sources for each site are in valuable as an *aide memoire*, as well as a guide

An alphabetical list of sites represented in the collection also serves as an index

Qualitative Inorganic Analysis

By A J Berry Pp viii+147 (Cambridge At the University Press, 1938) 6s

PERHAPS the main features of this book which distinguish it from many other excellent text books on qualitative analysis are (1) the inclusion of several so called rare elements (such as thallium, zirconium, vanadium and lithium) which are now less expensive and are also of scientific and technical interest, and (2) the inclusion of many modern reagents (particularly organic compounds) in the descriptions of the reactions of the radicals

After a short but commendably clear and instructive theoretical introduction, the book deals fully with the reactions of the metals in the order of the usual groups, with the reactions of acid radicals, with the systematic analysis of the metals, and with the examination for acid radicals The author does not approve of the use of analytical tables, so he omits them , many teachers will wish that they had been included The directions for group separations are, however, quite clear, and the disadvantages of turning over pages and getting more of the book stained by reagents may be outweighed by some advantages which are not very clear to the reviewer

Antarctica and Glacial Ages

By Prof. E. W. MacBride, F.R.S.

THE effects and causes of glacial ages have been discussed from many points of view—'observational and theoretical—and the meteorological aspects of the problem were very clearly presented by Sir George Simpson in his Royal Institution discourse published as a Supplement to NATURE of April 2 What is said in the present article may be regarded as complementary to Sir George's survey of the subject, the point of view being that of a zoologist and palæontologist instead of meteorologist or astronomer In the collection of the facts embodied in the article, I have had the advantage of help generously afforded me by Dr Stephenson, geologist attached to the Graham Land Expedition, and by Prof W W Watts

If we desire to know what a glacial age was really like, the obvious course is to study a part of the world where such an age is still in existence Greenland and Antarctica are two such regions, but Antarctica is preferable to Greenland because it is of continental size Antarctica is roughly circular in outline and has a diameter of 3,000 miles Its area thus works out at about 7,000,000 square miles The maximum height of the continent is 3,168 metres or about 10,000 feet This is situated about 200 miles north of the south pole

The whole continent is covered with a huge ice-sheet through which only the highest peaks protrude as two volcanic cones, Mounts Erebus and Terror The part so far principally studied is that directly south of South America, in which lies the inlet known as the Ross Sea The length of the ice-sheet known as the Beardmore Glacier flowing into the Ross Sea is about two hundred miles, but it joins the great barrier ice-shelf which extends several hundred miles farther out to sea and from the outer edge of which great tabular icebergs are constantly being cut off If we add the breadth of the ice-shelf to the length of the Beardmore Glacier, we arrive at a total extent of ice-flow of about five hundred miles, and this is considerably longer than any glacier the existence of which we have evidence in the Pleistocene Glacial Age From the evidence of erratics carried on the glacier, Dr Stephenson has been able to make a rough guess as to the nature of the geological formations buried beneath it. Rocks of the Gondwana age, with coal-seams carrying characteristic fern plants, are present the Gondwana age is usually described as Permo-Carboniferous Beneath it are folded schists of the Pre-Cambrian or Huronian age

Now, rocks of Gondwana age with the same characteristic fossil plants are found also in the Deccan of India, in South Africa, and South America, and it is evident that all four areas formed parts of a southern continent for which the name of Gondwanaland has been adopted. It is clear that this continent during the early part of the Gondwana age enjoyed a mild climate and hence must have been situated a considerable distance from the pole, but later it underwent a severe glaciation known as the Gondwana ice-age. Antarctica, however, which formed part of this continent, entirely escaped this glaciation We conclude, therefore, that during this period the continent must have drifted across the south pole but that Antarctica, which formed part of its northern edge, escaped this glaciation. The drift then must have originated to the south of Australia, and as Australia itself formed part of Gondwanaland, the drift must have begun after the breaking off of Australia from the rest

The point which we wish to emphasize is that this -the greatest ice-age of which we have evidence—was not due to the chilling of the atmosphere or of the sea but solely to the high latitudes into which Gondwanaland drifted Long ago Tyndall pointed out that to describe a glacial age as an age of cold was an entire misconception, for, he said, if we calculated the energy necessary to evaporate the enormous masses of ice embodied in the ice-sheets from the sea we should describe a glacial age as a period of greater heat—not cold What makes a glacial ice-sheet is the condition that in some part of the earth more snow should fall in winter than can be melted in the following summer For this condition to be fulfilled not only must there be intense local winter cold but also an abundant supply of atmospheric moisture. These conditions can be well studied in Canada in which I had the good fortune to live for twelve years In Montreal the average winter snowfall was six feet on the level. drifts up to depths of fourteen feet were common It was an ordinary experience to travel on ski or Indian snowshoes over the tops of buried fences. The ground under this snow-sheet was practically unfrozen. In contrast to Montreal the snowfall at Winnipeg was less than a foot and the ground beneath was frozen to a great depth and to this circumstance Winnipeg owed its magnificent wheat crops As the spring began the surface layer of the soil melted and the wheat grains pushed their radicles into this layer As the sun grew stronger the wheat roots grew longer and everywhere they encountered a reserve of water in the freshly melted ice of the soil

How narrow was the margin which separated Eastern Canada from the inception of a new ice age may be gathered by the following observations which were made by me During the whole of one August the back gardens of many Montreal houses were encumbered by vast masses of unmelted snow Now the first snow of the winter is expected on November 1 and considerably before that period there are hard ground frosts at night Even in September nights frosts occur so that if in this particular autumn these frosts had been a little more continuous a considerable portion of the August snow drifts would have survived into the winter and thus the formation of a new ice sheet would have been begun

Up to about 1880 the Pleistocene glacial age was the only one of which we had any geological evidence When at last the conviction was forced on geologists that there had been a severe ice age in Permo Carboniferous times the usual result followed there was a wild scamper on the part of enthusiastic pioneers to find ice ages in all periods of the world s history Such ages were discovered in Cambrian Ordovician Silurian Jurassic and Cretaceous times and a fearful mess was made of glacial chronology The pioneers always forgot that the ultimate cause of ice ages was not the chilling of the atmosphere but greater evaporation from the sea As the movement of an ice sheet produces a mixture of thick clay with large stones which easily becomes a conglomerate with lapse of time it was easy to suggest a glacial origin for all the conglomerates which recur in the stratified series If however glacial ages are due to the drift of land into high latitudes then this drift must be somehow the result of the rotation of the earth and must follow an orderly course we cannot at will ferry lands over sea and back again in order to satisfy our theories

There seems however to be a consensus of geological opinion that there was a Pre Cambrian ice age The best evidence for this in fact the only indubitable evidence is found in Canada In the Temiskaming region of Northern Ontario where the Huronian strata have been exploited for the world famous silver mines of Cobalt a conglomerate with large boulders has been found But these boulders when extracted from the mother rock are found to have smooth surfaces marked by parallel striæ exactly like those found on boulders in the Pleistocene boulder clay or for that matter in the moraines of recent glaciers Their glacial origin is therefore definitely proved Other records of Huronian strata from other parts of Canada showing evidence of ice action are almost certainly fragments of the same deposit

That there has been a northerly drift of secondary rocks since Permian times is shown by Old and New Red Sandstone beds of Europe and eastern Canada The red colour of these sandstones is due to grains of laterite but laterite is a degradation product of granite and is only found in tropical regions At the present day its formation is going on amongst the granite hills of Nigeria

Whilst the Gondwana ice age was raging in the south contemporary beds in Spitsbergen show evidence of a warm tropical climate There are beds of coal with fossil plants showing evidence of a rich tropical flora

We have seen that drift into high latitudes affords a complete explanation of all glacial phenomena previous to the Pleistocene When however we approach the consideration of the pleistocene glacial age we find that this explanation is no longer applicable The Pleistocene glacial deposits are represented both in the northern and the southern hemispheres and were therefore contemporaneous all over the world Further in the Pleistocene glacial ages alone do we find evidence of long continued interruptions of glacial activity During these interruptions stratified beds were laid down containing plants bones and shells bearing testimony to a comparatively mild climate There seem to have been at least four periods of intense cold separated by milder inter glacial periods The cold periods were named by Penck the Gunz the Mindel the Reiss and the Wurm The most interesting thing about these periods is that the bones and tools of the oldest indubitably human race are found in the interglacial interval between the Wurm and the Reiss periods

Since the Pleistocene ice period was world wide its cause must be sought outside the south in the sun If as we have already stated the primary cause of these periods is an increase in evaporation from the sea there must have been increased radiation from the sun Now some of the irregularly recurrent phenomena of the sun are sun spots These are solar cyclones of enormous dimensions and are associated with intense radiation They are connected with the well known magnetic storms and with displays of aurora borealis If then during a period extending over several million years there were frequently repeated increases in solar radiation, we should have increases in evaporation from the sea and consequent increases in precipitation in the colder regions of the earth The interglacial periods would be associated with few sunspots and reduced evaporation and precipitation During them the glaciers would gradually shrink, exposing great masses of boulder clay which would be washed away by the melting ice and deposited as thin bands of sand and clay elsewhere Visitors to Switzerland who have noted the milk-white appearance of the Upper Rhone during the summer months will need no further reminder of the nature of the water issuing from the foot of a melting glacier

Coleman, in his book ('Ice Ages"), mentions the continental drift theory but withholds his assent on the ground of the colossal forces necessarily assumed, which he holds to be incredible But, as Sir Thomas Holland has pointed out, there is no possible escape from the conclusion that the tearing asunder of primitive continents and their drifting apart really did take place Actually Greenland has been caught in the very act of drifting A Danish observer, Oersted, has measured the change in longitude of a station in the extreme south of Greenland between the years 1922 and 1932 The amount determined was 600 feet, that is, 60 feet a year If we calculate back 100,000 years, we find that Greenland must have then been lying close to Norway Now from observations on the annual layers of silt deposited every summer by the streams fed by the melting ice, it has been ascertained that it is about 13,000 years since an ice-sheet covered the whole of Sweden The great Wurmian glaciation may have lasted 100,000 years to judge from the enormous extent of the boulder clay which it produced On the west coast of Wales the clay and boulders carried by this ice-sheet which had crossed the Irish Sea were piled up to a depth of 200 feet A period of 120,000 years would carry us back into the interglacial period between the Reiss and the Wurm glaciations—the time indeed when Neanderthal man flourished

When the exposed boulder clay became dried out it broke up into dust, and this under the name of 'loess' was blown about by the wind In central China this loess is piled up to a depth of hundreds of feet A similar degradation of soil into dust is taking place in North America

We must conclude with a few words about the bearing of these climatic changes on evolution. What changes the Pre-Cambrian ice-epoch produced in life we do not know, but the researches of Prof D M S Watson and Dr R Broom on mammals prove that the growth of cold-blooded reptiles into warm-blooded mammals began directly after the Gondwana ice-age During the Miocene epoch a continuous forest stretched across the Old World from the shores of France to the coast of China Bones and skulls show that this forest was inhabited by the higher apes, the direct precursors of man , but in Pliocene times a northern drift of the old Africa and the Deccan of India began which, impinging on the tableland of central Asia, raised up the enormous barriers of the Himalayas and associated mountains and in Europe the Alpine chain

Thus the ape population was cut into a northern and a southern group the latter continued to find its living in the forest, where remnants of it persist as the chimpanzees, gorillas, orangs and gibbons of to-day The northern group, however, had to face a more severe climate, the first beginning, in fact, of the Pleistocene ice-age The forest gave way to steppe and the apes had to change their habits to hunting on the ground, and primitive hunting man was born

Thus there would be much truth in the epigram . the Gondwana ice-age produced the warm-blooded mammals, the Pleistocene ice-age produced man.

The Organization of Knowledge

THE unprecedented progress of science and its applications during the last hundred years has given rise to a flood of literature, the magnitude of which has dulled our senses into a sort of acquiescence About two thousand new volumes on scientific subjects are issued annually by British publishers, while the number of scientific papers published in a year throughout the world has been estimated to amount to three quarters of a million. A century ago, a scientific worker was expected and able to digest for himself practically the whole of the original literature of his subject. To-day it is with difficulty that he can keep abreast of a particular part of it, even with the aid of a new type of abstracting and indexing literature, which has been evolved specially for this purpose. If he would seek to know what discoveries, which might be useful to him, have been recorded in other branches of his own and different sciences, he must depend entirely upon such services

The need for the evolution of this new kind of library *aide memoire* is now universally recognized. Indeed, a terrifying sense of insufficient mental material is beginning to dawn upon the minds of a few individuals, particularly of those whose special interest lies in the domain of the applications of science to the benefit of mankind. For that is not knowledge which we do not know where to find. Nevertheless the present deficiencies and lack of organization in this new research service seem in danger of being overlooked, and the necessity of assembling and perfecting this mechanism of knowledge is not realized, although, perhaps, as much as fifty per cent of modern technical research could be saved if complete information as to recorded data could be made available.

We need to realize, as Mr. Maynard Keynes has expressed it, that "we do not even know what is to be known", and straightway to set about in earnest to organize a master key to the vast storehouse of recorded information. This is not a question of merely making bibliographies, but of providing a complete bibliographical service, so that anyone can ascertain immediately exactly what information has been recorded on every new question as it arises.

It was for the purpose of the solution of this important problem that the International Institute of Bibliography was founded by an international conference in Brussels in 1895. To this end the Institute has worked for more than forty years. The data concerning the problem have been ascertained, principles have been evolved, much progress has been made—progress which increases year by year. National sections of the Institute have been founded in many countries. The Institute has sought, with growing success, to link together all those—both institutions and individuals—whose interest lies in the collection, classification and dissemination of information. Last year at a World Congress on Documentation, held in Paris by invitation of the French Government, and attended by representatives of thirty Governments and forty international organizations, the Institute was recognized unanimously as the controlling international bibliographical organization, its federative character being expressed in the decision to change its name to International Federation for Documentation.

At this meeting it was decided to hold in England the Fourteenth International Conference of the International Federation for Documentation.

The British Government has extended its patronage, and Sir William Bragg, president of the Royal Society, has accepted the presidency. The chairman of the organizing committee is Dr. S. C. Bradford. The Conference will be held at Lady Margaret Hall, Oxford, on September 21–25, followed by final sessions at the Science Museum, South Kensington, S.W.7, on September 26. Advantage of the meeting being in England has been taken to include joint sessions with the annual conference of the Association of Special Libraries and Information Bureaux. Eminent representatives of every branch of intellectual activity have given their support to the Conference. Papers will be read by leading authorities from many countries. Successful as has been the work of the International Federation in the past, it has tended rather to confine itself to making more easily available the literature relative to the natural sciences and their applications. Opportunity will be taken of the forthcoming Conference to endeavour to secure greater collaboration with bibliographers in other fields, such as those of history, archive work and economics. Special attention to these subjects will be given in the papers to be read.

Among the hundred or more papers which have been offered to the Conference we notice the following: Grundsatzliches zur Frage der Vereinheitlichung und Normung auf dem Gebiete des chemischen Referatenwesens, by Dr. Maximilian Pflucke, chief editor of the *Chemisches Zentralblatt*; Bibliographical tools from the user's point of view, by Dr. J. Holmstrom; Le travail bibliographique internationale dans les domaines des études historiques, by P. Carron, director of the Archives de France; Archives in their relation to other forms of documentation, by Hilary Jenkinson, secretary of the Public Records Office; On the present state of documentation in Switzerland, by W. Janicki, past president of the Swiss National Section of the International Federation for Documentation; and The current German situation in the field of practical documentation, by Dr. A. Predeek, chief librarian of the Technische Hochschule, Berlin.

The titles of the papers to be communicated, together with full information concerning the Conference, are given in the preliminary programme, a copy of which can be obtained on application to the secretary, Miss M. Gosset, Science Library, Science Museum, South Kensington, S.W.7. The programme includes visits to some of the many interesting places in the neighbourhood of Oxford, together with other social functions, such as receptions by the Vice-Chancellor and the Mayor, and a Government banquet in the beautiful hall of Christ Church.

All who appreciate the vital importance of the organization of information will realize that the visit of this Conference to England provides a special opportunity of assisting in the discussion and development of a service which feeds the roots of intellectual progress.

Whales and Whaling

International Conference

UNTIL some ten years ago, modern whaling was conducted almost entirely from land stations, and the most important centres of the industry were in British territorial waters where suitable regulations could be enforced The development of the modern factory ship led to a great expansion of the industry in the form of unrestricted whaling on the high seas, and the operations extended over a vast area in the Antarctic The Governments of those nations most interested in whaling realized that unlimited hunting must eventually cause depletion of the stock and the collapse of the industry An International Conference was therefore held in June 1937, and an agreement was signed by representatives of the Union of South Africa, the United States of America, the Argentine, Australia, Germany, the United Kingdom, the Irish Free State, New Zealand and Norway By the terms of this agreement, measures were taken for the restriction of whaling, including the imposition of a minimum size limit for various species, the limitation of the Antarctic whaling season to three months, and, with minor reservations, the prohibition of pelagic whaling north of 40° S

In accordance with the recommendations of last year's Conference, a second Conference was held on June 14–24 last. The purpose of this Conference was to invite the adherence of other countries which had not yet acceded to the previous convention, to examine the results of the new regulations and to consider what further measures might be applied The following Governments sent delegates: Union of South Africa, United States of America, Argentine, Australia, Canada, Denmark, Eire, France, Germany, United Kingdom, Japan, New Zealand and Norway An observer also attended on behalf of the Portuguese Government, and the interests of Newfoundland were watched by the United Kingdom delegation

The Conference noted that although the provisions of the 1937 agreement had limited the scope of Antarctic whaling, it had not succeeded in checking the number of whales killed Indeed it appears that the number of whales taken in the 1937–38 season was approximately 44,000, which is about 10,000 in excess of the figures for the previous season This is partly attributable perhaps to the high price of whale oil last year. Had it not been for the agreement of 1937, a still larger number of whales would no doubt have been taken.

The new measures agreed to in this year's Conference are embodied in a protocol which amends the existing agreement, and the discussions and recommendations of the Conference are reported upon in a final Act The following are among the articles in the protocol

Factory ships are prohibited from taking Humpback whales anywhere south of 40° S for a period of a year There is evidence that the stock of Humpbacks stands in even greater danger than that of Blue whales, and the Conference considered a proposal for the world-wide protection of this species for a year Agreement to this could not be reached, since many land stations are largely dependent on Humpbacks Protection in Antarctic waters, however, is expected to save large numbers

Pelagic whaling is now totally prohibited in the Pacific sector of the Antarctic, south of 40° S. and between 70° W and 160° W This applies in the first instance for a period of two years Although whaling has not so far spread to these waters, it is known that the number of whales there is sufficient to be worth protecting Practical difficulties militate against the imposition of such a sanctuary in the established whaling grounds, but the new measure may at least act as a check on future expansion

The open season of three months in the Antarctic remains unchanged, as do the minimum size limits for the various species, but small concessions in size limits have been made for land stations where the whale meat is used as food for local consumption

The other articles of the protocol include a clearer definition of a land station (a point which provoked much discussion over the status of factory ships working in territorial waters) and minor amendments to some articles in the principal agreement

The Conference considered a resolution of the Whaling Committee of the International Council for the Exploration of the Sea in the following terms "The Committee, viewing with alarm the evident decline of the stock of Blue whales, is of opinion that nothing less than limitation of the total amount of whale oil which may be taken in any whaling season can be effective in preserving the stock of the whales from being reduced to the level at which it can no longer be the object of economic exploitation" It was felt, however, that at the present stage it would be impossible to reach agreement to such a measure which would involve fixing a global quota each year and arranging to cease all whaling when the quota was reached

Proposals for limiting the number of catchers attached to each expedition and for limiting the oil production of each factory ship were also abandoned on account of the difficulty of apportioning such restrictions equitably among the various expeditions

It will be seen then that the new measures agreed upon do not go very far but the first object of the Conference which was to secure the prolongation of the existing agreement and the adhesion of additional Governments has been achieved The principal agreement has been ratified by the Governments of Eire Germany Norway New Zealand United Kingdom and United States of America whilst Canada and Mexico have since acceded to it The Argentine is enforcing the principal agreement by executive decree and formal ratification is only a matter of time It is understood that ratification by Australia and South Africa has been delayed only by constitutional difficulties and the accession of France and Denmark is expected to follow The Japanese delegation informed the Conference that its Government was prepared to take steps to accede after the interval of a year and to observe the principles of the agreement as nearly as possible in the meantime This undertaking of the Japanese is regarded as of great importance since that nation is now operating on a large and increasing scale in the Antarctic

In the final Act it is recommended among other things that the Governments and the whaling enterprises concerned should do their best to encourage the development of whale marking as practised by the Discovery Committee

The question of holding a future conference is recommended for consideration in the light of developments N A M

Obituary Notices

Dr W W Campbell For Mem R S

By the death on June 14 of W W Campbell following that of G E Hale American science has suffered the loss of another astronomer who was also a foreign member of the Royal Society

William Wallace Campbell was born and bred on a farm in Ohio the date of his birth being 1862 He graduated in the University of Michigan in 1886 and the soundness of the academic training which he had then received is sufficiently attested by the nature of his later career A year or two were then spent as professor of mathematics in the University of Colorado after which he returned to the University of Michigan as instructor in astronomy In 1891 Campbell joined the Lick Observatory as astronomer The rest of his active life was connected for forty years with that institution and with the University of California Retirement came in 1930 and before his death he had made his home in San Francisco

Campbell became acting director of the Observatory on the death of Keeler and the appointment was definitely confirmed in the following year (1901) He had in an eminent degree that combination of qualities which is necessary for success in the head of a great observatory in an isolated situation and in this capacity he had the valuable support of his wife Elizabeth Ballard Thompson whom he married in 1892 There were three sons of this marriage all surviving He was also fortunate in finding a problem peculiarly adapted to his powers Keeler before turning to his classical researches on the nebulæ had pushed the study of the radial velocity of the brightest stars as far as was practicable by visual means Further progress required the introduction of photographic methods The circumstances on Mount Hamilton were exceptionally favourable but the technical problems involved in avoiding the effects of flexure and maintaining uniform temperature had to be solved by original devices Campbell developed great skill in dealing with the optical and mechanical problems thus presented and in the Mills spectrograph he achieved a classical design Chiefly by this instrument in conjunction with the Lick refractor the radial velocities of all the brighter stars within the reach of the Observatory were determined with high accuracy in the course of a few years To complete this new chapter in astronomy by extending the work to the whole sky an expedition was equipped and established at Santiago in Chile The effectiveness of this branch from its beginning at first under the leadership of Mr W H Wright is a proof that the success of Campbell's plans was by no means dependent on the famous Lick telescope

The Lick Observatory though it possesses a splendid equipment is generously maintained as a department of the State university but it has no endowment For all the expenses of the branch in Chile and the cost of additional instruments as the need arose Campbell had to rely largely on the generosity of wealthy friends of the Observatory among whom the late Mr D O Mills and Mr W H Crocker may be specially mentioned His conspicuous tact and persuasive qualities were clearly shown in gaining this necessary financial support

Eclipse expeditions occupied much of Campbell's time and thought In all he took part in seven

India (1898), Georgia (1900), Spain (1905), Flint Island (1908), Kiev (1914), Washington (1918) and West Australia (1922), where he obtained results confirming the theoretical value of the Einstein effect Apart from this, Campbell's main contribution was to the study of the flash spectrum by means of a spectrograph provided with a slit and moving plate, by which the height of the exciting elements in the reversing layer could be accurately recorded His preparations for an eclipse expedition were a model of organization

So conspicuous were these powers of organization and administration that Campbell was persuaded in 1923 to become president of the University of California a position which he retained until 1930 without giving up the control of the Lick Observatory These were years of notable expansion in the University, which is now perhaps the largest in the world having more than 15,000 students resident at Berkeley and a total enrolment with other local centres exceeding 24,000 After retirement from the University and from the direction of the Observatory in 1930 Campbell became president of the National Academy of Sciences (1931 35)

Campbell's astronomical writings will be found for the most part in the publications of the Lick Observatory His Elements of Practical Astronomy (1899) is an unpretentious work, which many students must have found useful His 'Stellar Motions , which was published in 1913, brings together in an attractive form that part of astronomy to which his own researches had made so large and important a contribution

In addition to numerous academic honours, Campbell received the gold medal of the Royal Astronomical Society in 1906, both the Lalande and the Janssen Medals from the Paris Academy of Sciences and the Bruce Medal in 1915 As president of the International Union of Astronomy in 1922 25, he presided over the Cambridge meeting of that body In the same year, 1925, he delivered the Halley Lecture at Oxford

The opening years of the present century witnessed a notable expansion in the methods and outlook of astronomy In this development Campbell played an outstanding part His character was energetic and forceful, and his successful career can be attributed to a perfect harmony between his considerable powers and the researches which the circumstances of the time led him to undertake An English fellow in the Lick Observatory cannot fail to add a tribute to his unfailing kindness, and the practical help which he was always ready to give His sense of duty was outstanding When, after recovering from the serious illness which brought his services to the University of California to an end, he became president of the National Academy of Sciences, he might have looked forward to an honourable period of comparative leisure at Washington But it was not to be The condition of national affairs led the Government to appeal to the Academy for help in a great variety of problems In dealing with these Campbell did not spare himself, with the result that these years of office, so far from bringing dignified ease, were perhaps even more strenuous than any in his busy life In him has passed away not only a great astronomer whose name will remain in the history of the science but also one who was no less conspicuous in the public service of his country H C P

Dr Alexander Galt

DR ALEXANDER GALT whose death at the age of eighty three years occurred on June 26, was appointed keeper of the Technological Department, the Royal Scottish Museum Edinburgh in 1901, the year in which the Department was founded He graduated at the University of Glasgow where he was a Thomson (Lord Kelvin) scholar in physical science, and a Donaldson scholar in natural science For eight years he was official assistant to Lord Kelvin in Glasgow University Among his publications were papers on physics and physical chemistry in the *Proceedings* and *Transactions* of the Royal Societies of London and Edinburgh He was external Examiner in Experimental Physics for degrees in Arts and Science in the University of Edinburgh in 1910–14

Soon after the Royal Scottish Museum came under the control of the Scottish Education Department, the new post of keeper of the Department of Technology was offered to Dr Galt The inauguration of this Department was really a reversion to the original purpose of the Museum founded in 1854 under the name of the "Industrial Museum of Scotland' Dr Galt had no previous experience of museum work, although he had the important qualifications of a large educational experience, a scientific training and a wide and intimate knowledge of science and its application to industry

While the work of organizing the Department was one of exceptional difficulty, it offered great opportunities to Dr Galt's creative abilities After careful study of the problem it was decided to illustrate, by means of models and specimens the great industries of general engineering coal mining, and the manufacture of iron and steel Other branches of science and industry were added later and the scope of the collections was extended

Under Dr Galt's personal supervision many very fine working models of engineering mining, and other interest were constructed in the Museum workshops, and added to the growing collections, which are to day of world wide repute

Miss Edith Stoney

THE British Federation of University Women has suffered a great loss in the death, on June 25, at the age of sixty nine years, of Miss Edith Stoney who, on the day of her death, had been elected one of its vice presidents Edith Stoney was a member of a distinguished Irish family of scientific workers , her father, an uncle and a brother all being fellows of the Royal Society, whilst her sister, Dr Florence Stoney, was one of the pioneers of X ray work in medicine

Edith herself was a mathematical physicist As a student of Newnham College in 1890–94 she took both parts of the Mathematical Tripos, being bracketed equal to the seventeenth wrangler in Part I She also had charge of the telescope at Newnham After leaving Cambridge she became head of the Physics Department in the London (Royal Free Hospital) School of Medicine for Women, a post which she resigned in 1915 to take up war work She joined the Scottish Women's Hospitals and served first in the Tent Hospital at Troyes where she put up and ran the X ray Department, and afterwards in Serbia, where the unit was ordered by the French authorities Later she became lecturer in physics at the King's College for Household and Social Science

Edith Stoney travelled considerably, and a visit to Australia convinced her of the need for visits from Great Britain to the Dominions She supported these views practically and generously by her gifts to the British Federation of University Women of research studentships in science to enable younger women graduates of the universities of Great Britain and Ireland, who were also members of the Federation, to go to these countries She was so pleased with the success of her first scholars in Australia and New Zealand that this year she gave a sixth studentship, this time to be held in South Africa, to which the award was made at a meeting attended by Miss Stoney only a week before she died The subjects of the studentships awarded included biochemistry, zoology (insect parasites) and botany It is learned that in her will she has left money to the Federation for the continuance of these Johnstone and Florence Stoney Studentships Her association with the Federation has been a great stimulus and pleasure to her fellow members, who will be deeply sensible of the loss they have sustained in her death

Prof. Rudolf Vondráček

By the death of Prof R Vondráček at Brno on June 12, Czechoslovakia has lost a distinguished chemist and technologist Vondráček began his career as a research worker in pure and applied chemistry whilst completing his studies under Prof Votoček at Prague, with whom he investigated the separation of certain reducing sugars by hydrazine Altogether he contributed about fifty original papers to Central European periodicals and he was the author of four text books

After a period spent in the laboratories of industrial concerns and during which his researches related mainly to analytical methods, Vondráček spent some time before and during the Great War as an examiner for the Austrian Patent Office in Vienna In December 1918 he returned to Czechoslovakia to take up the appointment as professor of chemistry at the Brno Polytechnic, a post he held until his death During this time he was twice dean (1920–21 and 1930–31) and he filled the office of rector during the session 1935–36

His most important researches are connected with a study of the corrosion of metals and with the chemistry and physics of fuel technology He made careful investigations into the calorific value of various fuels and directed attention to certain anomalies in fuel analysis such as the variation in the estimated water content, an apparently greater loss being recorded at 100° C than at 105° C He noticed, too, a 'time lag' in the absorption of moisture by coal

Prof Vondráček was an authority on the destructive distillation of fuels at low temperature, for the experimental study of which he used a bath of boiling sulphur He carried out analyses of the gases evolved by the Czechoslovak petroleum springs at Gbely and succeeded in removing carbon monoxide and unsaturated hydrocarbons from the gas which is used locally for lighting and heating Even his physico chemical researches had some bearing upon industrial technology Thus, almost his last work was a study of the binary systems of phenol with hydrocarbons He found among other things, that phenol is a suitable reagent for the separation of hydrocarbon mixtures being preferable to such means as nitration or bromination

He was a member of many continental scientific societies and was prominent in the activities of the Masaryk Academy of Work G D

Mr A W Shorter

We regret to record the death of Mr A W Shorter, assistant keeper in the Department of Egyptian and Assyrian Antiquities of the British Museum (Bloomsbury), which took place on May 31 at the age of thirty two years

Alan Wynn Shorter was the son of Mr Wilfrid Wynn Shorter, and was educated at St Paul's School and Queen's College, Oxford where he graduated in 1928 Before taking his degree he had for some time devoted himself to the study of Egyptology and more especially to the study of the religious beliefs and rituals of the ancient Egyptians, as set forth in The Book of the Dead On leaving Oxford in 1928 9 he spent a year working on the excavations of the Egypt Exploration Society at Tell el Amarna, and on his return to England he secured an appointment on the staff of the British Museum Here in the Department of Egyptian Antiquities he was able to continue his study of the material culture, arts and religion of the ancient Egyptian people He was the author of a number of popular books on these subjects, and also contributed to the publications of learned societies, specializing in the study of Egyptian papyri His principal contribution to Egyptology is a 'Catalogue of Egyptian Religious Papyri in the British Museum"

We regret to announce the following deaths

Prof R M Bird, professor of organic chemistry in the University of Virginia, on June 4, aged seventy one years

Dr B T Galloway, formerly pathologist in the U S Bureau of Plant Industry, on June 13, aged seventy four years

Sir Colin Mackenzie, formerly director of the Australian Institute of Anatomy, aged sixty one years

Mr H N Thompson, C M G, lately director of forests, Nigeria, on July 9

News and Views

R. L. Hobson, C.B.

MR. ROBERT LOCKHART HOBSON, keeper of the Department of Oriental Antiquities and Ethnography of the British Museum (Bloomsbury), will retire on July 20. Mr. Hobson, who was educated at St. John's, Leatherhead, and Trinity College, Cambridge, taking a first class in the Classical Tripos in 1893, joined the staff of the British Museum in 1897, when he was attached to the Department of British and Medieval Antiquities and Ethnography. Specializing in the study of ceramics, his early published work dealt with English pottery and porcelain, but later he directed his attention to the ceramics of the Far East, on which he became one of the first authorities in Great Britain, especially in the broader cultural aspects of the subject. His "Chinese Pottery and Porcelain" (1915) was followed by a number of volumes of both special and general interest, such as "The Wares of the Ming Dynasty" (1923), "The Art of the Chinese Potter" (1923) and "The Later Ceramic Wares of China" (1925), but his most considerable production was his authoritative "Catalogue of the Eumorfopoulos Collection" (1925–28). He was also the author of the official guide to the collections of Far Eastern pottery in the British Museum (1924). Mr. Hobson became deputy keeper of his Department in 1921, and on its reorganization some years later as the Department of Oriental Antiquities and Ethnography, was appointed keeper. He received the honour of C.B. in 1931.

Prof. R. V. Wheeler

PROF. R. V. WHEELER has been awarded the Melchett Medal for the current year of the Institute of Fuel. Prof. Wheeler will give the Melchett Lecture to the Institute at 3.30 p.m. on October 13, in the meeting room of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Non-members of the Institute who desire to be present at this meeting will be welcome. Prof. Wheeler has been for many years professor of fuel technology in the University of Sheffield. He is also the director of the Safety in Mines Research Board Experimental Stations in Sheffield and Buxton. Born in 1883, he was educated at Plymouth College, Plymouth, and Owens College, Manchester. He is a Dalton scholar and fellow of the University of Manchester. He is the author or joint author of many publications dealing with the constitution of coal, blast furnace coke, coal mining problems, scientific and technical papers on coal combustion and flame, besides being joint editor of *Fuel in Science and Practice*.

Pilgrim Trust Lectures

IN the annual report last year of the Royal Society, it was announced that the Pilgrim Trust had agreed to provide 250 guineas a year for six years for an annual lecture to be arranged jointly by the Royal Society and the U.S. National Academy of Sciences, and to be delivered alternately in London and Washington. It is now announced that the first Pilgrim Trust Lecture will be delivered in London on December 8, and the Royal Society has selected Dr. Irving Langmuir, a director of the Research Laboratory of the General Electric Company, Schenectady, as lecturer. The second lecture is to be delivered on April 24 of next year and the National Academy of Sciences, to which falls the task of selecting an Englishman as lecturer, has chosen Sir William Bragg. As Sir William emphasized in referring to the Lectures in his presidential address to the Royal Society last November, they present a unique opportunity for direct interchange of thought by leading men of science of the two countries, and the selection of Sir William to give the first lecture in the United States is both a well-deserved compliment and a gesture signifying approval of the views which he has expressed as to the functions of these lectures.

South African Protectorates and Transfer

A DEPUTATION representing the Committee on Applied Anthropology of the Royal Anthropological Institute has been received by Mr. Malcolm MacDonald, H.M. Secretary of State for the Dominions, in order to discuss the question of the consultation of native opinion with regard to the transfer of the Territories to the Union Government of South Africa. The deputation was introduced by Lord Onslow, who (as reported in *Man* of July) referred to the difficulty experienced by the Joint Select Committee on Closer Union in East Africa in understanding the point of view of native witnesses who appeared before it. A variety of points was discussed. Both Prof. B. Malinowski and Dr. Margaret Read, who have recently visited the territories, were in a position to emphasize the deep interest taken by the native population in this question. The latter indeed said that the subject was a matter of discussion so far north as Nyasaland while judging from her own consultations of native opinion, she urged that the traditionally recognized channels for ascertaining the opinion of the tribes should be utilized. This matter was also stressed by the Rev. E. W. Smith, who pointed out that as regards the Basuto a recognized organ for the expression of native opinion existed in the National Council, adding that their land was the matter on which they felt most deeply. Another matter of extreme importance which was mentioned by Dr. Margaret Read was the care that should be taken in the interpretation into native language of terms referring to political institutions. Mr. MacDonald assured the deputation that these points would be kept in mind in putting the issue before native opinion.

Protection of the Aborigines of Australia

THE series of three articles by Dr Donald F Thomson, reciting his experiences among the aborigines of Arnhem Land which appeared in *The Times* of July 5–7, will have been followed with close attention by all who desire a wider application of scientific methods in the approach to the problems arising out of the contacts of Western civilization and peoples of backward culture. A preliminary account of Dr Thomson's work appeared earlier and was noted in NATURE of January 8 (p 68). Dr Thomson, as he himself expresses it, was 'loaned' by the University of Melbourne to the Government of the Commonwealth of Australia to visit, establish friendly relations, and make an anthropological survey of the native tribes, who had been responsible for unrest and trouble in Arnhem Land in 1933. His expedition, as is now well known and as he records, was completely successful in getting into touch with tribes reputed unapproachable, and as a result of his investigations lasting over the two years 1935–37, he was able to present to the Federal Government a report in which he, as an anthropologist, suggested certain measures to be taken if this interesting and, in their way, attractive people were to be saved from degradation and extinction. That extinction is their inevitable fate, unless immediate steps for their protection are taken, is patent from Dr Thomson's alarming discovery that the number of aborigines in these tribes has fallen lower by far than was thought. Further, he was able to point to the grave injury which is being inflicted on the aborigines by well-meaning but mistaken philanthropy. A people who had established an equilibrium in the technique of existence in a country of difficult conditions are abandoning their traditional mode of life to obtain the inadequate benefits of a weekly ration and a few of the cast-off rags of civilization, to their irretrievable detriment.

DR THOMSON suggests as the immediate need of the situation the complete segregation of the aborigines on an inviolable reserve. The aboriginal reserves are in theory already 'out of bounds' for the white population, but in practice this has not been observed. He is also of the opinion that control of all aborigines should be handed over by the State Governments to the single control of the Federal Government. Dr Thomson was able recently to explain his suggestions in fuller detail than was possible in *The Times* before the Committee on Applied Anthropology of the Royal Anthropological Institute (as reported in *Man* of July). After analysing the causes of depopulation and alluding to the failure of missionary effort to turn the tribesmen into gardeners, he went on to suggest that the policy of complete segregation should be supplemented by a legal code adapted to native conceptions, the creation of a special native affairs service staffed by anthropologists, working as mobile patrols, and additional medical service. Further, that the system of segregation should be maintained until a constructive development policy has been worked out for those aborigines who are already detribalized.

An Expedition to North Rona

A SMALL expedition left the Summer Isles by Fishery Cruiser *Vigilant* for North Rona on July 11. Dr and Mrs F Fraser Darling of Tanera expect to spend six months studying the social behaviour and environmental influences on behaviour of the Atlantic or Grey seal, *Halichœrus gryphus*. Dr Fraser Darling has already published researches on the social life found in the red deer and in several species of birds. His work on the Grey seal began with a four months expedition to the Treshnish Isles in 1937. The gregariousness apparent in these seals is of patriarchal type and entirely different from the matriarchy of the deer herds and the communities of pairs which constitute breeding flocks of birds. Dr Fraser Darling's expedition is a private venture, but the cost is being defrayed in part by a fellowship from the Carnegie Trust and grants in aid from the Royal Society, the British Association, the Institute for the Study of Animal Behaviour and the Challenger Society. The Fishery Board for Scotland has co-operated generously in the all-important matter of transport. North Rona lies fifty miles north east of the Butt of Lewis and is a rock-bound islet of less than half a square mile in area. The Atlantic seal repairs there to breed in large numbers from September to November, and the island is also one of the few breeding places of that interesting nocturnal bird, Leach's fork-tailed petrel.

Engineers and International Affairs

IN his address to the North East Coast Institution of Engineers and Shipbuilders, when he received the diploma of honorary fellowship of the Institution on June 24, Rear Admiral G H Rock, of the Constructive Branch of the United States Navy, made special reference to the education of engineers and the participation of engineering organizations in international affairs. In educational circles in the United States, there has been an astonishing increase in the interest in such matters. All the leading nations, he said, are exporters and importers of education in its various forms. There are about 8,500 foreign students in the colleges and universities in the United States and an even larger number of American students are studying abroad. In the academic year 1936–37, 204 American professors were either studying or teaching in foreign universities, while at the same time in American colleges and universities there were 175 foreign professors. No professions are more concerned with international activities than those of shipbuilding and ship operation, and he suggested that institutions such as the North East Coast Institution should lend encouragement to the improvement in the education of naval architects and marine engineers, encourage successful professional men to assist actively in teaching, make more suitable arrangements for ensuring young engineers more reasonable opportunity for employment, and arrange for a more general exchange of students between Great Britain and the United States. Admiral Rock recalled that he received a part of his education in 1890–92 at the University of Glasgow, and he was then sometimes bewildered by leading articles in the *Glasgow Herald* which criticized the enrolment of foreign students in naval architecture and marine engineering. International co-operation, however, he considers, offers more of gain than of loss, in fact, gain for all with loss to none.

The Zeppelin Centenary

By the issue of commemorative stamps, the opening of a museum at Friedrichshafen and in other ways, Germany has been paying homage to the memory of Count Ferdinand Zeppelin of airship fame, the centenary of whose birth occurred on July 8. Born on the shores of Lake Constance, Count Zeppelin was educated at Stuttgart and at twenty years of age became an infantry officer. His military studies led him to visit Italy, France and England, and in 1863 he served with the Union forces in the American Civil War, in the course of his service making a balloon ascent. Returning home he took part in the war between Prussia and Austria and in the Franco-Prussian War and afterwards rose to high command. In 1891 he retired as a general. He had long conceived the idea of aerial navigation by airship, and free from official duties and possessing considerable means, he devoted all his energies to the construction of a rigid airship. In 1900 he achieved his first success with *Z1*, a craft 420 ft. long and 38½ ft. in diameter, the envelope of which contained seventeen gasbags with a total capacity of about 400,000 cub. ft. of hydrogen. The two cars suspended beneath the ship had two 18 horse-power Daimler engines. On July 2, 1900, the airship was hauled out of its floating shed on Lake Constance and covered a distance of 3½ miles before being landed on the water and towed back to the shed. As a military officer, Zeppelin had visualized the use of airships for observations and for carrying dispatches, but their use as a means of transport was his chief aim, and one of his ambitions was to see Europe and America connected by an airship service. This, however, he did not live to see, for he died in Berlin on March 8, 1917, in the midst of the Great War.

Auguste Forel and Alcoholism

In a paper on Auguste Forel and his campaign against alcoholism, read before the Society for the Study of Inebriety and Drug Addiction on July 12, Dr. J. D. Rolleston, after a short sketch of Forel's life, stated that though an active campaign against alcoholism had previously been carried out for many years in Great Britain and the United States, Forel was a pioneer in the scientific anti-alcoholic movement not only in Switzerland, his fatherland, but also on the continent of Europe. The lack of recognition of his work in Great Britain was attributed by Dr. Rolleston to two reasons. In the first place, Forel was strongly opposed to making the campaign against alcoholism inseparable from religion and Christianity in particular, as it is in this country and the United States. The second reason was the severe blow to Anglo-Saxon prudery and obscurantism caused by his classical work on the sexual question. On the other hand, the high appreciation of his work in foreign countries was shown by quotation of the opinions of eminent neurologists, psychiatrists and others in Germany, Hungary, Switzerland and the United States. Forel's contributions to the study of the alcohol problem were then considered under the headings of blastophthoria, alcoholism and the sexual question, exposure of popular errors concerning alcohol, such as the view that beer and wine do not cause alcoholism and the value of alcohol as a food, drug, and indispensable agent in sociability, alcohol and sport, and the treatment of alcoholism.

Inland Water Survey

Definite quantitative results of the Inland Water Survey Committee's investigations are forthcoming in the Surface Water Year Book of Great Britain 1935–36 (London: His Majesty's Stationery Office, 5s. net) which is a statistical report (issued by the Ministry of Health and the Scottish Office) relating to the inland water resources of Great Britain during the twelve months ended September 30, 1936. The publication provides detailed information about the surface water resources of a dozen drainage basins, together with their rainfall. Results for underground water are being published separately in a different form. Twenty-seven rivers at twenty-eight gauging stations have been the subject of continuous measurement and the results are tabulated in regard to daily maximum and minimum water levels and daily mean discharge in cusecs. The Year Book furnishes, moreover, in each case a brief description of the station and the drainage area, together with monthly evaluations of rainfall. The issue of this publication, which is to be continued annually, marks a further stage in the development of the Survey and it will be welcomed by all the various bodies who are interested in the use and application of water, whether for agricultural purposes, or for land drainage, fisheries, industries, navigation, sewage disposal or water supplies and the like. Some useful conversion tables are included.

The Norman Lockyer Observatory

The annual report of the Norman Lockyer Observatory, Sidmouth, shows that the activities of the Observatory are well maintained. The 12-in. McClean telescope has been used for taking spectra of ζ Aurigæ during its 1937 eclipse and also of Finsler's comet and of *A* type stars. Its chief work has been in preparation for colour temperature observations on early type stars, and the preliminary experiments have shown that colour temperature observations may be profitably taken up with this instrument. The 9-in. Kensington telescope has been used on a selected number of bright line stars, with special attention to γ Cassiopeiæ. Some photographs of star fields have been taken with the Zeiss triplet camera attached to the instrument. Three meteor cameras fixed outside the dome have been used for the photography of meteors, but unfortunately without success up to the present. Prof. Blumbach has used the Mond equatorial for photographs of galactic clusters, Finsler's Comet, and some test plates of the

Andromeda nebula Two photographs of the aurora of January 25, 1938, were taken by Mr D R Barber, who also contributed notes on its appearance to the local Press The director Mr D L Edwards, supplies many other interesting items in his report, dealing with publications, the laboratory, the library, buildings and grounds, etc

THE Observatory has recently issued the first of a series of bulletins, which will be published from time to time, probably averaging about one a year These will include articles less technical in character than the usual papers which appear in the *Monthly Notices of the Royal Astronomical Society*, and will describe special lines of research undertaken at the Observatory In the present number, the first paper, by Mr D L Edwards, deals with the spectra of γ Cassiopeiæ of which the late Dr W J S Lockyer gave an account a few years ago Considerable changes have taken place since, strong absorption lines replacing the early hazy ones, these absorption lines fading out again and new emission lines appearing The most striking stage was when the absorption lines had completely disappeared and there remained only the spectrum composed entirely of emission lines, the Balmer series of hydrogen being the most prominent feature Prof F I Blumbach contributes a paper which contains six photographs of Comet Finsler (1937 *f*), taken in August and this is followed by Mr D R Barber s paper, Note on the Spectrum of Comet Finsler (1937 *f*) which describes the objective prism spectrograms of this comet, secured on five favourable occasions in July and August A useful table is given which supplies a list of the identified emission features of the cometary spectrum, together with their probable origin, wave length and observed band limits In the next paper, by Mr Edwards, there is a description of a tube sensitometer made to a given specification by Messrs Casella and Co , Ltd , who are also constructing a microphotometer for the Observatory

Popular Astronomy at Mount Wilson Observatory

RECENTLY, the Carnegie Institution of Washington has catered in a practical way for the immense growth of public interest in astronomical research by opening a special building on Mt Wilson to be devoted entirely to satisfying the layman's thirst for first hand information on the many researches undertaken by the staff at Mt Wilson and other astronomers For many years, visitors have been privileged on one night per week to use the 60 in telescope for visual observations of the heavenly bodies, but since the completion of the Angeles Crest highway about two years ago, the number of visitors has become a difficult problem During 1936, it was estimated that 50,000 persons inspected the 100 in telescope when it was open to the public, and the total number who visited the Observatory on all occasions during that year reached the large figure of 100,000 The main features of the building are, first, a room for the display of models and photographic transparencies and, second, a lecture hall, capable of accommodating 270 persons, in which the general public are brought into direct and personal touch with the scientific staff of the Observatory The Carnegie Institution and the Mt Wilson astronomers are to be congratulated on their enlightened policy of giving to the public such unique facilities for the practical understanding of what scientific research is accomplishing in the realm of astronomy

Petrology of Igneous Rocks

WRITING with reference to the review of Hatch and Wells' Petrology of Igneous Rocks ', which appeared in NATURE of May 28, p 952, Dr A K Wells has directed attention to the second paragraph, which he believes suggests that he has been guilty of plagiarizing the scheme of classification of rocks put forward in the report of a research committee of the British Association This was not the intention of the reviewer, who states that at no time has he entertained such an idea He adds that considerations of space precluded mention of the fact, well known to him and to others interested, that Dr Wells was the moving spirit of the committee in question The main object of the review was to indicate the radical changes made in the new edition of Hatch and Wells well known text book

White Fish Commission

THE Minister of Agriculture and Fisheries and the Secretary of State for Scotland have appointed the following to be members of the White Fish Commission constituted under Part I of the Sea Fish Industry Act, 1938 Sir William Palin Elderton (chairman), Mr H G Maurice (vice chairman) Prof Alexander Gray, Mr G Dallas, Mr T Darling The Commission is charged under the Act with the functions of keeping generally under review matters relating to the white fish industry, and of advising and assisting the Ministers in regard thereto The Secretary of the Commission is Mr R G R Wall, to whom all communications should be addressed at the Offices of the Commission, Nos 6 and 7 Old Palace Yard, Westminster, S W 1

Weather Forecasts by Telephone

IN *The Times* of July 11, there is an account of a new enterprise on the part of the Dutch meteorological service and Dutch General Post Office In Great Britain, anyone can get the latest official weather report over the telephone by asking for it at the Meteorological Office, but on the Hague telephone system the subscriber need only call the number 393131 and he will hear automatically the latest forecast, not only for Holland, but also for Great Britain, Belgium and North and West Germany To this is added a statement of the distribution of high and low barometric pressure over Western Europe, and doubtless also an indication of the way in which the distribution is changing

British Empire Cancer Campaign

ON the recommendations of its various committees, the Grand Council of the British Empire Cancer Campaign has made the following grants, totalling

£3,715, which are in addition to the sum of approximately £45,000 already approved in grants for the calendar year 1938. £1,100 to the Radium Beam Therapy Research, £750 for research by Mr F C Pybus at Newcastle, £300 to Dr P. R Peacock, at the Glasgow Royal Cancer Hospital, for the salary of a whole time assistant, £495 for the salary of the physicist at the Strangeways Research Laboratory, Cambridge, £750 for investigations being carried out under the direction of Dr P M F Bishop and Mr H. J. B. Atkins, at Guy's Hospital, £270 to Dr John Bruce, at the University of Edinburgh for part time investigations, and £50 for a replacement in apparatus at the Strangeways Research Laboratory

THE re-appointment of Dr G Cranston Fairchild as the William Morris Research fellow in radiology at Mount Vernon Hospital has been approved for a further period of three years This fellowship was created by the Campaign in 1931 at the request of Lord Nuffield, who provided a sum of £25,000 for the purpose of promoting research work and study concerning the treatment and cure of cancer by radiology

Excavations at Lachish, 1937-38

AN exhibition of antiquities from Lachish, excavated at Tell Duweir, Palestine, by the Wellcome Marston Archæological Research Expedition to the Near East, was opened at the Wellcome Research Institution, 183-193 Euston Road, London, N W 1, on July 7 and will remain open daily from 11 a m. until 5 p m. until July 29 Films of the excavations will be shown daily at 11 30 a m and 3 p m A lantern lecture on "New Discoveries at Lachish" will be delivered by Mr. C H Inge, who has succeeded the late Mr. J. L Starkey as leader of the expedition, on Tuesday, July 19, at 5 30 p m, and on Wednesday, July 27, at 6 p m., admission being free without ticket.

International Congress for Applied Mechanics

THE fifth International Congress for Applied Mechanics will be held at the Massachusetts Institute of Technology on September 12 16, under the presidency of Prof. Karl T Compton At the close of the Congress in Cambridge the members will proceed to Washington, D C, where a programme of sightseeing and visits to Government laboratories will be arranged by the director of the National Bureau of Standards for September 19 Members will then proceed to Langley Field, Virginia (Old Point Comfort) to spend September 20 at the Langley Memorial Laboratory of the National Advisory Committee for Aeronautics. It is probable that other trips will be arranged for those members from abroad who may desire to visit Pittsburgh, Detroit, Niagara, Schenectady and other cities. The field of applied mechanics will be divided into the following general heads: (1) structures, elasticity, plasticity, fatigue, strength theory, crystal structure, (2) hydro- and aerodynamics, gas dynamics, hydraulics, meteorology, water waves, heat transfer; (3) dynamics of solids, vibration and sound, friction and lubrication, wear and seizure Further information can be obtained from the Joint Secretaries, Fifth International Congress for Applied Mechanics, Massachusetts Institute of Technology, Cambridge, Massachusetts, U S A.

Congress of Anthropology and Ethnology

THE International Congress of Anthropological and Ethnological Sciences which is being held in Copenhagen on July 31 August 6, promises an interesting programme While sufficient time is being allowed for giving the various sectional papers, a number of excursions have been arranged For example, a general meeting of the Congress is to be held in the Great Hall of the Castle of Kronborg, where native Greenlanders will show their skill in kayak paddling, etc The most important function of those international congresses undoubtedly is to enable *savants* from different countries to meet and talk together, too many sectional papers leave not enough time for this There are to be the usual number of banquets provided by the various official bodies After the close of the Congress an excursion has been arranged to visit the various places of historical interest in Denmark While one cannot expect to be repeated the outstanding generosity of the Rumanian Government, which last year provided *gratis* for the Congress of the International Institute of Anthropology a sleeping car train for a week to visit all the interesting places in Rumania the total expenses of a member of the forthcoming Congress in Denmark, when everything is considered, will not be at all excessive.

1851 Exhibition Scholarship Awards

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 announces the following appointments for 1938 for research at the various centres indicated *Senior Studentships* Dr W. E van Heyningen, biochemistry at the University of Cambridge, Dr H Walke, nuclear physics at the University of Liverpool, R. Brown, plant physiology at the Imperial College, Dr W A Deer, petrology at the Universities of Manchester and Cambridge, Dr R A Buckingham mathematical physics at the Queen's University of Belfast and the Massachusetts Institute of Technology *Overseas Scholarships* Canada Dr W M Smith, physical chemistry at the University of Cambridge, Dr G C Butler, biochemistry at University College Hospital, London, Dr H J Bernstein, physical chemistry at the University of Copenhagen or the California Institute of Technology; D C. MacPhail, engineering at the University of Cambridge. Australia: A. A. Townsend, physics at the University of Cambridge; A J Birch, organic chemistry at the University of Oxford; M. E. Griffiths, endocrinology at McGill University, Montreal. New Zealand: E F. Daly, physical chemistry at University College, London, or the University of Manchester India: Dr. R. S. Krishnan, physics at the University of Cambridge; Dr. N. K. Panikkar, zoology at the Marine Biological Laboratory, Plymouth.

Travelling Fellowships in Tuberculosis

THE Medical Research Council announces that Dorothy Temple Cross Research Fellowships have been awarded to the following candidates intending to study problems of tuberculosis at centres abroad, during the academic year 1938–39 N C Oswald chief clinical assistant, Brompton Hospital, London J I Paterson second assistant, Medical Professorial Unit St Bartholomew s Hospital, London Dr K M A Perry, medical first assistant and registrar London Hospital, Dr J O Westwater, formerly assistant medical officer, Glenlomond Sanatorium Kinross All these fellows propose to work at centres in the United States

Record Endurance Flight by Glider

Lieut W B Murray and J S Sproule, flying a two seater Falcon glider have set up a record for endurance by remaining in the air for 22 hours 13 minutes, from 4 9 a m on July 9 until 2 22 a m on July 10 The flight was made at the opening of the National Gliding Contests at Dunstable Downs and in difficult weather conditions

Recent Large Sunspots

PARTICULARS are given to date (July 8) of two recent sunspots noteworthy on account of size, which places them in the category of naked eye spots

Date on Disk	Central Meridian Passage U T	Latitude	Maximum Area
July 3 13	July 7 2	14° N	1000 units
4 17	10 7	13 S	850

The unit of area is one millionth of the sun s visible hemisphere A sunspot of area 500 millionths, not too near the edge of the disk, is usually visible to the naked eye when the brilliancy of the disk is sufficiently reduced by a dense glass filter

Addendum (July 12) Another large spot has come over the eastern limb in south latitude 11°, the time of central meridian passage being July 15 1 By July 11, the area of the spot had reached 1 500 units

Announcements

SIR WILLIAM BRAGG, president of the Royal Society and director of the Royal Institution, has been elected a foreign associate of the Paris Academy of Sciences The number of foreign associates of the Paris Academy is limited to twelve, and the only other living British man of science in this distinguished company is Sir Joseph Thomson

SIR ARTHUR OLVER, until recently animal husbandry expert, Imperial Council of Agricultural Research, India, has been appointed Principal of the Royal (Dick) Veterinary College, Edinburgh, in succession to the late Principal Bradley

THE following have been appointed to fill the vacancies which will occur in the Council of the Institution of Electrical Engineers on September 30 *President* Dr A P M Fleming, *Vice President* Prof C L Fortescue, *Hon Treasurer* Mr W McClelland, *Ordinary Members of Council* Dr P Dunsheath, Prof R O Kapp, Mr A P Young, Dr. L G Brazier

DR EDGAR COCHRANE, of Accra, Gold Coast, has been awarded the North Persian Forces Memorial Medal for 1937 for his paper on tuberculosis in the tropics published in the *Tropical Diseases Bulletin* last year

THE Howard Prize (an aneroid barometer, given annually for the best essay on a selected meteorological subject) of the Royal Meteorological Society has been awarded to Cadet Colin Derek Thorpe, of H M S *Conway* School Ship Consolation prizes have been awarded to Cadet Arthur Vernon Baker (H M S *Conway*) Cadet Godfrey Harry Hayes (H M S *Conway*) and Cadet Richard Christopher Stancliffe Hurst (H M S *Worcester*) who were bracketed second The subject of the essays was Clouds

THE following appointments and promotions in the Colonial Service have recently been made G F Boizot, assistant analyst, Malaya, Dr Campbell, plant pathologist, Zanzibar, G R Howat analytical chemist, Medical Department Gold Coast, W A Tooke chemist, Geological Survey Department Malaya, E J Gregory (manager of the St Augustine Experimental Station, Trinidad), agricultural officer Uganda, M D Lumsden (veterinary officer) assistant officer in charge, Government Stock Farm, Trinidad

LIEUT COLONEL E v WHITBY of the Royal Army Medical Corps, has been awarded the Leishman Memorial Prize for 1937 consisting of a silver medal and a sum of £30 The prize is awarded annually to an officer of the Royal Army Medical Corps or the Army Dental Corps for work of outstanding merit

PROF REYNALDO DOS SANTOS, of Lisbon, has been awarded the Violet Hart gold medal for his work on vascular surgery on the occasion of the recent Surgical Congress of the Southern United States

PROF WOLFGANG OSTWALD, professor of colloid chemistry at Leipzig, and Prof Eric Martini, professor of medical zoology at Hamburg, have been nominated as honorary members of the Rumanian Academy of Sciences at Bucharest

THE June issue of the *London Hospital Gazette* is a bicentenary appeal number containing an article on the staff in the past by Dr Robert Hutchison consulting physician to the hospital, the growth of the hospital laboratories by the director, Dr P N Panton, nursing at the London Hospital by the matron, and the coming bicentenary of the Hospital and College by Dr Cecil Wall, senior physician to the hospital

SIR HOWARD GRUBB, PARSONS AND Co have taken over the astronomical instrument and observatory equipment business hitherto carried out by Messrs Cooke, Troughton and Simms, Ltd, of York The address of Sir Howard Grubb, Parsons and Co is Astronomical Instrument Makers, Optical Works, Walker Gate, Newcastle on Tyne, 6

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 118

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Formation of Milk

WE have administered labelled (radioactive) sodium phosphate to goats and investigated to what extent phosphorus present in different compounds extracted from the blood and the milk became labelled In two cases the goat was killed after the experiment and the phosphorus compounds present in the organs investigated as well Some of the results obtained are seen in the accompanying table

Activity per mgm P in milk (Activity of plasma inorg P after 4½ hours taken as 1)			Activity per mgm phosphatide P extracted from milk and organs after 4½ hours	
Interval after the start of the experiment	Fraction	Activity per mgm P	Fraction	Activity per mgm P
0 2 hr	Inorg P	0 68	Milk	0 09
	Casein P	0 54	Plasma	0 02
	Ester P	0 32	Corpuscles	0 01
2 4½ hr	Inorg P	1 79	Milk gland	0 13
	Casein P	1 71	Liver	0 09
	Ester P	1 16	Kidney	0 11
4½ 6½ hr	Inorg P	1 71	Activity per mgm P of milk ester P accumulated in 0 3 hours	
	Casein P	1 71		
	Ester P	1 34		
23 26 hr	Inorg P	0 40	Hydrol 7 min	0 76
	Casein P	0 55	Hydrol 60 min	0 68
	Ester P	0 49	Remaining fraction	0 34
			Milk inorg P	1 48

Inorganic phosphorus The inorganic phosphorus extracted from the milk produced in the first two hours after the subcutaneous injection of the labelled phosphorus, shows considerable radioactivity Should the milk contain only those inorganic phosphorus atoms which were located in the plasma at some time after the start of the experiment, the specific activity of the milk inorganic phosphorus should be as high as that of the plasma inorganic phosphorus In making such a comparison, it must be borne in mind that the specific activity of the plasma inorganic phosphorus rapidly decreases with increasing time through interaction of plasma phosphate phosphorus with that of bone and other tissue[1] No definite conclusion can therefore be drawn from comparing a single value of the specific activity of plasma and milk phosphorus By following up, however, the change of the specific activity of the plasma inorganic phosphorus and milk inorganic phosphorus with time, we find that it takes 3–4 hours for the milk inorganic phosphorus to be almost entirely composed of individual atoms which had been present in the plasma after the start of the experiment

In milk produced shortly after the start of the experiment, a large part of the phosphorus atoms present were those which were located in the milk gland when the labelled phosphorus was administered The replacement of the gland inorganic phosphorus by plasma inorganic phosphorus is thus comparatively slow because of a slow rate of penetration of the phosphate ions through the cell walls Heavy water, on the other hand, injected simultaneously with the labelled phosphate was already, after a short time, equally distributed between plasma and milk, because of the low resistance water molecules encounter when penetrating through cell walls

Casein phosphorus The comparatively high specific activity of the casein phosphorus is only compatible with the assumption that the phosphorus atoms utilized in the synthesis of the casein in the milk gland are drawn from the inorganic phosphorus of the plasma From the difference in the rates at which the active casein phosphorus and the active inorganic phosphorus present in the milk are formed, the time of formation of the casein in the gland cells can be estimated to be about 1 hour

Ester phosphorus The rate of formation in the milk gland of the average labelled phosphorus ester molecule is lower than that of the average casein molecule (cf table) 1½ hours after the administration of radioactive hexose monophosphate (kindly presented to us by Prof Parnas) injected into the veins of the goat, an appreciable amount of labelled ester was found in the milk, while another larger part of the activity was found in the inorganic milk phosphate This result shows that a rapid enzymatic breakdown of the hexose monophosphate and rebuilding of ester molecules takes place in the gland The milk gland contains thus enzymes having the same action on *hexosemonophosphate* as Robison and Kray s[2] bone extracts, however, the bulk of the esters present in the milk are acted on by enzymes present in the gland at a much slower rate Similar behaviour is shown by the mixture of phosphorous esters present in the blood[3]

Phosphatide phosphorus The formation of active phosphatide molecules is, as seen from the table, a slow process The individual phosphatide molecules present in the milk were mainly built up in the milk gland and not taken up as such from the plasma (as is the case with the yolk phosphatide[1]) This follows from the fact that the specific activity of the phosphatide phosphorus extracted from the milk gland and also from the milk itself is higher than that secured from the phosphatide of the plasma The view is often encountered that the milk fat originates from the plasma phosphatides which decompose in the milk gland, supplying fat and inorganic phosphorus This view is entirely incompatible with the results obtained by us To mention only one argument, we find the phosphatide phosphorus of the milk to be slightly, the inorganic phosphorus present to be strongly, active The latter can therefore only originate from the highly active inorganic phosphorus of the plasma

It is well known that different milk fractions, secured consecutively within a short time, have a markedly different fat content As we find[3] that the inorganic phosphorus extracted from these fractions has a different specific activity, we have to conclude that these fractions cannot originate from an initially homogeneous liquid So we arrive at the result that some of the milk gland cells give off milk much more readily than others, but that some even of the first-mentioned cells retain a large part of their solid milk constituents, particularly the phosphatides (and fats) Not only are phosphorus compounds present in the milk not formed during the act of milking, as often assumed, but such compounds contained in the last fraction secured during the act of milking are partly of earlier date than those present in the immediately preceding milk samples

We wish to thank Profs Bohr Brønsted and Lundsgaard for numerous facilities kindly placed at our disposal, Prof Lawrence for the generous gift of some powerfully active phosphorus preparations and Miss Hilde Levi for carrying out the counting experiments

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June 15

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[1] Cf Hahn I and Hevesy G NATURE 140 1059 (193)

[2] Cf Robison R The Significance of Phosphoric Esters in Metabolism (New York 1932) 16

[3] A detailed account of the experimental results obtained will be found in the dissertation of A H W Aten jun to be presented to the University of Utrecht

Concentration and Measurement of Atmospheric Ozone

MORE than ninety years ago C F Schönbein, the discoverer of ozone claimed its presence in atmospheric air[1], his ozonometer, consisting of paper soaked in potassium iodide and starch indicated interesting variations in the ozone content of air which were deemed of such importance by meteorologists and medical men that regular observations were started in most civilized countries We possess daily records of many decades, and the statement that millions of ozone determinations have been carried out[2] is probably not exaggerated

Unfortunately, these numerous measurements are open to the criticism that the chemical reaction used is not specific, other oxidizing agents having the same effect on potassium iodide , as the presence in air of at least one of them, nitrogen peroxide, is certain, and can amount to the same order of magnitude[3] the value of all those 'quantitative' ozone records is extremely doubtful Since attempts to identify it by specific reagents were unsuccessful, some chemists were even inclined to deny altogether the presence of ozone in the air

The direct spectroscopic determination of atmospheric ozone, though possible, is too difficult and costly for routine measurements We have therefore attempted to make the old chemical method reliable[4], and believe we have achieved this aim by introducing the following refinement the current of air (at least 500 litres) is not passed directly over (or through) the reagent, but its ozone content is first concentrated by condensation, and then separated from less volatile oxidizing agents, for example, nitrogen peroxide, by fractional distillation This procedure became possible after we had found that even in very low concentration (about one part in 100 million parts of air) ozone can be condensed on silica gel at liquid air temperature, and re distilled without loss If, in the latter process, the temperature is not allowed to rise above −120°, the whole of the nitrogen peroxide is held back, and is itself available for colorimetric tests (We employed for this purpose the 2 4 xylen 1 ol method[5]) The determination of the purified ozone can be carried out in the usual way[6] in a few minutes by titration with potassium iodide and starch

It is also possible to collect the re distilled ozone in a glass tube with quartz windows and to measure its absorption of ultra violet light Thus an ozone thickness equal to the ozone in more than 30 kilometres of air can be concentrated in a short tube no complications arise through the absorption of light by dust particles and Rayleigh scattering and the calibration can be effected by direct chemical analysis consequently the spectroscopy of the atmospheric ozone becomes much simpler, and we hope, in collaboration with Prof H Dingle, to work it out in a quantitative way

The photographic records of the characteristic ozone absorption so far obtained show conclusively that the volatile part of the condensate is actually ozone Another qualitative proof was provided by the use of tetramethyl base , a colorimetric reagent less sensitive than the iodine starch method but strictly specific[7] thanks to the preceding concentration, the ozone was sufficient for the application of this method and these tests too, were convincing

The accompanying table gives some of the results obtained As can be seen, we also determined in each case the nitrogen peroxide content In most experiments the analysed air was taken in South Kensington outside the laboratory, in a wide street with little traffic (Imperial Institute Road) As it was conceivable that both the ozone and nitrogen peroxide values in a town atmosphere are very different from the average, we thought it advisable to carry out a few parallel experiments at Kew Observatory, which is near the open country

Date (1938)	Weather	(Per cent by volume) × 10^4	
		Ozone	Nitrogen peroxide
Feb 7	Dull and cold	0 8	0 4
8	Dull and overcast	0 5	0 6
10	Raining	0 8	0 1
14	Heavy snowstorm	0 8	<0 05
22	Dull and overcast	1 1	1 2
Mar 3	Warm and sunny	0 9	1 3
7	Spell of very fine weather warm and sunny	1 9	<0 05
10		0 6	<0 05
14		0 9	<0 05
17	Dull and overcast	1 1	0 5
May 6	Cloudy morning sunny afternoon S Ken	2 3	0 2
	Kew	2 3	< 0·05
10	Bright morning cloudy afternoon S Ken	1 3	0 5
	Kew	2 2	0 3

The mean value of the London ozone measurements is 1 1 × 10^{-4} vol per cent We hope later to apply this method to a systematic determination of the dependence of the ozone content on meteorological factors, geographic position and altitude , perhaps it will be possible also to measure the ozone in the higher atmosphere by the use of aeroplanes

In conclusion, we wish to thank Prof H Dingle heartily for his collaboration on the spectroscopic side, and Dr F J W Whipple for granting us facilities to work at Kew Observatory

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June 16

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[1] Schonbein C F *Ann Phys und Chem* **65** 69 161 (184)

[2] Sohon, E *Ber deutsch Chem Ges* **13** 1503 (1880) Fonrobert E, Das Ozon (Stuttgart 1916) 25

[3] See, for example Francis, A G and Parsons, A T *The Analyst* **50**, 262 (1925), Reynolds W C *J Soc Chem Ind Trans* **49** 168 (1930)

[4] cf Conference on Atmospheric Ozone at Oxford Sept 1936 (Supplement to *Quart J Roy Met Soc* **62** 13 1936) The trustworthiness of somewhat complicated chemical reactions recently used as a basis for ozone determinations is still uncertain

[5] McVey W C *J Assoc Off Agric Chem* **18** 4 9 (1935)

[6] For the time being we adopted Ladenburg's method Ladenburg A and Quasig R *Ber deutsch Chem Ges* **34** 1184 (1901) Treadwell F P and Anneler E *Z anorg Chem* **48** 86 (1905)

[7] Arnold C and Mentzel C *Ber deutsch Chem Ges* **35** 1324 (1902)

Luminescence of Solids at Low Temperatures

THE fluorescence of solids has generally been regarded as a comparative rarity confined to a few groups of compounds, of which the sulphides of zinc and calcium, the uranyl salts, and a number of platino cyanides are amongst the better known Recent observations at low temperatures suggest that many other compounds are fluorescent, and a fairly wide distribution throughout the periodic table is indicated Table 1 gives a list of some of the more striking compounds, a number of which are not fluorescent at room temperature The fluorescence intensity of a few of these compounds is weak even at the temperature of liquid nitrogen, compounds also showing appreciable fluorescence at room temperatures are indicated in italics

TABLE 1 COMPOUNDS FLUORESCENT AT LOW TEMPERATURES

Anhydrous beryllium sulphate	Samarium sulphate
Anhydrous magnesium chloride	Silicic acid
Zinc oxide and chloride	Stannous chloride
Zinc sulphate anhydrous	Lead nitrate
Zinc orthosilicate	Lead chloride
Zinc sulphide	*Phosphorus*
Cadmium chloride	Antimony trichloride
Cadmium bromide	Bismuth trichloride
Cadmium iodide	Anhydrous manganous chloride
Mercuric chloride	Anhydrous manganous bromide
Mercurous chloride	Manganous bromide
Cuprous chloride	*$PtCl_2$ dipyridyl red form*
Silver chloride and bromide	$PtCl_2$ dipyridyl yellow form
Indium acetyl acetone	Sodium fluorescein
Samarium sesquioxide	Rhodamine G B 500

Detailed comment is not possible here, but it may be remarked that the zinc sulphide mentioned in the table was sufficiently pure to be non fluorescent at room temperature under a strong focused beam of ultra violet light Cuprous chloride is of interest as it gives two different spectra according to the temperature, the effect is conveniently observed as follows A thin copper strip is coated at one end with a layer of chloride and cooled to approximately 80° K On quickly removing the strip from the cooling liquid and placing in the ultra violet beam, a narrow band of red fluorescence moves rapidly along the specimen from the warmer end As the red fluorescence disappears, it is followed by a much wider band of green fluorescence, the temperature range of this being very roughly −150° C to −100° C

It is considered that the fluorescence of some of these compounds is a feature of the pure substance, but it is naturally difficult to be sure of this when very minute traces of impurity may be effective, this aspect of the problem is under investigation Some of the compounds were extremely pure, and the remainder were of reasonable (analytical reagent) purity If the fluorescence observed should prove to be that of impurity phosphors, it is clear that the examination at low temperature provides a more sensitive test of purity than the more normal procedure

Lowering of temperature gives rise in many instances to a marked narrowing of the diffuse emission bands of fluorescent solids While this narrowing frequently leaves much to be desired, it is sometimes sufficient to indicate features that would not otherwise be observable In the present instance it has been used to compare the spectra of a number of impurity phosphors all activated by manganese, at temperatures between 20 K and 85° K Table 2 summarizes the results

TABLE 2

LOW TEMPERATURE SPECTRA OF IMPURITY PHOSPHORS ACTIVATED BY MANGANESE

Substance	Temp	Main features of fluorescence emission spectrum	
Zinc orthosilicate	20° K	4000 A 000 A	Mod strong continuum
		03 A	Sharp edge
		[illegible]	Weak line
		100	Weak line
		1	Strong line
		180	Mod strong line
		220	Centre of intense band
		320	Mod strong line
		5900 6300	*Weak band*
Zinc sulphide	20 K	*5940*	*Intense narrow band*
Zinc beryllium silicate	85 K	4000 A 000 A	Weak continuum
		300 A	Mod strong broad band
		920 A	*Strong narrow band*
Cadmium chlorophosphate	85 K	4000 000	Mod continuum
		5950 A	*Intense narrow band*
Cadmium silicate	8 K	4000 A 000 A	Mod strong continuum
		5960 A	*Mod strong narrow band*
Cadmium iodide	85 K	*5900* A	Broad continuum with peak at approx this wave length
	(300° K)	*6325* A	*Narrow band*
Silver chloride	85° K	[illegible]	Strong band
		6210	*Mod strong narrow band*

In this series zinc orthosilicate is the only substance showing a number of sharp lines in addition to a diffuse background Comparison of the spectra indicates that all six substances have a band lying between 5900 A and 6000 A Allowing for the varying nature of the matrix lattice, it is considered that this band is to be associated with the manganese impurity common to all If this suggestion is maintained, it follows that the fluorescence of these compounds is at least in part due to transitions within the manganese atom or ion Some support is given to this idea by the observed fluorescence of pure manganous compounds (Table 1), the two compounds noted each giving a narrow band at 6325 A approximately In the case of zinc orthosilicate, where the 'manganese band' is weak, the observed resolved spectrum in the green may also be due to manganese excited differently because of some difference in the number or distance of nearest neighbouring atoms. It also seems possible, however, that the manganese impurity may have here a different major role that of stimulating fluorescence in the matrix lattice If this explanation is the true one, the zinc atoms contributing to the fluorescence would be those nearest to the impurity manganese atoms The fluorescence of calcium oxide recently reported by Ewles[1] would appear to be of this type

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June 9

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[1] Ewles *Proc Leeds Phil Soc* **3** 2 and 416 (1937 1938)

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Rod-shaped Clay Particles

THE minerals found in clays and soil colloids are usually considered to be plate shaped and to have layer lattices built up from sheets of silicon - oxygen tetrahedra This may be true in the majority of cases, but rod or needle shaped particles can also occur and should not be overlooked Their presence may be due to one of the following two reasons

(1) Layer lattice minerals can under special conditions of growth be developed as rods

(2) Rod or needle shaped minerals may exist, with a structure based on single or double chains of silicon - oxygen tetrahedra similar to pyroxenes and amphiboles

An example of (1) was found in the crystals of pyrophyllite from Tres Cerritos, Sierra Nevada, California, which I received through the courtesy of Prof C E Tilley of the Department of Mineralogy, Cambridge Pyrophyllite usually occurs in flakes and its structure has been determined by J W Gruner[1] from powder photographs as a monoclinic layer lattice with Si Al Si layers parallel to (001) The crystals from Tres Cerritos form long, thin rods radiating outwards from the centres of spheres Sufficiently thin crystals give good X ray single crystal reflections with a period of 5 1 A for the needle axis This corresponds to the [100] direction of Gruner s structure, and also to the chain length unit (*c* axis) in amphiboles and pyroxenes According to their structure and orientation, the pyrophyllite rods have only one perfect cleavage parallel to their elongation The fact that bentonite suspensions may show negative streaming double refraction was taken by A v Buzágh[2] as evidence of the presence of rod shaped particles It is now well known that the main constituent of bentonite is the layer lattice mineral montmorillonite

An example of (2) seems to be the series of clay minerals known as palygorskites, which includes the minerals sepiolite and attapulgite Sepiolite is the magnesian end member, and a sample from Ampandandrava, Madagascar with a period of 5 3 A in the fibre direction, has been extensively studied by H Longchambon[3], who came to the conclusion that the whole group had an amphibole like structure, based on double chains of silicon oxygen tetrahedra The experimental evidence is, however, not quite conclusive, and J de Lapparent, who first described the mineral attapulgite[4] as the main constituent of two fuller's earths, maintains a mica like structure for the group of palygorskites The water relationships for sepiolite and attapulgite are similar to those for montmorillonite, but no lattice shrinkage or expansion has been observed, it is, therefore, possible that in these minerals channels of water between rings of Si_4O_{11} chains play the part of the sheets of water in montmorillonite

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[1] *Z Krist* **88** 412 (1934)

[2] *Koll Z* **47** 223 (1929)

[3] *Bull Soc Franc Min* **60** 1 (1937)

[4] *Ann Off Combustibles Liq Paris* No **5** 863 (1936)

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A New Phosphoric Ester Isolated from the Products of Yeast Juice Fermentation

THE fermentation hexosemonophosphate (Robison ester[1]) isolated from the products of fermentation of glucose, mannose, or fructose by yeast juice, consists mainly of an enzymic equilibrium mixture of glucose, fructose and mannose 6 phosphates[2,3], but as usually purified by means of the lead and barium salts may also contain traces of trehalosemonophosphate, phosphopyruvic acid, triosephosphate, α glycerophosphate etc A typical specimen of the Robison ester also gives a green colour when heated with orcinol and hydrochloric acid, the amyl alcohol extract showing an absorption band about 670 mμ This fact indicates the presence of an unknown ester in the mixture, since the reaction is not given by any of the above mentioned phosphoric esters, and differs from that given by pentoses (in absence of iron) in the position of the absorption band, it was found, however, that an identical reaction is given by the 7 carbon atom sugar mannoketoheptose isolated from the Avocado pear by La Forge[4]

The isolation of the ester responsible for the colour reaction has been achieved by a preliminary oxidation of the mixed ester with bromine at neutral *p*H, the whole of the aldose esters being removed as insoluble phosphohexonates, followed by fractional crystallization of the brucine salts of the residual sugar phosphates The barium salt, prepared from apparently homogeneous brucine salts giving an intense blue colour with orcinol - hydrochloric acid, has $[\alpha]_{5461} + 8°$, the analysis agrees with that of a ketoheptose phosphate On hydrolysis with bone phosphatase at neutral *p*H the ester gives rise to a non fermentable reducing sugar, giving the colour reactions of a ketoheptose, the properties of the sugar, which has not yet been obtained in a crystalline state, are not identical with those of mannoketoheptose but indicate that it may be a mixture of this sugar with others of a similar type

In normal hydrochloric acid at 100°, the ester is hydrolysed smoothly with a velocity constant, $k = 4 \times 10^{-3}$, practically identical with that of fructose 6 phosphate, on heating with phenyl hydrazine and glacial acetic acid, a precipitate containing 4 per cent phosphorus was formed, but the product could not be obtained crystalline These facts suggest that the ester is not a 1 phospho derivative since the known 1 phospho sugars are rapidly hydrolysed in acid solution and form phosphorus free osazones The ester is formed during the fermentation, constituting 1 2 per cent of a typical Robison ester, but is not present in the similar monophosphate fraction (Embden ester) prepared from muscle extract.

The mechanism of its formation affords an interesting problem in the enzymic synthesis of carbohydrate during the fermentation of hexoses. Meyerhof, Lohmann and Schuster have demonstrated the enzymic formation of ketosephosphates by the condensation of dihydroxyacetonephosphate with aldehydes in presence of aldolase[5] and this reaction might account for the formation of a 1 phosphoketoheptose. The enzymic transference of the phosphoric acid group to another position might then take place as in the case of the Cori ester glucose 1 phosphate[6].

R. Robison
M. G. Macfarlane
A. Tazelaar

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June 16.

Robison, *Biochem. J.*, **16**, 809 (1922).

[2] Robison and King, *Biochem. J.*, **25**, 323 (1931).

[3] Robison, *Biochem. J.*, **26**, 2191 (1932).

[4] La Forge, *J. Biol. Chem.*, **28**, 511 (191

[5] Meyerhof, Lohmann and Schuster, *Biochem. Z.*, **286**, 301 (1936).

[6] Cori and Cori, *Proc. Soc. Exp. Biol.*, **36**, 119 (193)

Oxygen Transport with Fully Reduced Arterial Hæmoglobin in the Human Being

It has been long known that infants, born with a transposition of the pulmonary artery and the aorta may be living with a very cyanotic appearance. In two cases which lately came under our observation not a trace of oxygenated hæmoglobin was found in the arterial blood with methods certainly sensitive to one per cent of oxygen saturation, although no further marked symptoms of oxygen want were present. The oxygen consumption of the two patients was not far from normal and, though we are not able to give a complete explanation of the curious conditions, we have found some interesting properties in the blood of one patient we had an opportunity of studying somewhat closely at the age of four months.

The hæmoglobin as judged by its spreading properties at various hydrogen ion concentrations its oxygen dissociation curve its alkaline resistance its vital decomposition and formation (icterus neonatorum) was normal, the concentration varied between 17 and 20 per cent. There was slight acidosis, the *p*H of the blood was in the normal range.

Whereas the oxygen capacity was calculated from the hæmoglobin percentage to be 27 vol. per cent the Barcroft manometric technique gave an absorption of 38 vol. per cent of oxygen by the arterial blood. Saturation of this blood by carbon monoxide decreased the uptake of oxygen by the expected 27 vol. per cent, leaving an extra absorption of 9 vol. per cent. The same treatment of samples of normal blood always reduced the oxygen absorption to zero.

So the patient's blood appeared to have, besides its normal oxygen capacity, depending on the presence of reduced hæmoglobin, an extra capacity of 9 vol. per cent, the rate of absorption by this extra capacity was about one fourth of that by the normal capacity at room temperature. The extra capacity was not found in the plasma, but only if corpuscles were present, it was not much influenced by small amounts of cyanide or iodoacetate.

The relation between the normal hæmoglobin and the extra capacity is indicated by the following observation. The superficial venous blood of the patient is found to be 20 25 per cent oxygenated by cutaneous oxygen absorption, if this blood is kept in a closed syringe for 30 min. at 37°, its hæmoglobin is at least 95 per cent reduced. Also, if one mixes equal parts of the patient's fully reduced arterial blood and of normal fully oxygenated blood (having the same hæmoglobin content) the resulting mixture after 2 min. is not 50 per cent but only 35 vol. per cent saturated. Again if the patient's blood is 30 per cent oxygenated and then kept for 30 min. at 37°, it is nearly reduced and now its oxygen capacity corresponds to the hæmoglobin content, the extra capacity being saturated now.

We have not been able to detect the biochemical mechanism of this extra capacity, but wish to direct attention to this probably not very rare occurrence of oxygen transport with the arterial blood in the completely reduced state.

R. Brinkman
J. H. P. Jonxis

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June 7.

Sugar Content of the Hormones of the Pituitary Anterior Lobe and of the Gonadotropic Hormone from Pregnancy Urine

During our investigation of the active principles of the pituitary anterior lobe and of the gonadotropic hormone from pregnancy urine we established the fact that the gonad stimulating factors of the anterior lobe and, more particularly prolan from pregnancy urine contain considerable quantities of carbohydrate, even when in a highly purified state. This carbohydrate could not be removed nor its percentage decreased by treatment with weak alkalis or by prolonged and repeated dialysis. Such properties seem to indicate the presence of glycoproteins in the gonadotropic protein factors. The sugar may be combined with the protein in the form of a polysaccharide. The nature and quantity of the basic carbohydrate was determined by means of the orcine sulphuric acid reaction. The gonadotropic factors of the pituitary anterior lobe contain 6 per cent (maximum value) of mannose, prolan obtained from pregnancy urine contains 19 per cent (maximum value) of mannose or possibly of galactose, or of both these hexoses (the preparations have not yet been tested for hexosamine).

The existence of mannose (or galactose) in the gonadotropic substances is not surprising. Sørensen and Haugaard discovered that the sugar protein complexes generally contained mannose or galactose (or both) and not glucose as previously thought. On the other hand, the large percentage of carbohydrate, in comparison with the other sacchariferous proteins, is very noteworthy. It is possible that the physiological activity of the gonadotropic factors is due to, or connected with, the presence of such glycoproteins. The rather remarkable observation was made that, on isolating the gonadotropically active portions of the pituitary anterior lobe, and of pregnancy urine, the sugar content increased. The difficultly soluble portion of the anterior pituitary extract shows no, or only a weak, sugar reaction, the prolactin fraction being practically free from sugar.

It should be mentioned that extracts of the pituitary gland and of pregnancy urine contain, in addition to the sugar present in combination with protein, comparatively large quantities of sugar in the uncombined state and thus separable by dialysis This sugar is very probably utilized in the synthesis of the hormone

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June 11

Limited and Unlimited Swelling of High Molecular Substances

THE material available at present allows the establishment of a hypothesis for the mechanism of the transition limited → unlimited swelling (that is, dissolution) of high molecular compounds On one hand Brønsted[1] and Schulz[2] have discussed the distribution of molecules of great size over several phases, on the other hand Hofmann, Frenzel and Csalan[3] and Katz[4] have investigated the one dimensional swelling of 'graphitic acid

The swelling of high molecular substances consisting of chain molecules however, is more complicated, since they may swell in two dimensions For the purpose of establishing a simple model the following assumptions may be made (1) The solid body consists of a number of long chain molecules of identical structure and length (2) The lattice energy has a constant value for all molecules (3) The sorbing activity of a group is independent of its place within the chain, the number of swelling agent molecules participating in the formation of the coating is proportional to the chain length (4) Chain molecules of different degree of solvation are miscible The probability, however, that the swelling agent molecules are distributed unequally over the chains dwindles in the case of long chains, and becomes zero for 'chains of infinite length as shown by the following consideration

The total amount of swelling agent taken up, Σ_n, is given by an isotherm

$$\Sigma_n = f(p), \qquad (1)$$

where p is the swelling agent pressure The transformation gel (solvation degree Σ_n) → gel (solvation degree $\Sigma_{n+\Delta n}$) takes place if

$$\Delta F_{\Sigma n} = \Delta H_{\Sigma n} - T\,\Delta S_{\Sigma n} < 0, \qquad (2)$$

where ΔF, ΔH and ΔS are the molar changes of free energy energy and entropy, Δf, Δh and Δs are the corresponding quantities for one mole of the monomer, π is the polymerization degree In consequence of assumption (3), the heat of swelling, to a first approximation, is given by

$$\Delta H = \pi\,\Delta h \qquad (3)$$

ΔS is different from zero as found by Fricke and Luke[5], and Stamm and Loughborough[6], Katz[7] suggested that the entropy change is mainly due to an orientation of the sorbed molecules Therefore, it may be written

$$\Delta S = \pi\,\Delta s \qquad (4)$$

Accordingly, the ratio $C^n/C_{n+\Delta n}$ of Σ_n molecules and $\Sigma_{n+\Delta n}$ molecules within the gel is given by

$$\frac{C_n}{C_{n+\Delta n}} \qquad e^{\frac{\pi}{R}\left(\frac{\Delta h}{T} - \Delta s\right)} \qquad (5)$$

When the numerical value of π is considerable, uniform swelling takes place The swelling is limited, until an amount of swelling agent Σ_{crit} is taken up sufficient to saturate completely the forces acting between neighbouring chains If

$$\Delta f_{\Sigma\text{crit}} < 0, \qquad (6)$$

dissolution (unlimited swelling) is effected This condition is fulfilled, if

$$\Delta h_{\Sigma\text{crit}} - T\,\Delta s'_{\Sigma\text{crit}} < RT \ln \frac{p}{kRT} \qquad (7)$$

where $\Delta s'$ is the solvation entropy change, p the pressure and k a constant The upper limit of p is given by the saturation pressure of the swelling agent Starting from equation (7), it will be possible to estimate the numerical value of $\Delta f_{\Sigma\text{crit}}$ in different systems

A substance, capable only of limited swelling at ordinary conditions, may dissolve, when the saturation pressure of the swelling agent is increased for example agar The interaction of the polar agar molecules is comparatively strong In other cases the interaction may be still stronger so that complete separation cannot be effected, for example in the cases of vulcanized rubber, and of Staudinger's[8] insoluble polystyrene

Intermicellar swelling is possible on the basis of a secondary structure This process is more complicated but essentially not different from that of intramicellar swelling

The above assumptions and the numerical values will be discussed in detail elsewhere

E BRODA

I Chemisches Universitaetslaboratorium,
Wien

[1] Brønsted Z phys Chem A Bod Festbd 257 (1931) **155** 343 (1931) **168** 331 (1934)

[2] Schulz Z phys Chem A **179** 321 (1937)

[3] Hofmann Frenzel and Csalan *Ann Chem* **510** 1 (1934)

[4] Katz *Rec Trav Chim Pays Bas* **54** 317 (1935)

[5] Fricke and Lüke *Z Elektrochem* **36** 309 (1930)

[6] Stamm and Loughborough *J phys Chem* **39** 121 (1934)

[7] Katz *Trans Far Soc* **29** 279 (1933)

[8] Staudinger *Trans Far Soc* **32** 323 (1936)

A Simple X-Ray Dosimeter

ALTHOUGH the direct current generated by a photo electric cell exposed to short wave radiation, extending from the region of the *Grenz Strahlen* to the gamma rays, is only of the order of one hundredth of that induced by visible light[1], it can be used as an accurate measurement of the radiation value In this Institute, it has for some time been used as a routine method of calibration of the dosage (in r units) applied to *Drosophila* cultures

The apparatus is extremely simple, consisting of a Weston photo electric cell, shielded from visible light by a wrapping of black (photographic) paper, connected by ordinary flexible leads (which need not be shielded and can be of any reasonable length) to a d'Arsonval mirror galvanometer, reading to 10^{-8} amp, and the usual illuminating system The galvanometer gives a deflection of 300 mm at one metre for a current of 1 microamp, this is very nearly the current produced by the Weston cell when exposed to an intensity of 300 r per minute The readings are linear between limits of 20 r and 300 r, with voltages of 40–120 kv applied to the tube The cell is usually placed at distances of 12–25 cm from the target, and at the same level as the irradiated material If a distance of more than 25 cm is employed, it is advisable to connect *two or four* cells in parallel the effect is approximately proportional to the number, but it may be necessary to select cells which match each other's characteristics In general, the cells are very equal in their output, and a comparison of cells five years old with cells one year old showed no significant difference

In cases where high intensities and short distances are used, the galvanometer may be replaced by a direct reading microammeter For example, using four cells in parallel at 12 cm from the target with an output estimated at 1 000 r, the reading was 12 microamperes with a single cell it was slightly more than 3

Such an arrangement has several advantages it is compact and portable, it is not affected by atmospheric conditions, gives a continuous reading which *immediately responds to fluctuations* of the radiation produced by voltage changes or thermal variations in the tube The cell can usually be placed in contact with the object radiated and once calibrated, by means of a dosimeter or a biological test can be relied on to give reproducible results It can be recommended to all who require a rapid and simple method of X ray dosage

K MACKENZIE

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June 7

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¹ NATURE 141 873 (1938)

Cytology of Metamorphosis in the Culicinæ

C R RIBBANDS¹, commenting on my recent communication², states that I apparently overlooked the work of Holt³ on the gut of *Culex* References to Holt's work may be found in two of my papers⁴, which appeared in well known journals during the past two years Having been a student of Prof Metz, I am also familiar with his work on the paired association of somatic chromosomes Indeed the present investigation was undertaken at the suggestion of Prof Metz and much of the work was done under his supervision

Regarding the several points of disagreement between Holt's results and mine it may be noted that the evidence for my results has been given briefly in four preliminary reports, referred to in this⁴ and a former communication², and that a detailed account with photomicrographs is in the current issue of the Contributions to Embryology of the Carnegie Institution of Washington

A possible explanation of our different results may be found in the technical advances of the past twenty years Holt's work was based entirely on sectioned material The iliac epithelium of *Culex* has the form of a narrow tube, the wall of which is a single layer of cells These cells are usually in the shape of a flattened ellipsoid The tube itself is not straight and different regions may be in different states of contraction and expansion Judging cell size from sections of an organ of this type is very difficult, if at all possible Camera drawings of such sections yield no certainty regarding cell size Yet a few such camera drawings by Miss Holt are taken by Ribbands as showing conclusively the lack of correlation between cell size and chromosome number

In addition to sections and aceto carmine smears, my best evidence for a correlation between cell size and chromosome number came from whole mounts of the larval hind gut, dissected out and stained by the Feulgen technique Whole mounts prepared in this way are invaluable in the study of metamorphosis All the cells are present whole, essentially undistorted and in their normal position The preparation is transparent and the upper and lower walls can be examined under the oil immersion In a series of such preparations relative cell size is apparent and the fate of each tissue during metamorphosis can be clearly followed

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¹ Ribbands C R NATURE 141 920 (May 21 1938)

² Berger C A NATURE 141 834 (May 7 1938)

³ Holt C M *J Morph* 29 607 (1917)

⁴ Berger C A *Proc Nat Acad Sci* 22 186 (1936) *Amer Nat* 71 187 (1937)

I REGRET that I wrongly concluded¹ that Prof C A Berger had overlooked the work of Holt², but no reference to it appears either in his original letter³ or in either of the other two preliminary accounts referred to therein in which he outlined his results, some identical with those of Holt others in contradiction to them His communications contained no mention of his own technique which therefore could not be compared with that of Holt

If chromosome number is correlated with cell size in this instance another example is added to a long list of similar cases⁴, but examples of lack of correlation are still known⁴ Berger's data relative to cell size have not been published, but he states that in the ileum of *Culex pipiens* the smallest cells, without complexes have a nuclear diameter of 3μ, and that greatest diameters of nuclei range from 10μ to 17μ' ⁵, these latter cells having complexes of up to 192 chromosomes³ Holt illustrated a prophase nucleus (Plate 2, Fig 19) *containing only* 18 *chromosomes*, which had a greatest diameter of about 13μ Since Holt's drawings are from sections it is unlikely that the nucleus has been artificially flattened, as it could be when using either smears or the new method which Berger describes above, and therefore this one example indicates that there is no exact correlation between chromosome number and nuclear volume in this tissue Cell volume is even less likely to be proportional to chromosome number, since instances are known in which chromosome volume affects nuclear volume without altering cell volume ⁶

None of the six preliminary reports of Berger give any proof of his more important disagreement with Holt's results, concerning the possibility of a regular reduction in the chromosome numbers in these cells so I await his detailed account in the hope of a *solution both of this problem and of the one concerning* correlation between cell size and chromosome number

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¹ Ribbands C R NATURE 141 920 (May 21 1938)

² Holt C M *J Morph* 29 607 (1917)

³ *Berger C A* NATURE 141 834 *(May 7 1938)*

⁴ Darlington C D Recent Advances in Cytology (2nd Ed London 1937) 221-228

⁵ Berger C A *Anat Rec* 67 Suppl 1 63 (1936)

⁶ Darlington C D Recent Advances in Cytology" (2nd Ed. London 1937) 55

A Triploid Asynaptic *Allium amplectens* from California

TRIPLOID forms of the Californian species *Allium amplectens* Torr ($2n=21$) are characterized by almost absolute lack of chiasmata at meiosis In some slides no chiasmata at all occur, in other slides there may be found 1 chiasma in about 500 pollen mother cells

The pachytene chromosomes are paired in the manner normal for triploid species and no structural differences between homologous chromosomes are observed Homologous chromosomes are held together during diplotene exclusively by the relational coiling

The 21 univalents present at the first metaphase are arranged in an equatorial plate Their centromeres remain undivided and all the chromosomes are included in one interkinese nucleus

The second division takes place regularly and leads to the formation of pollen dyads Almost all the pollen grains investigated exhibit 21 chromosomes, showing the regularity in function of this meiotic abnormality

Tetraploid forms, collected at the same locality as the triploids, have normal chiasma conditions, and their meiosis runs a regular course The pollen grains are formed in tetrads and contain ± 14 chromosomes

The asynapsis of *Allium amplectens* is evidently genetically caused, and is not due to failure of pairing It is of a more extreme type than the asynapsis earlier reported from *Zea*[1] and *Crepis*[2]

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[1] Beadle *Cytologia* 3 (1932)

[2] Richardson *J Genetics* 31 (1935)

Effects of Injury on the Teeth of *Selachii*

IN 1784 Andre[1] attempted to prove "succession' of teeth in cartilaginous fishes, illustrating his paper by a picture of a vertical row of divided teeth at the site of a spine embedded in the jaw of *Galeocerdo* He contended that the abnormal teeth had developed subsequent to the injury

Last year, Dr E W Gudger[2] reported similar splitting of teeth and one in which five corresponding teeth had been severed where they overlap those of adjacent rows in *Caracharhinus limbatus* He also attributed the abnormality to disturbances in the tooth germ

When considered together, the two halves of the split teeth correspond in every particular to normal teeth, except that the edges may have been smoothed off subsequent to the injuries received

Whilst extracting individual teeth from the jaws of *Caracharhinus*, I have sometimes caused identical splitting of teeth usually in the centre but sometimes at the side, but always in the same vertical row of teeth.

Careful consideration of the available literature fails to reveal evidence of teeth in the jaw of sharks having been formed subsequent to an injury or constant forward movement of a revolving gum

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[1] William A An Attempt to prove that the teeth of Cartilaginous Fishes are Perpetually Renewed *Phil Trans Roy Soc* **74** (1784)

[2] Gudger E W Abnormal Dentition in Sharks Selachii *Amer Mus Nat Hist* **73** 11 249-280 (1937)

Points from Foregoing Letters

Prof G Hevesy and A H W Aten have administered radioactive sodium phosphate to goats and determined the amount of labelled phosphorus found in blood and in milk, after varying periods It takes 3-4 hours for the milk inorganic phosphorus to be almost entirely composed of individual atoms present in the blood plasma after the start of the experiment Casein is apparently formed in the gland cells in about an hour, while it takes rather longer for the formation of the esterified phosphorus and longest to form the phosphatide molecules

Prof F A Paneth and J L Edgar describe a method for the concentration of atmospheric ozone by condensation and fractional distillation The ozone was thereby separated from nitrogen peroxide and could be identified spectroscopically and determined chemically The ozone content of London air was found to vary considerably, its mean value was 1 1 × 10^{-6} vol per cent

A table of thirty compounds which fluoresce at low temperatures (80° K) and some of them at room temperature is given by Dr J T Randall The fluorescence in most cases is apparently that of the 'pure' compound A number of substances (ZnS, AgCl, etc) activated by manganese showed a common band between 5900 A and 6000 A

Dr G Nagelschmidt finds that crystals of pyrophyllite from California form long thin rods radiating outwards from the centres of spheres, and directs attention to the possible presence of rod shaped particles in other clays

Sugars containing 7 atoms of carbon in the molecule (similar to the mannoketoheptose isolated from the Avocado pear) have been detected by Prof R Robison, M G Macfarlane and A Tazelaar in Robison's ester (phosphate ester from the products of fermentation of glucose)

The arterial blood of a child four months old with transposition of the large vessels was found by Dr R Brinkman and J H P Jonxis to be completely reduced Its capacity for oxygen absorption was 1 3 times as large as the value calculated from the hæmoglobin content This was due to an extra capacity, interacting with the hæmoglobin system

Dr Max Hartmann and Fritz Benz find that the gonadotropic hormone of the pituitary anterior lobe and the gonadotropic hormone from urine contain a considerable quantity of sugar, the former 6 per cent of mannose and the latter 19 per cent Prolactin and thyrotropic hormone contain only a small amount of mannose It is possible that the sugar content is an essential factor for the activity of this hormone

The transition limited → unlimited swelling of long chain molecules is discussed by Dr E Broda He points out that the entropy change connected with swelling may be proportional to the chain length The transition occurs discontinuously at a certain activity of the swelling agent The transition point may be calculated from thermodynamical data concerning the solvation properties of the different groups.

Research Items

Social Symbiosis in Nigeria

AN attempt to adapt the well-established biological concept of symbiosis in social anthropology is made by Mr. S. F. Nadel (*Man*, June 1938) to define a new, that is, not yet formulated, and specific category of social organization. It applies to development, not in any abstract theoretical sense but as relating to concrete observable social processes, namely, the reorientation of a social system under certain conditions of external change and pressure. The facts examined concern the Nupe town of Kutigi in Northern Nigeria in which in a population of approximately 3,000 the development studied reaches back to events of some two hundred years ago. The population embraces four different tribal sections, originally distinct separate cultural groups which have migrated into their present domicile in different periods. The way in which these groups reacted and adjusted themselves to each other and eventually evolved a *modus vivendi*, represents the phenomenon it is proposed to call social symbiosis. Of the four groups two are of Nupe origin, one came from Bornu as wealthy traders and attained political and economic ascendancy, and the fourth consists of freed slaves, Yorubas imported to instruct the Nupe in weaving and dyeing. In the arrangement of the town, which is typically Nupe locality and tribal section, living place and migrational stratum, coincide. But between the separate localities and migration strata there exists to-day the closest co-operation which is the fruit of a far-reaching adjustment. The bonds of contact and common interest gain the significance of a specific and new social factor in the sphere of religion and kinship organization. The three activities of the sections—economic, religious, and social—can be shown to represent a reciprocity and interdependence linking section with section in the framework of a larger embracing social group unit, that is, a symbiosis, which represents the possible origin of clanship, and is one of the three possible developments in attaining a social equilibrium between diverse cultural groups—co-operation, symbiosis, and complete fusion.

Man of the Old Stone Age in America

PROF. E. B. RENAUD, of Denver University, whose explorations in search of archæological sites in Colorado and the neighbouring States have contributed largely to knowledge of the stone age cultures of the south-western United States, devotes his tenth report of "The Archæological Survey of the High Western Plains", sponsored by his University, to a study of the "Black's Fork Culture" of southwest Wyoming. This culture, which consists of series of stone implements of palæolithic type, or rather types, was first recorded so long ago as 1931. The difference in form, patination and appearance of age of these implements from the more usual type of stone implement of the area naturally attracted considerable attention, and its comparison with European palæolithic implements of a similar character provoked no little criticism. Further explorations in 1935 and 1936 increased the number of sites on which these implements occur to sixty-nine, situated in an area extending from Utah on the west to long. 109° on the east and lat. 43° on the north to the Utah line on the south. This area is drained by the Green River and its tributaries, of which Black's Fork is the most important and apparently the focal centre of the culture. Hence the name. In all, some four thousand specimens have been collected, besides collections in other hands. The camp sites, on which the implements are found, bear a general resemblance to one another. As a rule two cultures are present, an older and a recent, but the two are quite distinct, the older being associated with an older floor of occupation. The materials used are chert, moss agate and quartzite, the specimens falling into six classes, of which three belong to the chert group. Classified on broad lines the implements are bifaces and unifaces—coup de poing, choppers, end scrapers, side scrapers, pointes and blades. They belong to the early and middle palæolithic—pre-Chellean, Chellean, Acheulean, and Mousterian as well as Clactonian flakes. There is also a pebble industry, which is comparable with the rough quartzite pebble industry of the Upper Garonne. This terminology is used by Prof. Renaud descriptively only, and carries no implication as to age, though his own comparisons and the verdict of a number of distinguished European archæologists concur in seeing in these implements a close resemblance to the African races.

Measurement of Temperamental and Personality Qualities

REPORT No. 83 of the Industrial Health Research Board, by P. E. Vernon, is an account of the various tests that have been used to measure temperamental and personality qualities by means of rating scales and questionnaires, oral and written, but excluding the ordinary interview and clinical techniques. There is a short description of practically every published test within these limits, with an account of the method adopted, the statistical or other techniques used to evaluate the results, and a critical survey of the results and criteria. That a survey is necessary is implied by the surprisingly large number of the questionnaires in use, and by the fact that both in the medical and industrial field temperamental or emotional problems are proving to be urgent. Efficiency and even happiness in many walks of life are partly bound up with the temperamental make-up of the individual and some objective measure by which this could be assessed would be of great value. The conclusion of this painstaking study, however, does not permit of any belief that this at least by the means studied, is an immediate possibility. The author suggests that more care should be taken in compiling the tests and that investigators should not neglect the work of their predecessors. He gives a very clear discussion of the possibilities and drawbacks of this very popular verbal test.

Serological Reactions in Cancer Diagnosis

THE polarographic method developed by Prof. Heyrovský depends on the potential set up in a cell between a polarizable dropping mercury electrode and a non-polarizable reference electrode. The literature of the method and of its numerous applications is detailed in a comprehensive bibliography (Bibliography of Publications dealing with the Polarographic Method" by J Heyrovsky and J Klumpar *Coll Czechoslovak Chem Comm*, 10, No 2–3, pp 23, 1938), which covers the period 1922–37 Dr Brdička has applied this method to serological reactions, with special reference to cancer diagnosis ('Serologische Untersuchungen mit Hilfe der Polarographischen Methode und ihre Bedeutung fur die Krebsdiagnostik" by R Brdička, *Acta Internat Verein fur Krebsbekampfung*, 3, 13–30, 1938) Purr and Russel, and Waldschmidt Leitz, have produced evidence tending to show that in the blood of cancer patients there are relatively less sulphydryl groups than in normal blood The potential set up at the dropping mercury cathode, being a function of the reducing systems present, may be used to detect the amount of these groups in very small quantities of serum With this method, the author has investigated sera from 187 normal and pathological subjects, including cancer patients The cancer sera gave a diminished polarographic reaction, but this was also found in numerous inflammatory conditions, and is therefore not specific for cancer

Localized Nature of Photoperiodic Response

Dr W F Loehwing has recently published (*Proc Soc Exp Biol and Med*, 37, 631, 1938), the results of experiments in which the bases and tops of soybean plants were submitted to different photoperiods by training them to grow through a slit in a vertical opaque panel The plants were divided into three groups (1) controls with leaves and flowers intact, in one set of which tops were given long day and bases short day, in the opposite set tops were given short day and bases long day, (2) tops defoliated and bases exflorated, criss crossed as in controls, (3) tops exflorated and bases defoliated criss crossed as in controls The responses to differential lighting are clear cut Dr Loehwing concludes that the data indicate that the flowering stimulus is a foliar influence entirely distinct from carbohydrate synthesis The formative floral organization apparently depends upon one or more specific inductors the production of which in the soybean results from short day illumination Both the flowering stimulus of short day and its inhibition in long day exhibited a direct quantitative relationship to the amount of foliage The largest number of flowers on defoliated parts appeared on those plants with the greatest number of leaves under short day illumination

Protein Synthesis in Detached Leaves

In an extensive series of experiments on detached leaves of daffodils, *Pelargonium zonale*, *Iris Pseudacorus*, *Tropæolum majus*, *Ligustrum vulgare*, *Helianthus perennis* and *Vicia Faba*, W H Pearsall and M C Billimoria have shown, by floating the leaves on nutrient solution which allowed of rapid protein synthesis, that the capacity of leaves for protein synthesis under experimental conditions may depend upon their age, protein content and certain factors associated with the physiological condition of the whole plant (*Ann Bot*, New Series, 2, No 6, 317, April 1938) It is also suggested that the permeability of the dissolved solutes in the experimental medium may be an important factor The main significance in the results obtained is that it is probably undesirable to attempt to apply to other genera conclusions based on any one type of plant

Control of Michaelmas Daisy Wilt

Mr N C Preston has recently tested a method of control, originally suggested by W J Dowson, for the Verticillium wilt of the Michaelmas daisy (*Gard Chron*, May 14, 1938) The disease is caused by the fungus *Verticillium Vilmorinii*, which apparently does not extend into the smaller top shoots of an infected plant These can be struck as cuttings, and usually grow into disease free plants The malady appears to be rather widely distributed, and it is not always possible to obtain clean stocks for nursery propagation, hence the value of top cuttings as a practical means of multiplication of valuable strains, even though they be infected with the wilt fungus

Nature of Ultra-virus and Bacteriophage

A useful review of present day hypotheses about the nature of bacteriophage and ultra viruses is contained in a recent paper by Prof C Levaditi ("Les Ultravirus, *Bull Soc d Encour pour l Indus nationale*, 27–42, Janv Févr 1938) Prof Levaditi is scientific director of the Alfred Fournier Institute, and is in a good position to review the subject widely After considering the physiological similarity between bacteriophage and virus, he sifts the evidence for various theories as to their nature Are they inorganic, or unorganized organic matter comparable to enzymes are they organized living cells in the full sense of the term, or do they represent life laid down with illiberal autonomy ? Prof Levaditi inclines to the last mentioned view les ultravirus et les bactériophages paraissent appartenir a un monde vivant ignoré jusqu à ce jour ' The considerations are mainly illustrated by animal viruses, though plant viruses are also mentioned A good deal of modern knowledge is collected in the paper, and many interesting questions for future research arise from its perusal

Segregation in a Species Hybrid

By pollinating *Tragopogon pratensis minor* with pollen from *T porrifolius*, a hybrid was obtained by Dr O Winge (*C R* Lab Carlsberg Sér Physiol, 22, No 9) between two well known Linnæan species, one of which has yellow and the other violet flowers This cross was originally made by Linnæus himself and grown in 1759 The species also differ markedly in size of flower heads, foliage characters size of plant, achenes and pappus Both are found to have six pairs of chromosomes, but *T pratensis* has one pair of satellites while *T porrifolius* has two There are also differences in the size and constrictions of certain chromosomes The F_1 shows hybrid vigour but is highly sterile, producing only 8 per cent of good achenes in comparison with the parents Yet meiosis is regular Later generations were grown to F_7 and were much more fertile The F_1 were nearly uniform and intermediate between the parents Five independent pairs of segregating genes for flower colour were identified, but the ratios were frequently modified By selection in later generations, both parental species were obtained, with the corresponding chromosome morphology It is concluded that all the specific differences arose as genic differences in the chromosomes, and that there is therefore no absolute boundary between species factors and variety factors Two fine coloured plates illustrate the colours and other characters of the heads in the parent species and the various segregates

Tilting of the Ground at Wellington

In September 1930, an Ishimoto tiltmeter was installed at the Dominion Observatory Wellington in the hope that its records might lead to the prediction of local earthquakes The instrument continued in action until March 5, 1934 when it was broken by the severe earthquake of that day An account of the results obtained with its aid has now been published by Mr R C Hayes (*Dom Obs Bull* No 133, 625–628, 1938) The records showed marked diurnal and seasonal variations The diurnal tilt, sometimes exceeding 2 seconds follows the temperature variation, the curves of mean hourly tilt and earth temperature at a depth of one foot corresponding very closely The most interesting movement is a persistent westerly tilt of at least 10 seconds in less than 3½ years perhaps connected with crust displacements preceding the earthquake of 1934 With this possible exception, no connexion has been traced between the tilting of the ground and the occurrence of local earthquakes

Ultrasonic Dispersion

The technique used by Mr B V Raghavendra Rao of Bangalore in obtaining the preliminary results described in NATURE, (139 885, 1937) is given in full in a recent paper (*Proc Indian Acad Sci*, 7 Pt 3) The source of light was a cathode cooled, low density mercury lamp wave lengths 4046, 4078 and 4358 being used, 4078 in general proving most suited in spite of its low intensity The dust free liquids investigated were contained in a Wood tube and the fine structure of the radiation scattered backwards was examined by means of a Fabry Perot étalon the distance piece of which was chosen to suit each liquid For carbon tetrachloride using a 5 mm gap étalon, the author finds that while the velocity of ultrasonic waves of 1 1,000 megacycles per second is 920 m per sec that of hypersonic waves of more than 1,000 megacycles is 1 070 m per sec For acetone on the other hand, using a 4 5 mm gap etalon, the ultrasonic velocity is 1 205 and the hypersonic 978 m per sec For benzene and toluene measurements of hypersonic velocities have not proved accurate enough to warrant publication

Elements 43 and 61

A DISCUSSION of the possibility of the existence of stable nuclei of atomic numbers 43 and 61 is given by H Jensen (*Naturwiss*, 26 381, 1938) The importance of Mattauch's rule which states that if two isobares differ in nuclear charge by unity one of them must be unstable is emphasized and it is pointed out that the elements adjacent to element 61, ^{60}Nd and ^{62}Sm, have many isotopes This points to the fact that a nucleus with atomic number 61 would be unstable, and the same applies to element 43 The possibility that β active isotopes with these atomic numbers might exist and have very long lives, cannot be entirely ruled out, but is unlikely The existence of anomalies in the structure of certain nuclei is also mentioned Considering nuclei with odd mass numbers and only one isobare, the passage from one of these to the next is always accomplished (with four exceptions) by the taking up of either one neutron and one proton, or two neutrons, so that the atomic number only increases by 1 at the most Hence every chemical element must have at least one odd isotope The exceptions are the mass numbers 37 ($Z = 17$), 97 ($Z = 42$), 139 ($Z = 57$) and 145 ($Z = 60$) In these cases transition to the next nucleus of odd mass number is accomplished by taking up two protons so that the nuclei of atomic numbers 18 43 58 and 61 are passed over Nuclei with atomic numbers 18 and 58 do however, exist with even mass numbers On the other hand, the remaining two having odd atomic numbers (43 and 61) can have no isotope with an even mass number (owing to the rule that heavier nuclei with even mass numbers have always an even atomic number), and so should not exist at all

Polyphenol Oxidase

Keilin and Mann have recently described the preparation from *Psalliota campestris* of a highly purified polyphenol oxidase (*Proc Roy Soc* B 125, 187 1938) The enzyme contains copper as an essential constituent of its active group The less pure preparations contain large amounts of copper which, however does not belong to the enzyme, and no proportionality is found between copper content and activity until the copper is between 3 2 γ and 3 5 γ per enzyme unit At this level, the copper content and the enzymatic activity are strictly proportional The enzyme in its pure form has a high specificity Even when crude it oxidizes ortho dihydroxyphenols with great rapidity, but affects only a few monophenols such as *p* cresol As it is purified the enzyme gradually loses its power of catalysing the oxidation of monophenols

Constant of Nutation

DR H SPENCER JONES has recently published a paper (*Mon Not Roy Astro Soc* 98, 6, April 1938) on The Determination of the Constant of Nutation from the Greenwich Latitude Variation Observations in which he deals with the material available for the period 1911 36 from observations with the Cookson floating zenith telescope at the Royal Observatory Greenwich Dr J Jackson had previously utilized the observations from 1911 until 1929 to determine the constant of nutation from the latitude variations and while his method was closely followed certain minor alterations were introduced Amongst these may be mentioned the revision of the star places and proper motions, the application of corrections for wind and diurnal latitude variations and the reduction of morning and evening observations to identical epochs The value of the constant of nutation derived by Jackson was 9 2066″ ± 0 0055″, and that found by utilizing the results up to 1936 is 9 2173″ ± 0 0040″ The latter approaches much more closely the theoretical value than the former which presented a difficulty to Jackson he described the discrepancy as one of the outstanding discordances of the constants of the solar system By using Newcomb s formula, which connects the luni solar precession, the constant of nutation the mass of the moon and the mechanical ellipticity of the earth, the inferred value for the reciprocal of the mass of the moon is 81 53 This is based upon a luni solar precession for 1900 0 of 50 3899″ found by Newcomb, but according to Oort, who took into consideration the rotation of the galaxy, the value is 50 4012″ from which the inferred value for the reciprocal of the mass of the moon is 81 59 It is hoped that the observations of Eros at the 1931 opposition will provide a more accurate determination of the mass of the moon than that derived by Hinks from the 1901 opposition As a result, the nutation constant should be found with greater accuracy

Cambridge Meeting of the British Association

Sectional Programmes

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES)

THE programme of Section A, as seems appropriate at Cambridge, is less concerned with applied physics than has been the case for a year or two. The opening morning is devoted to a symposium on nuclear physics, in which Niels Bohr and W Bothe will represent the Continental workers On Friday, after the presidential address, the Section will divide into two, one part discussing the fundamentals of magnetic theory and the other hearing three papers on subjects of astronomical interest The first, by Shapley, is on the galaxy, the second is by Ives, and deals with his recent experiments in which the theory of special relativity receives direct support from experiments on the light emitted by positive rays, and the third is an account by R W Wood of the new diffraction gratings, which have so improved the technique of astrophysical work with spectrographs The Saturday morning will find the Section at work on problems of cosmic rays, with an American and a German guest, in the persons of Prof Furry and Prof E Regener In the second week come symposia on low temperature (particularly that queer material, liquid helium II), and on seismology, the latter taking place at the same time as a further discussion on magnetism, this time jointly with Section G (Engineering)

Those who have missed the general excursions by attendance at the meeting on Saturday will find consolation in the fact that the Section dinner, to be held for the first time, is booked for that evening, they may fill in the afternoon at a garden party in the Observatory Other visits during the week are to the works of the Cambridge Instrument Co, Ltd, and to the Cavendish and Mond laboratories, where a film of solar prominences will be shown, and a record of the voice of the late Lord Rutherford will be heard

THE Department of Mathematics has a programme which is exceptionally attractive mathematically Among the visitors expected are Prof. G D. Birkhoff, Prof. S Lefschetz, who will lecture on the fundamental problem of fixed points in topological transformations, Prof A. Ostrowski, bringing a modification of Newtonian approximation, and Prof A Speiser, looking at elliptic functions from the point of view of elementary geometry The theory of groups and topological algebra are represented further by Mr P. Hall, Dr. B H Neumann, Dr O Taussky and Mr J H C Whitehead, as well as by Mr M H A Newman, who is to speak on the topological characterization of the sphere in n dimensions, a problem which goes back to Poincaré Prof. W V. D Hodge and Mr B. Kaufmann have contributions on geometry and analysis, and Prof E H Neville and Mr D H Sadler will follow Prof Ostrowski

The Association's Committee on the Calculation of Mathematical Tables, acting through Dr. W. G. Bickley, Dr J C P Miller and Dr A. J. Thompson, will take members behind the scenes to look at some of the problems, mathematical and typographical, that come between the simple decision to tabulate a function and the appearance of the printed volume. The National Accounting machine used by the Committee for sub-tabulation and the preparation of printers' copy is to be brought from London for inspection and demonstration, with an operator to explain the adaptations and ingenuities which have effected its conversion from commerce to pure science Explanations and demonstrations will be given also of a number of other machines, including a model of the Bush integrator, the Mallock equation-solver and Hollerith and other machines; in this exhibition the companies concerned are co-operating with the Association Interest in the practical side of computation has been expressed and stimulated at Cambridge by the establishment of a mathematical laboratory, and a visit is planned to this embryonic institution

Lastly, the application of methods and ideas of combinatorial analysis to the planning of biological experiments will be explained in a series of papers by Dr C C Craig, Mr H W Norton, Mr W L Stevens, Mr. F Yates and Dr W J. Youden.

SECTION B (CHEMISTRY)

The president, Prof C S Gibson, in his opening address, will review the recent advances that have been made, chiefly by himself and his co-workers, in the chemistry of gold. This will be followed by a discussion on the recent advances in the organic chemistry of the metals with special reference to the noble metals, in which the principal speakers will be Dr. F G Mann, Prof L O. Brockway (Pasadena) and Prof N V Sidgwick Attention will be directed mainly to the electronic and stereochemical aspects of the subject In the afternoon, Prof Gibson, with the assistance of Dr F. G Mann, Mr. H. V. Thompson and Dr F. H Brain will give a demonstration on the production and application of gold films by ancient and modern methods The processes employed in the ceramic industry and methods depending on the decomposition of organic compounds of gold will be demonstrated. Many specimens will be on exhibition The demonstration is arranged to be of general rather than purely sectional interest

A discussion on modern methods of chemical analysis, including physical and microchemical methods, will be opened by Dr. J. J. Fox, Government Chemist. Contributions will be made by Prof Walther Gerlach (Munich), Prof. Fritz Feigl, Dr Janet Matthews, Dr. H Jackson and Dr K K Nygaard (Oslo)

Prof. W. L. Bragg will open a discussion on "Clays". He will be followed by Dr R. K. Schofield, Dr Nagelschmidt and Prof. J. D Bernal The speakers will deal with the atomic architecture of clay and clay like minerals, with the origin of the electric charges on clay particles, with base exchange, the absorption and yielding up of water and the behaviour of clays in soils.

The fourth symposium of the meeting, entitled "Repercussions of Synthetic Organic Chemistry on Biology and Medicine", which has an added interest in view of the exceptional circumstance that the Physiological Section will not meet this year is being arranged by Prof E C Dodds and Prof J W Cook Recent work on the production of new compounds having the biological action of the sex hormones will be described by Prof Dodds and Prof L Ruzicka (Zurich), and Dr A S Parkes will deal with some of their interesting biological interrelationships The second half of the programme will be occupied with descriptions of synthetic compounds which are able to induce cancer (Prof J W Cook) of new compounds having the physiological action of the life maintenance hormone of the adrenal cortex (Dr T Reichstein, Zurich) and of the synthesis of vitamin B_1 and analogous compounds (Prof A R Todd) Specimens and apparatus relating to these discussions will be on exhibition throughout the meeting

By the kind invitation of Sir William Pope a visit will be made to the University Chemical Laboratories Sir F Gowland Hopkins has also kindly invited the Section to visit the Departments of Biochemistry and Parasitology Visits will be made to the Cambridge Instrument Co , Ltd , and Messrs Stewarts and Lloyds' steel works at Corby

The sectional dinner will be held in Sidney Sussex College by kind permission of the master and fellows The following chemists have accepted the Council's invitation to attend as foreign guests of the Association Prof G Bertrand Paris , Prof L O Brockway Pasadena Prof Fritz Feigl , Prof Walther Gerlach Munich , Dr T Reichstein Zurich , and Prof L Ruzicka Zurich

SECTION C (GEOLOGY)

Up to the delivery of Prof H H Swinnerton's address on Development and Evolution the interest of the programme of Section C is mainly on the stratigraphical and palæontological side After the address the petrological side dominates

The post glacial history of the Fenlands is to be considered jointly with Section K (Botany) Short papers dealing with levels and benchmarks archæological correlations, conditions in Roman times and the Foraminifera in the deposits will provide the basis around which the discussion can range

A more specialized subject is The Distribution and Migration of Certain Animal Groups in the British Lower Palæozoic Fauna Dr C J Stubblefield will open and deal with the Trilobites, and Dr G L Elles on Graptolites, Dr W K Spencer on Starfishes and Dr A Lamont on Brachiopods will follow With such experts on these particular groups important points in *palæogeography may emerge*

The association and origin of alkali rich igneous rocks with limestones has long been of considerable petrogenetic significance This time the question is to be debated from the opposite angle The Origin of the Carbonate Rocks associated with Alkali Rich Intrusions Dr H von Eckermann of Sweden will open the discussion

Water supply matters are very much to the fore at the present time Dr J Buchan in dealing with the underground supplies of London will show that the progressive lowering of the water level there is giving rise to concern about the life of the supply This lowering, also, is leading to a deterioration in quality due to the drawing in of contaminated surface waters

Among the papers to be given, those concerning some peculiar leucite rocks from Australia the granites of the Egyptian desert the palisade diabase sill of New Jersey and the occurrence of zonal olivines should be of considerable interest

SECTION D (ZOOLOGY)

Section D (Zoology) will be presided over by Dr S W Kemp whose presidential address will deal with the future of oceanography

The item in the programme of the Section which will perhaps arouse the most general interest is a discussion on the mechanism of evolution extending over a whole day The range of the discussion will cover such aspects of the subject as the importance of character gradients selection orthogenesis consequential evolution polymorphism and isolation as factors in the evolutionary process The speakers include Prof J S Huxley Prof R A Fisher and Prof A E Trueman

Prof J Gray will introduce a discussion on the role of the environment in animal locomotion and the papers which follow will treat mainly of the work of the Cambridge school in the analysis of locomotion in aquatic terrestrial and aerial forms of life A symposium on sense perception and the evolution of colour and pattern will be introduced by Prof J S Huxley and contributions from Dr H B Cott Mr D Lack and Mr I Burkill will treat of the subject from the point of view of protective coloration the courtship of birds and the correlation between insect vision and flower colour respectively

Dr H C Gilson is to give a semi popular lecture on the recent expedition to Lake Titicaca

There will again be an exhibition of biological films of educational interest These will include two films produced by the Strand Film Co , Ltd , on mites and monsters and monkey to man shown by Prof J S Huxley, and films produced by Gaumont British Instructional Films Co Ltd on the liverfluke the crayfish, and the development of the trout shown by Mr H R Hewer An excursion to Wicken Fen and Breckland is included in the programme of the Section for the Saturday of the meeting

SECTION E (GEOGRAPHY)

The programme for Section E will be opened by the president, Prof Griffith Taylor, who proposes to deal with geography as an aid to social problems, history and race His address will be followed by a number of short papers and a film dealing with the impressions of geographers during the recent visit of the Association to India

On Friday there will be a series of local papers, including two lectures preparatory to the excursions on Saturday and Sunday Of these latter the first will be to the north Norfolk coast, while the second will visit the Fens Monday is to be given over largely to a consideration of the physical factors affecting English ports and estuaries and will include a visit to the Great Ouse Catchment Board

On Tuesday morning a sectional discussion on Some Aspects of the Regional Concept' will be opened by Dr S W Wooldridge, while in the afternoon two papers will discuss some particular features of population distribution On the last morning Dr Vaughan Cornish will continue his plea for the preservation of coastal scenery, this time at Sidmouth, and Brigadier Macleod will discuss the Departmental report on the Ordnance Survey

Among individual contributions not already mentioned may be instanced a discussion on the geographical laboratory, to be opened by Prof F Debenham an account of some of the discoveries of the recent Graham Land expedition by Mr Bertram, and some further results of his work on cirque formation by Mr W V Lewis The programme includes a much larger number of short papers than usual and by reason of its wide field should offer many items of interest to members of other sections

SECTION F (ECONOMICS)

The programme of Section F is very largely given up to the discussion of current matters of public importance and with the development of statistical and other methods for investigating them

There will be three papers by Sir William Beveridge Mr D Champernowne and Mr R C Tress on various aspects of unemployment in relation to the trade cycle its connexion with the local diversity of industry and its recent trends The statistical methods of testing trade cycle theories and of measuring the mobility of labour are being discussed by Prof Tinbergen and Dr Marschak of the Institute of Statistics Oxford, respectively Other topics of current importance under discussion will be public works policy in the trade cycle the economics of road haulage since the Road and Rail Traffic Act of 1933 and the economic recovery of Germany Mr J M Keynes has promised a paper on The Problem of Government Storage of Food Stuffs and Raw Materials

Mr R F Harrod the president is speaking on The Scope and Method of Economics a topic which should be of interest in relation to contemporary developments and controversy The Section has also made arrangements for a discussion of papers on general sociological questions, by Mr T H Marshall on Professionalism ' and Prof M Ginsberg on The Present Position of Sociology'

SECTION G (ENGINEERING)

In his presidential address Prof R V Southwell will deal with the Changing Outlook of Engineering Science

There will be a group of papers on problems of vibration, opened by a short paper and demonstration given by Prof C E Inglis There will be another group of papers dealing with problems in connexion with magnet steels Major Cook, chief engineer of the Ministry of Transport, will open a discussion with an important paper on the design of roads

An innovation of great interest is the experiment of including ten short papers by junior engineers who will describe work with which they are intimately connected Each paper and its discussion will occupy no more than thirty minutes The meeting will conclude with a lecture and demonstration of engineering instruments given by Mr Mason of the Cambridge Instrument Co , Ltd

SECTION H (ANTHROPOLOGY)

The anthropological programme is unusually full, and it has been necessary to arrange several parallel series of lectures On Thursday morning there will be a general discussion on the Australian aborigines, and a film, recently taken by Dr Donald F Thomson, will be shown in the new Arts Theatre In the afternoon papers will be read on local archæology in preparation for the excursions on the Saturday and Sunday

Friday is given up to two symposia the topic for the morning meetings is the Swanscombe skull and for the afternoon, the Middle Palæolithic In both symposia papers will be read on the geology skeletal remains and human artefacts The presidential address will be given on Monday morning by Prof V Gordon Childe, and Miss Caton Thompson and Miss Gardner will describe the results of their recent expedition to South Arabia In the afternoon Sir Arthur Keith will speak on the Mount Carmel skeletons and on a reconsideration of the Piltdown skull Other papers will also be given on Cypriote skulls the stability of English rural population and on natural selection

There will be a number of papers on folk culture on Tuesday morning and in the afternoon four papers on ritual —ritual and emotion, ritual and tradition, ritual and myth, and ritual and magic General ethnology will also be represented by a number of contributions on Cambridge, Lapland West Africa and Zanzibar and by papers on boats primitive art currency, and on sign language

SECTION I (PHYSIOLOGY)

The International Physiological Congress is being held at Zurich on August 14–19 it has therefore been decided not to hold meetings of Section I at Cambridge

SECTION J (PSYCHOLOGY)

Section J (Psychology) has a very full programme The presidential address to be delivered by Dr R H Thouless is entitled Eye and Brain as Factors in Visual Perception

Roughly grouping the other topics there are papers on social psychology covering the social implications of vocational guidance friendliness and unfriendliness between different social groups, generalized foreign politics (this last a mathematical analysis) and problems of the social psychology of childhood General psychology is being dealt with in papers on present trends in American psychology and on hormic psychology while merging into things therapeutic we get problems of the mature personality, the background of the problem child the teaching of mental hygiene through literature with a turn towards heredity in papers on heredity and mental hygiene and the inheritance of temperament respectively

Dealing more with the experimental side are papers on motor learning and the morphology of responses, the direction of thought a curious pitfall in factor psychology, verbal problems connected with the definition of personal qualities, factors affecting the reliability of interviews, behaviour when attempting difficult tasks, sensory adaptation (in vision and hearing) and colour blindness Animal psychology is represented by a paper on recent experiments with birds, while there is a joint session with Section L (Educational Science) on the influence of wireless and the cinema on education

SECTION K (BOTANY)

The botanists and foresters who gather at Cambridge may anticipate an interesting meeting, for a full programme is in prospect The president, Prof W Stiles, will open the proceedings with his address on the general physiology of the plant cell This will be followed by the address of the chairman of Department K*, Sir Roy Robinson who will speak on the supply of home grown timber

A number of joint meetings have been arranged Sections C and K will unite in a meeting on the post glacial history of Fenland in which botanical geological and archæological matters will be discussed A meeting of Sections D and K, spread over two sessions, will be concerned with the mechanism of evolution a subject which should provide abundant argument both formal and informal Botanists and foresters will consider together the relation of ecology and forestry

A group of contributions on the virus diseases of plants, followed by a discussion, will indicate the present position of this important branch of plant pathology

In addition to the selected subjects which have been mentioned, many separate communications will be presented These include series of papers on plant physiology, mycology and palæo botany and others on genetics morphology and ecology

The foresters (Department K*) in their separate meetings, will devote three sessions to a consideration of the cultivation and utilization of British hard woods and a further session to soil problems and to pathology

Prof A H R Buller will deliver the semi popular lecture he will speak on sex in the rust fungi

An extensive display of exhibits will illustrate many aspects of botany It is expected that much of the material will be on view during most of the week and during one afternoon session, exhibitors will give demonstrations and explanations

Excursions to places of interest to botanists and foresters will take place during the meeting the principal excursions falling on Saturday and Sunday

SECTION L (EDUCATIONAL SCIENCE)

The greater part of the Section's programme as in recent years, will be devoted to one or two main subjects , the principal theme for 1938 is Education for a Changing Society The speakers on this theme will examine to what extent the education given in the senior, secondary and technical schools aims at preparing their pupils to meet the complex needs of the rapidly changing world of to day Miss Dawson of Middlesbrough and Mr Robinson of Sheffield will speak as heads of senior schools, while Miss Davis of Streatham and Dr Freeman of Winchester will discuss the contribution of secondary schools Mr Paley Yorke of Poplar, Dr Richardson of Derby and Mr Frank Pick of the London Passenger Transport Board will analyse the part played by technical education, and Dr Winifred Cullis will represent the point of view of the universities

Another outstanding item will be a symposium on Thursday on "Tendencies in School Design", when papers will be read by Mr S Urwin of Cambridge, Mr Denis Clarke Hall and Mr W G Newton of London and Mr W D Seymour (In connexion with this subject there will be an exhibition of school models and designs by courtesy of the Royal Institute of British Architects) A joint session will be held with Section J (Psychology) on the influence of films and wireless on the education of the school child, Mr R C Steele of the B B C and Dr P B Ballard speaking for Section L

The president, Mr J Sargent director of education for Essex will deliver his presidential address on Friday taking as his subject the Function of the Administrator The interim report of the Research Committee on the Informative Content of the Curriculum will be presented at the same session by Mr H G Wells and Sir Richard Gregory

SECTION M (AGRICULTURE)

The general theme for all the paper reading sessions of Section M is Agriculture in Relation to the Life of the Community On the Thursday morning there will be a symposium on Agriculture in Relation to National Employment Prof C S Orwin will open this and will deal in general with the demands for labour in agriculture He will be followed by Prof Scott Watson who will consider the influence of systems of farming on labour requirements by Mr S J Wright who will speak on Men and Machines (including transport on the farm) and by Dr F Kidd who will deal with the Preservation Storage and Transport of Farm Produce There will be a general discussion opened by Prof R G White

On Friday morning Prof R G Stapledon will give his presidential address entitled Ley Farming and a Long Term Agricultural Policy This will be followed by two papers on soil problems namely Problems of Marginal and Waste Land by Dr W G Orr and The Maintenance of Soil Fertility by Dr E M Crowther The general discussion will be opened by Sir Daniel Hall

Monday morning will be devoted to a consideration of The Practical Problems of Crop Production in which Mr J A McMillan will deal with crop husbandry Prof F L Engledow with the place of plant physiology and of plant breeding in the advancement of British agriculture and Mr C T Gimingham with crop pests and disease Sir John Russell will open the general discussion which follows

On Tuesday morning there will be a symposium on The Practical Problems of Animal Production Prof R Rae will open this with a paper on animal husbandry He will be followed by Prof F A E Crew who will speak on animal breeding, and by Dr E L Taylor, who will deal with parasitic diseases in animals

CONFERENCE OF DELEGATES

The Conference of Delegates of Corresponding Societies will be presided over by the Right Hon the Earl of Onslow and among the principal subjects to be considered are some of wide and national importance Lord Onslow in his address will deal with The Importance of National Parks in the Preservation of the Flora and Fauna of Great Britain while the urgent desirability of the preservation of Crown lands will be especially referred to by Dr Vaughan Cornish

Another subject of more than local interest is that of Wicken Fen and what the National Trust has done for East Anglia, upon which Mr N B Kinnear and Dr M F Valentine will speak

The problem of obtaining periodical and simultaneous field observations over wide areas upon such matters as bird and insect migrations, the prevalence and distribution of wild plant and animal communities both harmful and beneficial and the effects upon these of the widespread planning and industrial development of recent years is becoming a matter of significant importance in biological studies, and the co operation of the corresponding societies in the study of systematics in relation to general biology, which will be discussed in a communication from Mr H W Parker should prove of assistance and value in effectively ascertaining the desired information by co ordinated field observations upon specific subjects

An innovation will this year be introduced at Cambridge when the delegates of the corresponding societies and their guests will dine together, Lord Onslow presiding They will also attend an afternoon garden party at the Cambridge Botanic Gardens as the guests of Prof F T Brooks The view has been expressed that the business of the Conference affords insufficient opportunity for that social contact which is considered desirable and can best be attained by such functions

National Efforts in Cancer Treatment

THE eighth annual reports of the National Radium Trust and Radium Commission, 1936 1937 (published in December 1937)* is of special interest in that it breaks away from the immediate task which confronted it in 1929 and now seeks to guide activities on a broader basis The following paragraph taken from p 23, illustrates this

'The Commission believes that to secure a reasonable standard of service for the treatment of cancer cases throughout the country there is need for the whole problem to be attacked by the Government along national lines This belief is supported by the fact that only a proportion of patients suffering from cancer in sites suitable for treatment by radiotherapy are receiving that treatment

With the resources initially placed at the disposal of the Trust and the Commission, it was decided that a practical beginning to the problem of using radium in the treatment of disease could best be obtained in the way the Commission strove, namely, to secure *so far as possible the concentration of radium treatment* at the large voluntary hospitals which provide teaching facilities It was inevitable that this left large parts of the country unprovided with radium facilities, and in consequence centres other than the national centres were set up so that a glance at the map provided on p 2 of this report shows 13 national centres, 9 regional centres and one recognized hospital where the Commission has its immediate interests

In the report for the preceding year, the National Radium Trust, in looking to future needs stated that The views of the Radium Commission as to the need for further considerable supplies of radium have received and are receiving anxious consideration the more so as it seems clear that with the trend towards the use of larger units the ultimate need over the next few years will be far beyond the financial resources of the Trust The Commission now sees this whole problem of the radiological treatment of cancer looming larger with each succeeding year

This may occasion little surprise to those who have witnessed at close range the developments of radiological treatment especially in cancer, but it may well be different for those who, with the constant reminder of cancer statistics in front of them, may question how valid is the warrant for any big extension of these services The fact is that surgical and radiological methods of treatment are the only two methods which are practised on any scale in Great Britain, and with a death rate not far short of 60,000 people yearly, it is really an urgent matter to make the most of what we have got Thirty years ago it was not unusual for people to exclaim as to how gladly money would be given for a cure for cancer It has not been claimed in any one of the reports which have been issued from the Radium Commission that radium treatment is a cure for cancer, but it is claimed, and supported by the most carefully gleaned (not selected) statistics that large numbers of cancer patients have been treated with radium and have successfully survived periods of five years Since cancer is likely to recur in the body it is generally held to be unwise to use the term cure, but 'freedom from the disease is a term which is accepted on a clinical basis, and the survival rate' is one which is of the first importance in adjudging the value of any remedial measure

To return to the belief expressed by the Commission that the treatment of cancer is a problem to be attacked by the Government This is shared by many people, but the steps by which it could be carried out have never been laid down, and are but hinted at in the report in question The Commission does, however, state that an increase of bed accommodation at or in association with the existing *national centres* will be required The words "at or in association with suggest and are probably intended to convey, that any such scheme could only be carried out with the active co operation possibly the direction, of the Ministry of Health It is, in fact, very difficult to see, with the pressure upon the bed accommodation of voluntary hospitals all over Great Britain, how any large increase in treatment facilities could occur without very extensive building and staffing The position is indeed one which calls for the most sympathetic consideration by the Ministry, because by far the greater proportion of radium therapy carried out at present is done at the voluntary hospitals, the part played by those under the direction of the Ministry being, in fact, relatively small though doubtless locally very important If, then, the best that we can offer in the way of treatment for cancer can only be shared by the whole country by the operation of some comprehensive scheme such as that outlined by the Commission, it is a plain duty to be undertaken

It has been pointed out more than once that the first need of the population is to be fed, the second is to be housed, the third (perhaps) is to be educated. Then comes the question of fitness in health, and unfitness through ill health It may well be that the claims of the treatment of people suffering from cancer may be dislodged from the official mind by the claims of the really healthy, that money should first be spent on the attainment of physical fitness rather than on the relief of the sick

S RUSS

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* Eighth Annual Reports of the National Radium Trust and Radium Commission 1936–1937 including a Statistical Report (Cmd 5612) Pp 80 (London H M Stationery Office) 1s 3d net

Science News a Century Ago

Frédéric Cuvier, For Mem R S (1773 1838)

Frédéric Cuvier an eminent French naturalist and younger brother of the more celebrated Baron Georges Cuvier, was born at Montbeliard on June 28, 1773. At his brother's suggestion he went to Paris in 1797, where he attended lectures on physics, chemistry and natural history. In 1802 he became chief editor of the *Journal de la Société d'Encouragement pour l'Industrie Nationale* and was entrusted by his brother with the compilation in collaboration with Duvernay of the catalogue of the animals in the Jardin des Plantes commenced by Buffon and Daubenton. In 1804 he became director of the Jardin des Plantes, where he made some valuable observations on the economy and physiology of the animals, which were published in the *Annales du Muséum*. In 1824 appeared his chief work, written in conjunction with Geoffroy St Hilaire, entitled Histoire Naturelle des Mammifères, in which more than five hundred quadrupeds were carefully described. He also published a large number of zoological articles in the Dictionnaire des Sciences Naturelles and the volume on Histoire des Cétacées in Suites de Buffon. In 1831 he was appointed inspector general of the Academy, and in 1837 professor of physiology at the Paris Museum of Natural History. He died on July 17 1838.

Early History of Embryology

In a retrospective address delivered at the sixth anniversary meeting of the Provincial Medical and Surgical Association held at Bath on July 18 19 1838, and published in the *Transactions* of the Association Dr Jonas Maldon senior physician to the Worcester Infirmary, made the following remarks: Embryology or that department of anatomy which traces the gradual development of an animal (more particularly of man) from the early stage of intra uterine existence until it arrives at its perfect formation, is a branch of anatomy almost unknown in this country although during the last twenty years it has been investigated with great success on the Continent. It is to the labours of the French and German anatomists, more especially those of Meckel and Tiedemann, of Geoffroy St Hilaire and Serres that we are indebted for almost all we know upon this interesting subject. Their researches have made known to us the wonderful truth that the intra uterine being passes through a series of successive changes of existence, beginning with the most simple state, and gradually advancing to the more complicated and perfect. They have shown us that the human embryo at the earliest period of its evolution is analogous to some of the simplest members of the zoophytic class, being nothing save a mere vesicle or globule, filled with a glairy fluid, and exhibiting no appearance of variety of parts, and that, gradually, organ after organ, and system after system, are developed, and more and more completely formed, each successive change representing as it were the structure and formation of an animal higher and higher in the scale of organization."

Death of Pierre-Louis Dulong, For Mem R S

On July 19, 1838, the eminent French chemist and physicist Pierre Louis Dulong died in Paris at the age of fifty three years. He was born at Rouen on February 12, 1785. In his sixteenth year he entered the famous Ecole Polytechnique in Paris in which he afterwards was given chairs of chemistry and physics and held the post of director of studies. In early manhood he appears to have practiced medicine for a time treating poor patients free but attracted by the discoveries of Davy and others he devoted himself to chemistry and worked in the laboratory of Berthollet. When twenty six years of age he lost an eye through an accident with nitrogen chloride. Much of his work was done in collaboration with his colleague Alexis Thérèse Petit (1791 1820). Together they made elaborate experiments on mercury and air thermometers in 1817 they published a memoir on the rate of cooling of bodies, which was crowned by the Paris Academy of Sciences and in 1819 they enunciated the law bearing their names, connecting the atomic weight and specific heat of a solid. On Petit's death in 1820 Dulong succeeded to the professorship of natural philosophy at the Ecole Polytechnique in 1823 he was elected a member of the Academy of Sciences and nine years later was made one of the permanent secretaries. Some of his later researches related to the elasticity of high pressure steam afterwards studied by Regnault.

University Events

Belfast. The degree of D Sc *honoris causa* has been conferred on Prof J P Hill professor of embryology Department of Anatomy University College London.

Cambridge —H B Cott Selwyn College and Dr J E Smith (London) have been appointed University lecturers in zoology and Dr V J Chapman Gonville and Caius College University demonstrator in botany.

Prof F T Brooks has been appointed a governor of the National Fruit and Cider Institute until June 13 1941.

The Benn W Levy Research studentship in biochemistry has become vacant. Applications for its tenure should be addressed to Sir F Gowland Hopkins at the School of Biochemistry before July 16.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of a studentship for research. The studentship is open to male graduates of any university in any country who were born at any place within the British Empire other than Scotland. The Student appointed will work in the Department of Medicine of the University of Cambridge under the direction of the regius professor of physic. The commencing salary will be £300 a year and the appointment will be for two years in the first instance. Further information may be obtained from the Regius Professor of Physic, Department of Medicine University of Cambridge, to whom applications, together with three testimonials, a statement of previous appointments, and copies of published papers, should be sent not later than August 1, 1938.

At Sidney Sussex College Dr R A McCance, formerly research student of the College, University reader in medicine, has been elected to a fellowship.

London —Dr F A Paneth has been appointed, as from October 1, to the University readership in atomic chemistry tenable at the Imperial College Royal College of Science. Since 1933 he has been a consultant of Imperial Chemical Industries, Ltd, and has been engaged in research work with post graduate students at the Imperial College.

Societies and Academies

London

Royal Society (*Proc* A 166 No 927, 449 589 June 16 1938)

D R Hartree and **W Hartree** Self consistent field with exchange for potassium and argon

Sir Arthur Eddington and **G L Clark** The problem of *n* bodies in general relativity theory

G I Taylor Measurements with a half pitot tube

J G Wilson The energy loss of penetrating cosmic ray particles in copper

H J Bhabha On the theory of heavy electrons and nuclear forces

W Heitler Showers produced by the penetrating cosmic radiation

F L Arnot and **Marjorie B M Ewen** The formation of helium molecules

M Born Application of reciprocity to nuclei

D H Bangham and **S Mosallam** The adsorption of vapours at plane surfaces of mica (2) Heats of adsorption and the structure of multimolecular films

D H Bangham and **R I Razouk** The swelling of charcoal (5) The saturation and immersion expansions and the heat of wetting

(*Proc*, B, 125, No 840 291 414, June 16 1938)

R N Salaman A discussion on new aspects of virus disease

A Walton and **J Hammond** The maternal effects on growth and conformation in shire horse — Shetland pony crosses

G O Langstroth, **D R McRae** and **G W Stavraky** The secretion of protein material in the parasympathetic submaxillary saliva

M Klein Relation between the uterus and the ovaries in the pregnant hamster

C H Waddington Studies on the nature of the amphibian organization centre (7) Evocation by some further chemical compounds

R D Preston The structure of the walls of parenchyma in *Avena* coleoptiles

C S Hanes and **Margaret Cattle** Starch iodine coloration as an index of differential degradation by the amylases

Edinburgh

Royal Society, June 6

Enid Charles Differential fertility in Scotland, 1911 1931 (1) Tables were presented giving gross reproduction rates in 1911 and 1931 for the counties of Scotland, for the total small burghs and landward areas in each county and for the large burghs and cities Between 1911 and 1931 the range of fertility in Scottish local areas has contracted and the percentage fall has been greater where initial fertility was higher The highest current fertility is found in the Clyde industrial area and in some relatively prosperous agricultural regions The lowest fertility is found where the textile industry is important and in some of the crofting counties

R M Neill Food and feeding of the brown trout (*Salmo trutta* Linn) in relation to the organic environment A detailed quantitative study of the invertebrate population of a defined river area and of the food of trout therein The range of the trout's diet —the potential range of which is controlled by the physical environment—is indefinite, covering all the co existing fauna of its habitat Species are fed on to an extent depending on their degree of accessibility and the extent of their representation in the fauna This is sufficient to account for the nature of stomach contents without invoking discrimination on the part of the fish

V Tchernavin Malformations in the adult salmon as a key to the understanding of the fate of smolts during their sojourn in the sea A detailed examination of two salmon with injured opercula shows the disturbances to be more deep seated than apparent externally The operculum preoperculum suboperculum and branchiostegal rays are considerably involved and in one of them the chondrocranium also The gills on the injured side are much reduced From a consideration of these and other malformations not infrequent in salmon coming in to spawn the author concludes that the enormous loss of smolts in the sea is due to periodical catastrophes Further, that these periods are of short duration and are not the result of a struggle for existence as usually understood

J A Moy Thomas and **Bradley Dyne** The actinopterygian fishes from the Lower Carboniferous of Glencartholm Eskdale, Dumfriesshire The actinopterygian fauna of the Lower Carboniferous of Glencartholm Eskdale Dumfriesshire, has been re examined and the general anatomy of these forms redescribed with particular reference to the dermal skull bones *Rhadinichthys fusiformis* was found to include *Rh angustulus* and the Glencartholm specimen of *Elonichthys striatulus* Three species, *Mesopoma pulchellum* *M politus* and *M crassum* have been separated from the genus *Canobius* Two new genera, *Paramesolepis* and *Proteurynotus* have been erected The nature of the bones of the snout region in palæoniscids is discussed and it is concluded that the premaxillary of teleosts is absent in the majority of Palæoniscids

E M Anderson Dynamics of sheet intrusion, with some considerations on faulting Use is made of C E Inglis's formulæ for the stresses surrounding plane cracks, in a solid under tension These can be applied, with slight modifications, to the case when the crack is filled with fluid under hydrostatic pressure

Gunnar Dahlberg Rare defects in human populations with particular regard to the inbreeding and isolate effects A suggested way of decreasing rare recessive defects is prevention of cousin marriage In a large isolate, there are not many cousin marriages In a small isolate on the other hand, there may be many cousin marriages but there cannot be an infrequent gene These factors are balanced so that the effect of preventing first cousin marriages is a decrease of the very rare defects with a maximum of 30 per cent but, in practice, the figure is expected to be, and is, about 15 per cent Another mechanism which may decrease the frequency of rare recessives is crossing over boundaries of pre existing isolates The frequency of cousin marriages in Germany has decreased from 0 70 per cent to 0 20 per cent in the last fifty years From this is to be drawn the conclusion that isolates are more than doubled through crossing over their former boundaries This must have decreased the frequency of rare recessives to less than half its former values This process has brought about an increase of heterozygotes and a decrease of homozygotes

Paris

Academy of Sciences, May 23 (C R 206 1517 1600)

Alexandre Guilliermond and **Roger Gautheret** Observations on the action of various colouring matters on living plant cells Plant cells are permeable to acid colouring matters under special conditions, whilst basic colours penetrate easily Some fix themselves easily on the cytoplasm and the nucleus and these are the most toxic Others less toxic colour both the cytoplasm and the vacuoles The least toxic, such as neutral red accumulate exclusively in the vacuoles

Serge Bernstein The inverse problem of the theory of the best approximation of continued functions

Marcel Godchot and **Mlle Germaine Cauquil** The preparation of two stereoisomeric 2 methyl 1 cyclohexanol 1 carbonic acids

Jean Cabannes, Jean Dufay and **Junior Gauzit** Atmospheric sodium The sodium found at an altitude of about 130 kilometres is most probably of cosmic origin

Louis Couffignal The general solution by mechanical means of the fundamental problems of deductive logic

François Châtelet Rational points and the classification of curves of genus one

Marc Krasner A generalization of the local theory of bodies of classes Conductor law of unicity law of ordination, law of existence

Jan Potoček A remark on the reversible chains of Markoff

Damodar Kosambi The spaces of generalized paths which can be associated with a Finsler space

Alexandre Ostrowski The moduli of zeros of integral functions

H Heins A theorem of existence in the theory of interpolation

Julius Wolff The trajectories defined by the equation $dz/dt = w(z)$ a holomorph function with real positive part in the demi plane $D(x \succ 0)$

Kwok Ping Lee The directions of Borel of meromorph functions of infinite order

Jean Dufay The spectra of comet nuclei and the bands of the CH molecule

Jean Lagrula The values of gravity in the Sahara and the Sudan Table of results for 58 new stations

Jean Roubaud Valette Mass and gravitation

Georges Dechêne Study of a semi conductor with alternating current

Henri Morin An oscillator of relaxation with a double grid valve

Jean Lucien Andrieux and **Marcel Chêne** The electrolytic preparation and properties of iron phosphide, FeP The method described readily furnishes the phosphide FeP in pure crystals

Mlle Marguerite Quintin The normal potential of cadmium and the radius of the cadmium ion in solutions of the benzene sulphonate

Albert Michel Lévy and **Henri Muraour** The metallic spectra obtained by shattering explosives

Jean Lecomte Infra red absorption spectra of the trisubstituted derivatives of benzene The symmetry of benzene

Georges Carpéni The ultra violet absorption spectra and dissociation constants of the α ketonic enediols Reductone reductinic acids *l* ascorbic and *d* gluco ascorbic acids

Raymond Rohmer The dehydration of cobalt sulphate with 7 gm mol water The intermediate hydrates

Roger Perrot The reactional aptitude of nitrosyl chloride

P Boischot and **G Drouineau** The presence and constitution of ferruginous concretions in a Mediterranean soil

Georges Choubert and **Louis Neltner** Phenomena of intrusion and metamorphism in the Pre Cambrian at Kerdous (Morocco)

Maurice Roques The discovery of limestones with entrochites and of basic eruptive rocks in the metamorphic schists of Génis (Dordogne)

Jean Coulomb and **Georges Dugast** The variations of terrestrial magnetism accompanying chromospheric eruptions

Pierre Bernard The solar cycle in micro seismic agitation

Paul Becquerel Cellular freezing and syneresis

Mme Lucienne Lavier George Floral anomalies in *Narcissus pseud Narcissus*

Pierre Lassablière Maurice Uzan and **Alain Monnet** The trophophylactic power of certain edible oils towards toxic substances

Mlle Andrée Durivault First contribution to the study of the action of calcium salts on *Aconitum palmatum*

Achille Urbain Raymond Cahen and **Jean Servier** The cryoscopic point of the serum of various mammals

Cracow

Polish Academy of Science and Letters, April 4

T Banachiewicz (1) The principles of a new technique in the method of least squares (2) The fundamental relations between the elements of a spherical polygon formed by arcs of small circles

L Marchlewski and **B Skargynski** The absorption of ultra violet rays by certain organic substances (47)

K Dziewonski and **W Dymek** A method of synthesis of compounds diaryl derivatives of 2 4 diaminoquinoline

R J Wojtusiak and **B Ferens** Experiments on the sense of direction from a distance and the velocity of return in birds The velocity of return to the nest and sense of direction in swallows (*Hirudo rustica*)

S Skowron Researches on the endocrine system of the hedgehog (*Erinaceus*) Histological changes in the testicles and the accessory glands of the genital apparatus of the male occurring periodically and under the influence of the endocrine stimuli

B Jalowy Heteroregeneration of the nerve terminations in tactile hairs

May 2

T Banachiewicz The principles of a new technique for the solution of linear equations

J Tokarski and **Mme H Gawinska** The micro planimetric analysis of Osnick (Volhynia) granite

W Szafer The Pliocene flora of the Carpathians found at Kroscienko on the Dunajec

L Monné Studies on the vital coloration of *Amœba* (*A proteus* and *A dubia*)

Mlle J Ackermann Histochemical researches on the lipids and carotenoids in the intestine of the hibernating frog

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

LECTURER IN MECHANICAL ENGINEERING in the School of Engineering Khartoum Controller Sudan Government London Office Wellington House Buckingham Gate S W 1 (July 20) marked Lecturer in Engineering

AN ASSISTANT LECTURER AND A DEMONSTRATOR IN PHYSICS in the Manchester Municipal College of Technology The Registrar (July 22)

LECTURER IN MECHANICAL AND ELECTRICAL ENGINEERING in the *Croydon Polytechnic*—The Education Officer Education Office Katharine Street Croydon (July 23)

UNIVERSITY LECTURER IN ANATOMY and a UNIVERSITY LECTURER IN PHYSIOLOGY in the *University of Cambridge* Dr F J W Roughton Department of Physiology Cambridge (July 2[illegible])

UNIVERSITY LECTURER IN PSYCHOLOGY in the University of *Cambridge—The Secretary General of the Faculties The Registry* Cambridge (July 25)

LECTURER IN ZOOLOGY in the University of Glasgow The Secretary *of the University Court* (July [illegible])

GOLDSMID PROFESSOR OF MATHEMATICS at University College London to give special attention to a branch of mechanics or applied mathematics *The Academic Registrar* University of London Senate House W C 1 (July 29)

DIRECTOR OF THE CHEMICAL RESEARCH LABORATORY Teddington —The Establishment Officer D S I R 16 Old Queen Street S W 1 (August 3)

ASSISTANT WORKS MANAGER at the Cordite Factory Aruvankadu (Nilgiri Hills) with qualifications in chemistry The Secretary Military Department India Office London S W 1 envelopes marked Ordnance Recruitment (Aruvankadu) (Sept 5)

SENIOR LECTURER IN ECONOMICS in the University of the Witwatersrand Johannesburg—The Secretary High Commissioner for the Union of South Africa (South Africa House Trafalgar Square London W C 2) (Oct 1)

ASSISTANT LECTURER IN PHYSICS at University College Southampton The Registrar

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy Vol 44 Section B No 10 The Bogs at Ballybetagh near Dublin with Remarks on Late Glacial Conditions in Ireland By Knud Jessen and A Farrington Pp 205 260 (Dublin Hodges Figgis and Co London Williams and Norgate Ltd) 4*s* [276

British Budget 1938 being an Exposition of the Money System and a Synopsis of the Author s Reformed Scientific National Monetary System (proposed 1926) in 100 Verses By Dr Frederick Soddy Pp 28 (Oxford The Author 131 Banbury Road) 1*s* [2'6

National Union of Teachers, Margate Conference 1938 Addresses by Dr Evan Davies Mrs Alderman K Wainwright F A King W I Stevenson His Grace the Archbishop of Birmingham F F Potter W I Hoare Miss K M Halpin Pp 72 (London National Union of Teachers) 6*d* net [276

British Association for the Advancement of Science The Alexander Pedler Lecture 1938 Humanity in Geological Perspective By Prof H I Hawkins Pp 12 (London British Association for the Advancement of Science) 6*d* [286

Alkali etc Works Regulation Act 1906 and Alkali etc Works Orders 1928 and 1935 Seventy fourth Annual Report on Alkali etc Works by the Chief Inspectors Proceedings during the Year 1937 Pp ii+56 (London H M Stationery Office) 1*s* net [286

Department of Scientific and Industrial Research Forest Products Research Records No 24 African Pencil Cedar Studies of the Properties of *Juniperus procera* (Hochst) with particular reference to the Adaptation of the Timber to the Requirements of the Pencil Trade Pp iii+9+2 plates (London H M Stationery Office) 6*d* net [47

City and Guilds of London Institute Report of the Council to the Members of the Institute for the Year 1937 Pp lxii+106+3 maps (London City and Guilds of London Institute) [47

National Trust for Places of Historic Interest or Natural Beauty Report 1937 1938 Pp x+114 Properties acquired or protected during the Year 1937 1938 Pp 16+4 plates (London National Trust) [77

Transactions of the Institution of Chemical Engineers Vol 15 1937 Pp iv+260+1 plate (London Institution of Chemical Engineers) [77

Other Countries

Bulletin of the Bingham Oceanographic Collection Peabody Museum of Natural History Yale University Vol 6 Art 4 Further Observations on the Hydrography of the Eastern Caribbean and Adjacent Atlantic Waters By Albert Eide Parr Pp 29 (New Haven Conn Bingham Oceanographic Foundation) [246

Field Museum of Natural History Botanical Series Vol 17 No 5 Studies of the American Flora—1 By Julian A Steyermark (Publication 414) Pp ii+411-443 40 cents Zoological Series Vol 20 No 30 Notes on the Anatomy of the Treeshrew Dendrogale By D Dwight Davis Pp 383-404 25 cents Zoological Leaflet No 14 Turtles of the Chicago Area By Karl P Schmidt Pp 24+2 plates 25 cents (Chicago Field Museum of Natural History) [246

U S Department of the Interior Office of Education Project in Research in Universities Bulletin 1937, No 11 College Student Mortality By John H McNeely Pp vi+112 15 cents Bulletin 1937 No 14 Successful Practices in the Teaching of English to Bilingual Children in Hawaii By Prof Willis B Coale and Prof Madorah E Smith with the assistance of Jitsuichi Masuoka Pp xi+163 20 cents Bulletin 1937 No 15 Learning English Incidentally a Study of Bilingual Children By Prof J L Meriam Pp ix+105 15 cents Bulletin 1937 No 26 Education in the Southern Mountains Prepared by W H Gaumnitz Revised and edited by Mrs Katherine M Cook Pp iv+51 15 cents Bulletin 1937 No 37 Guidance Bibliography an Annotated List of Books Pamphlets and Periodical References on Guidance appearing during the Calendar Year 1936 Compiled by Marion H Witmer and Maris M Proffitt Pp v+71 10 cents Pamphlet No 79 Legislative Plans for financing Public Education By Timon Covert and Ward W Keesecker Pp v+43 10 cents (Washington D C Government Printing Office) [246

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 113 Studies on Coast Disease of Sheep in South Australia By H R Marston R G Thomas D Murnane E W L Lines I W McDonald H O Moore and L B Bull Pp 91+4 plates (Melbourne Government Printer) [276

U S Department of Agriculture Circular No 457 Mushroom Pests and their Control By A C Davis Pp 22 (Washington D C Government Printing Office) 5 cents [276

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 116 The Relation of Phosphate to the Development of Seeded Pasture on a Podsolised Sand Progress Report on Co operative Investigations at the Waite Agricultural Research Institute By Dr H C Trumble and C M Donald Pp 47+8 plates Pamphlet No 77 A Study of Persistency Productivity and Palatability in some Introduced Pasture Grasses By Dr A McTaggart Pp 16+3 plates (Melbourne Government Printer) [17

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 90 A New Procryptic Phasmid from Cuba (Orthoptera Phasmatidae) By James A G Rehn Pp 103 107 (Philadelphia Pa Academy of Natural Sciences of Philadelphia) [47

Memoirs of the Faculty of Science and Agriculture Taihoku Imperial University Vol 18 No 13 (Mathematics No 28) Beiträge zur Geometrie der Kreise und Kugeln (22) Von Sôzi Matumura Pp 275 323 Vol 21 No 1 (Mathematics No 29) Beiträge zur Geometrie der Kreise und Kugeln (23) Über Flächen und Kurven (19) Von Sôzi Matumura Pp 24 (Formosa Taihoku Imperial University) [77

Statens Meteorologisk Hydrografiska Anstalt Tillhor Årsbok 18 1937 Årsberättelse för 1937 Pp 19 Årsbok 19 1937, 1 Manadsöversikt över väderlek och vattentillgång Pp 78 2 50 kr (Stockholm Statens Meteorologisk Hydrografiska Anstalt) [77

Publications of the Dominion Observatory Ottawa Vol 12 Bibliography of Seismology No 17 Items 3828 3902 January February March 1938 By Ernest A Hodgson Pp 354 364 (Ottawa King s Printer) 25 cents [77

Imperial College of Tropical Agriculture The Report of the Governing Body the Principal s Report for the Year 1936 37 and the Accounts for the Year ended August 31 1937 Pp 38 (St Augustine Trinidad and London Imperial College of Tropical Agriculture) [77

U S Department of Agriculture Leaflet No 162 Screwworm Control By W E Dove Pp 6 5 cents Circular No 459 Effect of Imported Insect Enemies of the Satin Moth By T H Jones R T Webber and P B Dowden Pp 24 5 cents Technical Bulletin No 593 The Bean Weevil and the Southern Cowpea Weevil in California By A O Larson and C K Fisher Pp 70 10 cents (Washington D C Government Printing Office) [77

U S Department of the Interior Geological Survey Water Supply Paper 779 Geology and Ground Water Resources of South Central Nebraska with special reference to the Platte River Valley between Chapman and Gothenburg By A I Lugn and L K Wenzel Pp vii+242+16 plates 70 cents Bulletin 877 Geology and Ore Deposits of the Bayhorse Region Custer County Idaho By Clyde P Ross Pp vii+161+18 plates 1 dollar Bulletin 884 Geology and Mineral Deposits of the Snowmass Mountain Area Gunnison County *Colorado By John W Vanderwilt Pp viii+184+24 plates* 1 dollar Bulletin 889 Spirit Leveling in Kansas 1896 1935 Pp ii+88+1 plate 15 cents Bulletin 895 B Geophysical Abstracts 89 April June 1937 Compiled by W Ayvazoglou P ii+43 92 10 cents Bulletin 898 A Spirit Leveling in Missouri Part 1 Southeastern Missouri 1896 1937 Pp xiv+132+1 plate 25 cents (Washington D C Government Printing Office) [77

Kansas State College Bulletin Vol 21 No 9 Summary of Twenty five Years of Work in the Departments of Entomology and Zoology at Kansas State College Pp 55 (Manhattan Kansas State College) [77

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 90 What is Commelina Communis ? By Francis W Pennell Pp 31 40+1 plate A Revision of the Neotropical Euthymiae (Orthoptera Acrididae Cyrtacanthacridinae) By James A G Rehn Pp 41 102+7 plates (Philadelphia Pa Academy of Natural Sciences of Philadelphia) [77

Catalogues, etc.

Chemische Novitäten Bibliographie der neuerschienenen internationalen Literatur der reinen und angewandten Chemie und der chemischen Technologie Jahrgang 27, Heft 5 6 Marz Pp 137 232 (Leipzig Gustav Fock G m b H)

Germanistik Deutsche Niederländische und Nordische Philologie U A aus dem Besitz der Professoren Hugo Gering und Konrad Zwierzina (Antiquariatskatalog Nr 723) Pp 193 (Leipzig Gustav Fock G m b H)

Zeiss Nachrichten 2 Folge, Heft 5 Pp 149 181 (Jena Carl Zeiss)

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Vol 142 SATURDAY, JULY 23, 1938 No 3586

Co-operation in World Affairs

THE annual reports in which the Director of the International Labour Organization surveys world industrial conditions owe their exceptional value not only to the large resources of knowledge upon which they draw their wide outlook and measured but unequivocal judgments but also to the admirable way in which Mr H B Butler avoiding excessive occupation with the detail of the work of the Organization has given a balanced estimate of tendencies and changes in the economic and industrial situation for which the scientific worker no less than the economist or statesman should be grateful Mr Butler's latest and last report* is no exception and his review of current conditions is followed by an appreciation of the changed distribution of economic power in the world which should facilitate judgment as to the extent or severity of the recession in trade

On the purely economic side Mr Butler is indeed fairly hopeful Notwithstanding the continued political unrest and the hindrances deliberately put in the way of international trade the world has struggled back to a prosperity which if anything surpasses the level of well being in 1929 In spite of the severity of the American depression he anticipates an early resumption of activity and sees some signs of greater international co operation in trade and in currency matters

This optimism is however restrained and against this prosperity Mr Butler sounds two notes of warning First the present is an unstable prosperity and in part issues precariously from vast expenditure on armaments and the outlay of borrowed money Peace as well as prosperity depend largely on international trade The effort of nations to live more and more to themselves the pursuit of policies which make it imprudent to be dependent on other countries for essential supplies and consequent disengagement so far as possible from a world economic system—these all menace such comparative prosperity as we still enjoy While the energies of every great nation are primarily devoted to war economic development encased in a military strait jacket and social welfare subordinated to the construction of guns warplanes and battleships expectation of the future must be tempered with anxiety rather than hope

Secondly Mr Butler contrasts what prosperity at present exists with what might be enjoyed in a different atmosphere It is certain that genuine prosperity might have been more abundant and the prospects of endurance greater had not an excessive portion of the wealth of almost every country been diverted to war purposes As the International Chamber of Commerce recognized at Berlin last year in all countries the rapid progress of science and invention and modern methods of production and transport would permit of the standards of living being greatly improved provided the world would co operate in rational distribution In an atmosphere of autarchy or national competition there is no prospect of attaining the standard of feeding clothing health housing working hours or leisure which the vast technical progress of this century has brought within our grasp

It is well therefore to be reminded by this sober review that in spite of all the national experiments, many of which have achieved a considerable measure of success a high standard of living cannot be achieved by national effort alone No country can realize its full economic and social potentiabilities except as a part of the world community Failure to recognize this truth is not merely the gravest threat to prosperity everywhere The progressive subordination of the whole national life and the activity of every individual to the requirements of the State the cramping and distortion of individual freedom and economic expansion are already blocking some of the main lines of social advance and now threaten to sap the social edifice which this generation has raised

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*International Labour Office Twenty fourth Session Geneva, 1938 Report of the Director Pp 81 (Geneva International Labour Office) 1s 6d paper 2s 6d cloth

The sombre picture which Mr Butler gives is one which requires careful consideration by all thinking men including scientific workers as such Only by a determined effort can the present progressive deterioration be averted and that effort is now demanded in the interests of science itself Moreover though science cannot take more than a small part of the blame for mankind's failure to utilize scientific knowledge to the fullest advantage in service of man's daily needs or for the use of scientific knowledge for destructive purposes scientific workers are also citizens and as such must accept the greater responsibilities which their knowledge and training entail

It is not of course within the scope of Mr Butler's report to suggest ways and means of securing action He can only give a warning and it is one to be heeded by scientific workers Moreover the report is not without certain suggestions which merit their special attention In discussing the question of unemployment Mr Butler points out that although in most countries the employment situation was much better in 1937 than at any time since 1929 due partly to demands for war material and the expansion of armed forces there is in many countries a marked shortage of skilled workers This is due partly to military requirements but mainly to the failure to educate a sufficient number of apprentices during the depression Accordingly it is suggested that the whole question of industrial education and training for industry should be reconsidered

This is a question with which scientific workers are very closely concerned Even in regard to the problem of training for technical positions in industry professional associations cannot be said to have given anything like adequate attention to the many important questions involved The great demand in mechanized industry for highly trained workers possessing a wide range of technical knowledge cannot be met without their co-operation Apart altogether from its reaction on the position and efficiency of the scientific worker in industry the solution of this problem has social aspects at least as important as its effect on industrial efficiency The provision of such highly trained workers would do something to counteract the ill effects of the monotony of mechanization which have sprung up with the passing of the craftsmen and would also make for the mobility of labour and lessen the tendency of specialized work to create men who are unemployable in other capacities

Here and elsewhere as in its references to the work on nutrition the extension of the principle of social insurance the continued tendency towards shorter hours of work the report marks signs of progress and opportunities for further advance by international co-operation The main value of the report lies however in the world picture it gives and the clear warning it sounds as to the danger of certain policies which are widely countenanced to-day No thoughtful reader can fail to recognize the necessity for facing a changed situation and evolving new methods to deal with it The very expansion of the activities of the International Labour Organization itself to meet the increased need for international co-ordination with the passing of economic *laissez faire* the increased importance attached to the problems of agriculture migration housing nutrition indigenous labour attest the existence of an immense amount of international co-operation even in these days of anxiety and unrest and forecast the immense opportunities of development in many of which scientific workers have their part to play

Beyond this the distribution of economic power is shifting The economic development of the Far East is inevitable and there is little doubt that Europe will ultimately lose some of its pre-eminence in the economic sphere a process likely to be accentuated by the division of Europe into groups pursuing different social objectives and working upon different economic principles Here again are problems to be worked out rather than fought out and Mr Butler's survey is pregnant with challenge to commercial and industrial statesmanship

Ultimately however it is the challenge to men of good will everywhere to unite in the task of securing for all mankind the advantages which the achievements of modern technology have put within our grasp that most commends the report The prostitution of scientific knowledge to destructive purposes and the pursuit of retrograde national economic policies threaten the whole social edifice and with it the freedom and continuity of scientific work itself For scientific workers Mr Butler poses clearly the question whether they are prepared to take up the arduous task with their fellow citizens of evolving means of arresting the drift to disaster making their own special contributions to the solution of specified technical problems or by their indifference and neglect allowing the forces of disruption and retrocession to gain strength until scientific workers are overwhelmed with the rest

British and German University Enrolments

IN another column (p 175) we print an article on Numerical Changes in the German Student Body by Dr E Y Hartshorne of Harvard author of German Universities and National Socialism The main conclusions in Dr Hartshorne s article may be summarized by saying that the reduction in number of students in German universities and seats of higher learning was approximately 42 per cent between 1932 and 1937 so that where there were a hundred in 1932 there were only fifty eight in 1937 The process has since continued and it seems probable that there are now not more than half the number of students in Germany that there were in 1932 Of the survivors more than a third—approximately 34 per cent in 1937—were students of medicine The great reductions have been in humanities in pure science and in law and allied studies These conclusions naturally suggest an inquiry whether there are similar tendencies if of a less degree in the British student body A preliminary investigation of the returns of the Universities Grants Committee shows that this question must be answered in the negative

Since the academic year 1933 34 there has been a slight fall in the number of students entering British universities The changes are of the order which those who administer universities regard as normally associated with fluctuations of prosperity There is no reason to suppose that they have any permanent or deeply seated social causation Moreover within the British student body itself there are only minor fluctuations in the distribution of numbers The British classifications are scarcely comparable to the German but with due reservations it is possible to construct tentatively a comparative table of student groups in Great Britain and Germany expressed as percentages of the total enrolment in each country Such a table can be interpreted however only in the light of the enormous absolute fall in the total number of German students

It will be seen that the highly significant drop, both relative and absolute in the sciences and in engineering in the greatly diminished German student body has no parallel in the British universities A distant analogy may be suggested in the rise in the percentage in medical studies in the two countries The relatively greater attention paid to these by British students is however easily explicable by the rise in importance of the social services in Britain and the increased demand for British trained medical men overseas

PERCENTAGES OF TOTAL ENROLMENT

	1932 33	1936 37
Agriculture Great Britain	1 6	9
Agriculture Germany	1	
Pure Science Great Britain	16	10 3
Natural Science and Mathematics Germany	11 1	7 0
Technology Great Britain	9 0	9
Engineering Germany	12 5	11 4
Medicine Great Britain	4	6 7
Medical Sciences Germany	7 9	33 9

So far as foreign students are concerned the movement in Great Britain is in the opposite direction to that in Germany The report of the Universities Grants Committee notes that the number of students from overseas in British universities reached in 1936 37 the record figure of 6 792 This is an increase of about 50 per cent over 1932 33 Dr Hartshorne records a decrease in the number of foreign students in Germany from 6 693 in 1932 33 to 4 768 in 1936–37 The Universities Year Book of the British Empire shows the countries of origin of students from abroad in British universities The numbers from Germany in the six years 1932–33 to 1936 37 were respectively 169 375 436 439 416 444 These may be compared with the corresponding numbers of students from Holland 46 55 42 55 69 58 and from France 80 73 81 78 76 50 We leave our readers themselves to judge whether the increase in the number of students from Germany since 1933 is due to an increased recognition of the advantages of study in Great Britain or to the racial and other limitations which are now imposed in that country upon entrance to universities

Biological Aspects of Health

Biologists in Search of Material
An Interim Report of the Work of the Pioneer Health Centre Peckham Pp 104 (London Faber and Faber 1938) 2s net

A SMALL company of private individuals established what they described as a Pioneer Health Centre in April 1926 in a small house in Peckham London It was situated in the middle of a densely populated artisan district and staffed with a resident medical officer a social secretary and a housekeeper Families living in the neighbourhood were invited to join a family club for a small weekly sum in return for which they were offered a periodic medical and dental overhaul for each individual a parents clinic with men and women doctors ante natal post natal and infant welfare clinics and to these were added an orthopædic clinic and a children s afternoon nursery The service offered to each family was advisory No disease received treatment at the centre Its objects were inquiry social and medical investigation to evoke a desire for health to detect and direct attention to the beginnings of disease and to give advice as to how to procure necessary and effective treatment After several years experience an explanatory book was issued entitled The Case for Action (1931) and now a report is published under a rather formidable and ambiguous appellation of the principal findings

The document now issued explains the growth and expansion of this interesting and somewhat unusual family club in and around which various social activities have grown up The report is concerned with the incidentals of the readjustment and rehabilitation of the sick and the promotion of health But it necessarily raises many large social and medical questions some of which are controversial and others open up issues which are not perhaps as fully considered or presented as the reader would like The Case for Action was widely criticized locally at the time because it seemed to be insufficiently realistic of the actual public services provided for the control and treatment of disease and for the promotion of public health in Peckham and elsewhere The Case seemed to be more one for amendment of private practice and the existing medical services than the establishment of yet another form of clinic and one not easily assimilable with existing institutions Perhaps the conservative mind of the British public did not apprehend the purpose of a social club for families to have periodic medical examination without a bottle of medicine perhaps the purpose itself was presented in terms too technical and philosophical to be attractive to the lay mind However this may be the scheme has reached a stage when it is evident that it has confirmed some of the findings of Sir James Mackenzie s work in Burnley and at St Andrews and not a few of the findings of the institutions in America which advocate and practice the periodical medical examination of the normal person There is much to be said for this as the Metropolitan Life Insurance Co of New York long ago proved as Mackenzie proved the value of early subjective symptoms Whether our urban populations are better satisfied when the medical man is biologist and themselves are material is another question There is certainly no one more popular with them than the family doctor and none more keen on health when they understand it We must remember that Hippocrates himself said if you miss being understood by laymen you will miss reality

One thing is equally plain The Peckham Health Centre has excellently demonstrated beyond all doubt or question the great principle old and ever new of the importance of seeing and knowing the *family* both in diagnosing disease and in teaching the individual the way to health and still more in detecting disease which is minor or unsuspected This was one of the advantages of the old fashioned family physician But this is not the only advantage revealed by the Centre There is also the gain of a regular overhaul (so much advocated in America and so little practised in England) It would also be well that such examinations of the normal should have the purpose of health education rather than the objective of detecting unforeseen disease One of the strong points indeed the primary purpose of the Centre is the promotion of personal hygiene its assessment and indications and the increase in length of life in capacity and in well being and happiness which may result from it

We are glad that the promoters in this second statement are more positive and constructive than in The Case for Action —and naturally so as the result of their labours—and are consciously or unconsciously wisely adjusting their case to the current advances in national health and the progress which has occurred in the locality since 1926 The sections dealing with the methods of examination and with nutrition are excellent and full of suggestion to many other clinics Indeed their experience in regard to nutrition is timely and very instructive The Centre families have no shortage of food and are in contact with good and cheap markets and able to obtain sufficient and suitable food, *and yet there is malnutrition*, some of it severe. In short, the problem of nutrition cannot be solved by confining ourselves to food, quantity or quality. Apparently iron and calcium deficiency, the presence of worms, various febrile states, and ineffective assimilation of the food are responsible for much of the poor nutrition. Thus it seems there is no panacea for malnutrition, not even family allowances. Its cause, or one of its causes, is ineffective utilization by the body of the food consumed. This section of the report is very illuminating.

It seems that the Centre is not recruiting or keeping its membership quite as much as it had anticipated, and is not receiving all the support it had fairly hoped for, with the result that it is unduly restricted in the fulfilment of its purpose. This, we fear, is the usual disability of all pioneers. But the promoters of the scheme need not despair; their report contains positive elements of utility, and they have accomplished much in health education.

Hamilton and Geometrical Optics

(1) Geometrical Optics:

an Introduction to Hamilton's Method. By Prof. J. L. Synge. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 37.) Pp. ix + 110. (Cambridge: At the University Press, 1937.) 6s. 6d. net.

(2) Geometrische Optik.

Von C. Carathéodory. (Ergebnisse der Mathematik und ihrer Grenzbegiete, Band 4, Heft 5.) Pp. iv + 104. (Berlin: Julius Springer, 1937.) 9.90 gold marks.

(1) FEW men were more versatile than Sir William Rowan Hamilton (1805-1865). In early youth he showed amazing linguistic ability, and attained a high standard in Latin, Greek, Hebrew, Italian, French, Persian, Arabic, Chaldee, Syriac, Sanskrit, Hindustani, Bengali, and other languages. He then turned to mathematics, astronomy and physics, and at the age of seventeen years he began to produce original work in geometrical optics. Hamilton's achievements were so great and so varied that it has taken the scientific world a long time to appreciate their full extent. Nineteenth century mathematicians esteemed him principally for his theory of quaternions. Since the rise of quantum mechanics, we now realize the fundamental importance of Hamiltonian dynamics. His optics, although his earliest work, has been the last to be appreciated.

The long neglect of Hamilton's methods in geometrical optics may be attributed to the fact that he attached primary importance to their theoretical aspect, and so he allowed his extensive work on the practical applications to the design of optical instruments to remain unpublished. These manuscripts were almost unknown until 1931, when they were printed in volume 1 of his "Collected Papers" (edited by A. W. Conway and J. L. Synge). Another reason why practical designers have neglected Hamilton's work is that, as published, it dealt throughout with the highly general and difficult case of anisotropic media, although it had been originally worked out for the much simpler isotropic case, which is all that is usually needed.

Hamilton's method is based on Fermat's principle, originally stated in the metaphysical form, "Nature always takes the shortest path." More accurately, the path by which light travels from one point A' to another A will be such that the time taken will be, in most cases, the least possible (and in general what is called 'stationary'). Hamilton's *characteristic function* V is proportional to this time, and theoretically all his results are obtainable from the mathematical conditions that V should be stationary. In practice, however, it is difficult to calculate V for an optical instrument. It is easier to deal with the *angle-characteristic* T, proportional to the time from N' to N, where N' is the foot of the perpendicular from a fixed point O' on to the initial ray, and N is similarly derived from the final ray and another fixed point O. We can also use the *mixed characteristic* W, proportional to the time from A' to N. H. Bruns (1848–1919), who, unacquainted with Hamilton's work, rediscovered part of it, though in a more complicated form, introduced the term *eikonal*. One of his eikonals was equivalent to Hamilton's T. Others were obtained by drawing planes through O' and O perpendicular to the axis of the instrument, cutting the initial and final rays in P' and P respectively, and then considering the time from N' to P, or from P' to N. These eikonals are functions of four variables, whereas V involved six, W five, and only T as few as four. Prof. Carathéodory considers that Bruns made an important advance on Hamilton's work in this respect, but Prof. Synge strongly dissents from this opinion, and declares that the use of the word eikonal is neither necessary nor desirable. His tract is a simple and straightforward account of

V W T with their applications to the leading properties of optical instruments He deals with the relation between object and image the foci focal lines and planes nodal points principal points magnification the defects (spherical aberration astigmatism coma curvature of image and distortion) Abbe s sine condition and some cases of dispersion (chromatic aberrations) For the system treated as a whole Hamilton s methods (or their modifications) seem the most powerful yet devised though for isolated problems shorter solutions can be found

(2) Instead of starting from Fermat s principle geometrical optics may be based on Huygens s principle that the wave front is the envelope of secondary waves the centres of which are on a previous wave front The rays (in an isotropic medium) are the normals to these wave fronts Prof Carathéodory reversing Hamilton s procedure starts with Huygens s principle which he develops by the aid of Cauchy s theory of characteristics of differential equations This leads to Poincaré s and Cartan s theorems on integral invariants which are generalizations of Malus s theorem that rays initially normal to some surface finally emerge after any number of reflexions and refractions as normals to another surface Much stress is laid upon *canonical direction co ordinates* which are analogous to the momentum co ordinates used in Hamilton s dynamics The usual equations of the calculus of variations expressing the conditions for a stationary path are replaced by the canonical equations of the Hamiltonian function again as in dynamics In the subsequent work a great part is played by Lagrange s brackets and canonical transformations Rather unexpectedly these lead to the eikonals and we suddenly realize that the formidable pure mathematics has after all a physical application However Prof Carathéodory s emphasis is certainly on the mathematics while Prof Synge s is on the physics Both books may be warmly commended and the fact that Hamilton s work can be developed in two such different ways is evidence of the versatility of his genius

H T H PIAGGIO

Presentation of Physical Chemistry

(1) An Introduction to Physical Chemistry

By F A Philbrick Pp ix + 368 (London J M Dent and Sons Ltd 1937) 5*s*

(2) Elementary Physical Chemistry

By Prof Hugh S Taylor and Prof H Austin Taylor Second edition Pp xiv + 664 (London Macmillan and Co Ltd 1937) 16*s* net

(3) Lehrbuch der physikalischen Chemie in elementarer Darstellung

Von Prof Dr John Eggert Vierte verbesserte Auflage Pp xii + 681 (Leipzig S Hirzel 1937) 25 50 gold marks

(4) Praktische Einführung in die physikalische Chemie

Von Karl Lothar Wolf und Hans Georg Trieschmann Erster Teil Molekule und Krafte Pp viii + 114 (Braunschweig Friedr Vieweg und Sohn 1937) 4 80 gold marks

(1) IN recent years physical chemistry has been specifically included in the syllabuses for the various higher school certificate examinations and this book is intended for students who are working for these and similar examinations All the topics generally included in elementary physical chemistry are discussed and in addition there is a useful chapter on the theory of analysis The treatment is simple and clear and essentially descriptive rather than mathematical The point of view is commendably modern the student whose knowledge of physical chemistry is based on this book will find that he has little to unlearn during the course of his more advanced studies at the university Subjects such as radioactivity isotopes atomic structure and electronic theory of valency are not included and the author has wisely avoided a number of other matters which are much better left to a later stage

The reviewer s chief criticism of the book as a whole is that the historical background has been almost entirely ignored Traube and Pfeffer are not mentioned in connexion with osmotic pressure where the only names recorded are those of Morse and Frazer and Graham finds no place in the chapter on colloids where due credit is given to von Weimarn and to Bredig There are however many good points about this book it would be impossible to refer to them all but special mention must be made of the neat deduction from the kinetic theory of the pressure of an ideal gas

When another edition is in preparation the author would perhaps consider making some small changes for example it is doubtful whether sulphuric is weaker than hydrochloric acid (p 103) and whether simultaneous adsorption of both reactants is generally involved in heterogeneous catalysis (p 120) The molecular conductivity has fallen into disuse for good reasons and should be replaced by equivalent conductivity A phase diagram for phosphorus would help considerably in connexion with the description on p 302, and mention of the terms enantiotropy and monotropy would not be out of place there These matters are, however, relatively unimportant, for the book is one which can be recommended for its intended purpose, both pupils and teachers should benefit from its use

(2) The first edition of Taylor's well-known "Elementary Physical Chemistry" suffered to some extent from the fact that it had been adapted from the two-volume treatise compiled by a number of different authors there were certain gaps and some inequalities of treatment The appearance of a new edition, revised by Profs H S and H A Taylor, is to be welcomed, because there has now been an opportunity for the material to be welded into a more coherent whole

In addition to a general revision, two new chapters have been introduced, one deals with the development of the quantum concept and its application to atomic and molecular systems, whereas the other considers these applications in more detail with reference to gases, and includes such subjects as rotational and vibrational heat capacities, ortho- and para-hydrogen, and zero-point energies Elementary quantum concepts have also been introduced into the chapter on the velocity and mechanism of chemical reactions, and this portion of the book, as is to be expected from its authors, is of exceptionally high standard

The section on the atomic concept of matter has been brought up to date, but it is unfortunate that the impression is given (p 36) that the nucleus is still considered to consist of protons and electrons In accordance with modern ideas the treatment of solutions is based on Raoult's law, the authors should, however, have given greater emphasis to this point in the discussion of ideal solutions (p 327). Although the chapters on electrochemistry are quite good, the treatment of salt hydrolysis is open to criticism, and it is hoped that an early opportunity will present itself for this section to be amended

The book concludes with three appendixes, dealing respectively with the deduction of Maxwell's distribution law, of Planck's expression for the mean energy of a linear oscillator, and of the imiting law of Debye and Hückel The first and ast of these involve fair mathematical skill, and t has evidently been considered advisable to keep them out of the main body of the text this procedure will meet with the approval of many students who are still finding their way among the foothills of that imposing mountain range which is physical chemistry

Since the first edition of this book was published n 1927 it has been reprinted four times, and there s every reason to expect, from its content and style, that the demand for the new edition will be even greater

(3) Although the third book on the list is described as an "elementary presentation", it is doubtful whether it could be appreciated by a reader who has not already some knowledge of the fundamentals of physical chemistry, and this point should be borne in mind The treatment of atomic structure, and of related topics, is particularly good, but a severe critic might question the wisdom of devoting more than a quarter of the book to the consideration of atomic and molecular structure, although less than four pages are accorded to the modern theory of valency There is always a danger, when writing a relatively advanced text-book, of occupying too much space with matters in which the writers are specially interested or which happen to be topical, with the result that others of fundamental importance are treated too briefly This may be illustrated by the fact that in this book only 16 pages are given to the osmotic properties of dilute solutions, including experimental methods and diffusion in the opinion of the reviewer, this is too small a proportion of a book with 640 pages of text

The arrangement of the material is unusual in some respects, although it could probably be readily justified It is surprising, however, to find that the phase rule is not mentioned until after the treatment of one- and two-component systems Nevertheless, this is one of the most interesting of modern text-books of physical chemistry Its wide appeal is shown by the translation of earlier editions into English, Italian, Russian and Spanish, and four German editions have been published in eleven years

The present issue, like its immediate predecessor, has been revised by the author in conjunction with Dr Lothar Hock, and it is quite evident that the work has been well done not only have many portions been rewritten or rearranged, but also the material added has necessitated an increase of nearly 80 pages The book has one disadvantage from the point of view of readers in Great Britain and in the United States the thermodynamic symbols are not those generally employed in these countries

(4) The book by Wolf and Trieschmann is of an unusual type it is not so much a text-book of practical physical chemistry as an account of the principles of the subject A number of exercises are suggested and their theoretical basis explained, but for experimental details the reader is referred to standard German texts of theoretical and practical physical chemistry and physics Where these are available this small book, which covers the field of ions, atoms and molecules, and gases and liquids, should be very useful, but otherwise its value is restricted. S G.

Physiological Chemistry of the Bile

By Harry Sobotka Pp xii + 202 (London Baillière, Tindall and Cox, 1937) 13s 6d

THIS volume aims at providing the experimental worker in physiology, pharmacology and experimental medicine with a survey of our present knowledge of the biliary secretion It is intended to be read however, in conjunction with a companion volume by the author called Chemistry of the Sterids" Without reference to the latter, certain sections on the bile acids in the present book are not clear, since the author refers to the rings and carbon atoms of the bile acid structure by numbers, for example, 'ring III', $C_{11}-C_{12}$', these sections would be much easier to read if a skeleton structural formula of the bile acids with the rings and C atoms appropriately numbered were included, thus avoiding unnecessary references to the companion volume

The first half of the book deals mainly and thoroughly with the composition of normal bile, and there is an introductory chapter on the general physiology and structural relations of the tissues involved in bile formation One feels that a book on the physiological chemistry of the bile is incomplete without at least a brief account of the bile pigments, a discussion of which has been excluded from the present volume The author however, disarms criticism by stating that they could not be treated adequately without an extensive exposition of the physiology of the blood pigments and the chemistry of pyrrole derivatives

The last half of the book deals mainly with the pharmacological aspect, especially with choleretics and cholagogues A brief account is also given of bile and bile acids in pathological conditions

The book should be stimulating to research workers, since gaps and uncertainties in our knowledge of the bile, together with suggested lines of investigation, are clearly indicated and constantly referred to by the author Many of the earlier results in this field require re investigation There is an extensive bibliography, which occupies one quarter of the book The latter has the merit of satisfying a need and of collecting together in an orderly fashion a large number of scattered data concerning the biliary secretion R T W

On Guard against Gas

an Account of the Principles of Gas Warfare and of the Steps to be taken by the ordinary Citizen to defend his Family By H A Sisson Pp 91 (London Hutchinson and Co (Publishers), Ltd, n d) 2s net

IT is a pleasure to turn to a book dealing with poison gas which has been written by an expert who has had personal experience of it not only in the laboratory and experimental ground, but also on the battlefield itself Major Sisson held an important appointment in the Gas Directorate of the British Expeditionary Force during the Great War, and he has first hand knowledge of the practical use of gas and can estimate its probable effects if it is employed against a civil population His opinions, therefore, should carry weight with the majority of people, who are naturally ill informed in a matter remote from their ordinary experience and have been grossly misled in the past by sensational writers

The author considers that gas would be a minor danger in an air raid if people can be made to understand it Besides being told what precautions to take against it, they ought to learn the reasons for the recommendations made It may not be possible to make one s home safe against fire and explosives but it can certainly be made reasonably proof against gas, and scarcely any serious casualties need be expected from it among a fully instructed community

The book is not intended to be a substitute for the official A R P Handbooks, which the author considers excellent, but to supplement them by giving a more general view of the subject in the form of a connected story It describes in non technical language the different kinds of gas that are most likely to be used in air raids and explains their action and the method of catching them in modern respirators There are also chapters on the experience gained from the Great War in regard to the employment and effects of gas, and on the preparation of gas shelters in the home

This excellent little book is within the reach of every pocket and it should be widely read especially by nervous householders C H FOULKES

Bio-Politics

an Essay in the Physiology, Pathology and Politics of the Social and Somatic Organism By Morley Roberts Pp xv + 240 (London J M Dent and Sons, Ltd 1938) 15s net

MR MORLEY ROBERTS S study of the social organism as he admits and indeed proclaims, is based on analogy, specifically on the thesis that the communities of bees, ants and termites and therefore also human societies, resemble organisms 'Whatever the groups, the laws of organic development which produce order, form, interdependence and differentiation are everywhere the same Hence studies in the pathology of single animals can be applied to the functions of social and national groups 'Where protoplasmic units, however simple or complex, work together in symbiosis or communal life, they can best be considered as organisms, and as such liable to the diseases and disorders which change or destroy them He is not afraid of carrying his analogies to an extreme For example "After what was said earlier on immunity, students of medicine will have no difficulty in thinking that sarcoma, or malignant revolt of various connective tissue elements, may be nearly matched by a revolt of the police '

It would take many pages to explain that Mr Roberts s assumption of the existence of biological laws of any kind is rash, as the "laws" are no more than abstractions from observations limited strictly to the precise conditions in which they were made, and without wider validity But he is a writer of great ability, and has collected a large number of interesting facts, so that his book is stimulating and useful

Geology and Archæology of the Hadhramaut, South-west Arabia

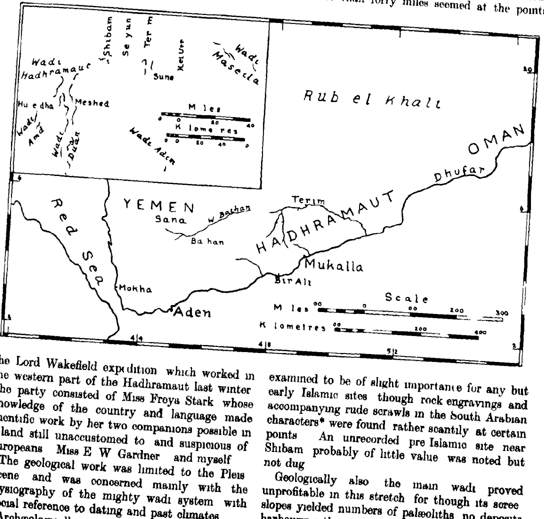
Preliminary Notes on the Lord Wakefield Expedition

By Miss G Caton-Thompson

ON September 18 1937 Dr S A Huzayyin gave a preliminary account in NATURE of the results of the Egyptian University Scientific Expedition to the Yemen and Hadhramaut It may be advantageous therefore also to record in brief the geological and archæological results of the Lord Wakefield expedition which worked in the western part of the Hadhramaut last winter The party consisted of Miss Freya Stark whose knowledge of the country and language made scientific work by her two companions possible in a land still unaccustomed to and suspicious of Europeans Miss E W Gardner and myself

The geological work was limited to the Pleistocene and was concerned mainly with the physiography of the mighty wadi system with special reference to dating and past climates

Archæologically we were confronted by a land of romantic traditions centring round the incense trade of which the early material culture was virtually unknown and which consequently had tended to become a dump of untested theory not unusual in regions where literary and epigraphical records have been unpartnered by archæological facts Consequently all relics of pre Islamic habitation irrespective of date were welcomed provided only these were found in association and *in situ*



The Wadi Hadhramaut from Terim westwards for more than forty miles seemed at the points examined to be of slight importance for any but early Islamic sites though rock engravings and accompanying rude scrawls in the South Arabian characters* were found rather scantily at certain points An unrecorded pre Islamic site near Shibam probably of little value was noted but not dug

Geologically also the main wadi proved unprofitable in this stretch for though its scree slopes yielded numbers of palæoliths no deposits harbouring them *in situ* were found If gravel terraces exist they are deeply blanketed by great deposits of æolian silt which floor the valley and drown the lower talus slopes

In the Wadi Amd a northward draining major tributary of the Wadi Hadhramaut where shortly before Christmas we settled in the little town of Hureidha luck changed and we were kept busy with a superabundance of material and its systematic excavation

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* It seems better to avoid the terms Himyaritic and Sabæan or their compound until they are chronologically and geographically defined by archæological method

GEOLOGY*

The Wadi Amd is two to three kilometres broad and is floored like the main valley with a gently sloping fine æolian silt a deposit partly wind partly water laid Bordering the main flood channel gravel is exposed both in terraces and interbedded with the silt These we were anxious to date for after the original cutting of the valley to some unknown depth the deposition of gravel and silt were the most important events in its history There are three terraces The highest and best developed lies at ten metres above the wadi floor the lower ones are laid against it at five and three metres

The ten metre terrace is distinguished from the others by the æolian silt interbedded in it and in places overlying it This is identical with the silt of the valley floor and the finding of tools both in it and more abundantly in the gravels dates the infilling or at least the upper part of it to palæolithic times The implements specially numerous in the ten metre terrace belong to the Levalloisian culture but unlike many of their relatives in Egypt in Palestine or others as geographically near as Somaliland these Hadhramaut tools are crude in workmanship and undifferentiated in type Here no succession of stone age cultures breaks the monotonous continuity of the Levalloisian tool making Hand axe cultures seem to be absent (the Egyptian expedition found one specimen in the Yemen) likewise the blade and burin industries of which the route into Africa may therefore not be sought via Southern Arabia as many including myself had believed Wherever we searched on the high plateau or jol on the spurs and screes of the Wadi Hadhramaut in the lateral valleys the Levalloisian type of tool alone was found and in great numbers It seems as though its manufacture must have persisted in these parts long after Africa and the Near East had progressed to more advanced stages of stone age development An obsidian industry of small blade cores and geometric forms was indeed found but this was proved conclusively to be historic and at most not older than a few centuries before the Christian era—a conclusion already reached by Dr Huzayyin

The Egyptian expedition had traced in the Yemen a series of pluvials in prehistoric times and a minor oscillation in the historic period the latter based on archæological evidence such as dry wells and empty tanks We cannot say we found indications of greater rainfall in the Hadhramaut in historic times but on the evidence of the palæolithic gravels it seems indisputable for part of the Pleistocene

That the æolian silt deposition in the valleys is due to climatic rather than to local physiographic causes such as ponding by lava flows in the lower reaches of the main wadi seems assured also by our observation of similar deposits choking the shallow valleys on the high plateau far removed from the influence of Wadi Hadhramaut and lying between it and the sea Climatic implications were extended further by the discovery of Pleistocene travertines crowded with vegetation these which were dated by derived pebbles in the ten metre gravels may throw interesting light on the past flora of the country

If the upper part of the filling of these great wadis trenched 300 metres in the limestone plateau is Middle to Late Pleistocene it is evident that the original cutting is pre Quaternary The climatic changes of the European Ice Age with which the cutting of the Hadhramaut valleys had formerly been correlated affected only the nature and amount of their subsequent infilling and re cutting

ARCHÆOLOGY

The work which was necessarily of an exploratory nature was centred on Hureidha It covered the chief aspects of pre Islamic activities in the region and yielded information concerning domestic dwellings irrigation works and places of worship and burial

No reliable information could be had beforehand as to prospects of getting labour for digging and difficulties had been prophesied It was a surprise therefore to find a sufficiency of recruits for the unfamiliar work They were on the whole intelligent and agreeable to direct and compared well with similar untrained labourers in the Near East

Irrigation and Houses At first glance the ruin field intermittently scattered over about ten square kilometres of the loess like plain looked uninviting Its noticeable feature was a large number of fairly evenly spaced stone rubble heaps which sprang from bare wind swept ground Detailed mapping proved them to be relics of a big irrigation system In this respect fortune had economized her resources for it so happened that Miss Gardner some years ago had mapped a Ptolemaic irrigation system discovered in the desert Faiyum Comparison of the two systems will be an interesting study in ancient man s ingenious inventions in both regions to turn a desert into a fertile plain on a scale seldom initiated to day

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* I am indebted to Miss Gardner for the geological notes

The source of the water was the monsoon summer rain the flood was led off the main channel far above the irrigated area and carried to it by a canal 16–20 metres broad still discernible in the sandy waste From this numerous smaller channels distributed the water in a network of runnels

There was no evidence that a town or even a village had existed amongst these fields now desert But some knolls smothered in sand showed by a scatter of sherds that house foundations singly or in clusters lay beneath One such homestead was excavated and disclosed a five to six roomed mud brick building formerly limewashed fitted with mud brick benches Logs of wood reinforced the door treads and the ceiling had been constructed in the fashion still practised in the region of twigs laid in parallel bundles across rafters and over daubed with mud Few objects except broken pots were found here but the form of these supported by inscribed fragments served to equate the dwelling with the temple and tombs we excavated near by

The Temple The temple the first of its kind to be excavated in South Arabia which was completely buried in drift stands in the formerly cultivated plain It is an oblong structure 17 metres × 20 metres in size set on a raised platform capping a natural eminence with its main façade on the south west From here the ground falls sharply to a depression or basin the artificial origin of which is attested by a bordering throw up of clayey silt now greatly weathered but still impressive in extent We noted a similar depression at the foot of the unexcavated temple mounds at Meshed and surmise that these basins may form an integral part of temple plans in South Arabia

The podium is faced by massive stone rubble walls four to five metres high and half a metre thick set on a batter of 7° Twenty one courses of roughly shaped sandstone blocks bonded and mortar bedded still stand topped by a coping of huge ashlar blocks of rusticated work with drafted borders The interior was levelled up by a dry filling of great boulders A top dressing of small mortar laid pebbles formed the bed of a flagged pavement which still lay intact over a considerable area

Little remained of the superstructure except the stumps of five tapering blocks with square bases set in parallel alignment which may be the remains of thin columns* or aniconic objects and vestigial partition walls of polished lime plaster of finest quality, in part recessed These define a forecourt giving access to the main pillar area through a narrow flagged passage and entrance

Structural evidence was obtained for at least three phases of building rebuilding or readaptation which finally raised the platform floor above that of the podium coping and extended the original building by important additions to the south west front These are referred to in one of more than fifty inscriptions found and interesting light may be thrown on rebuilding activities and their authors names when all have been studied by Prof Ryckmans of Louvain who has most kindly undertaken the task

The temple platform was reached by two stone stairways One the older and more important though even so not part of the original structure gave access from the south east its base widened out to nearly three metres and an inscribed slab had been carelessly reutilized in a tread The other later stairway only a metre wide approached via the south west angle Built into it also were several discarded inscriptions Both these flights took off from a circumambulatory pavement considerably above the surrounding level of the original building Sherds were collected in test pits down to 2 80 metres below this pavement

There is reason to suppose that the building was originally wholly plastered pavings stairways and partition walls were certainly thus faced Whether the rubble retaining walls were treated in the same way is uncertain but not improbable

Clearance of the very interesting peripheral buildings crowded round the temple base had of necessity imposed by time to be confined to those lying at the foot of the south west façade itself added in the latest period A temenos area was therefore not delimited The cluster of outlying buildings was however of outstanding interest for it included a pair of perfect and remains of other imperfect apsidal structures of small size characterized by a central free standing altar like stone surrounded by a low kerb or by a bench of flat slabs rectangular on three sides convex on the front

That these places though amongst the latest additions were shrines of aniconic religion seemed proved for standing erect against the base of one such altar were two baetylic stones one rudely fashioned from a stone brick into human form the other a symmetrically tapered rough dressed stone Both were carefully embedded upright in plaster and before both were placed stone incense burners of rectangular form stained red and patterned as well as earthenware saucers and a stone offering tray

The temple referred to in one of the dedicatory inscriptions by the name of Madabûm, was devoted to the worship of the Moon God whose name occurs on all the inscriptions so far examined by Prof Ryckmans, and whose symbols appear also on funerary pottery and stone. To that deity burnt offerings were made in fire-altars

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* Columns are an important feature in pre Islamic temples in Yemen (*cf* Rathjens and Wissmann Südarabien Reisen Band 2 Hamburg 1932)

The inscriptions must belong to the earlier periods of the building's existence, for the large number actually *in situ* were obviously in secondary, and not original, positions Some indeed had been built-in upside down or sideways to the lettering, others were exposed only on removal of a plaster-coated floor or step, yet others lay beneath the circumambulatory pavement, or had been ruthlessly cut down to fit their new position Traces of a red staining like that on the incense-burners were repeatedly observed upon them

Of considerable interest in this context is a graffito of a running camel with outstretched neck, resembling in style many of the naturalistic rock-drawings sometimes rashly assumed to be of prehistoric age

The Tombs Those examined lay in the lower slopes of the cliffs some half-mile from the temple and dwellings, the general contemporaneity of which was proclaimed by the pottery common to all They consisted of artificial caves quarried back into the sloping talus, and were roughly circular cavities of varied size, the couple excavated measured 8 metres in diameter by 2 40 metres in height Drift and cave-rubble filled them almost to their ceilings One example had low benches cut in the walls to receive the corpses singly, or in double-decked loculi This tomb was entered by a narrow down-sloping dromos 5 metres long, cut into the cliff side, passage and entrance had been skilfully repacked with scree, difficult to distinguish from the natural undisturbed article The cliffs here seem to be riddled with cave tombs, a few of which have been cleared by bedouin and reused as dwellings or goat pens Others have been partially plundered and abandoned

The second cave-sepulchre examined amplified and corrected the deductions drawn from the first It contained one bench only, upon which a skull and single bone rested amongst a group of ten pots, shells and miscellanea. But here, unlike the other tomb, the floor itself presented an astonishing mass of sherds and pottery vessels—sixty more or less complete ones were recovered, some inscribed—mixed up with forty-two skulls, disarticulated and fragmentary bones, and simple grave goods It seemed at first legitimate to infer very complete plunder of a communal tomb by contemporary robbers But this in no way explained the singular disproportion gradually observed in the parts of the skeletons present For example, whereas this chamber contained forty-two skulls, it yielded only seven lower jaws, and these mostly in fragments A theory of fractional burial seemed beside the mark, for the confusion exceeded the bounds probable in any pious practice It seems preferable to invoke the explanation of an ossuary In the first place the population, as evidenced by the loculi caves visited, buried their dead in family sepulchres Over a fairly prolonged period (during which the temple was twice altered) an insufficiency of suitable tomb-sites within reasonable distance or permitted limits developed The older tombs were cleared of their mouldering bones and grave goods, and these were unceremoniously redeposited *en masse* in an ossuary Future work will test the validity of this interpretation, which on present data seems best to fit the facts

Twelve skulls alone were complete enough for preservation They are markedly long-headed, and uniform in type, but along with the other finds await detailed study

Viewed as a whole, the semi-civilized culture thus brought to light near Hureidha can lay no claim to be in the vanguard of progress of its period Pronouncement on the date must be reserved, it probably lies within the last few centuries before the Christian era Apart from the irrigation system, imitation is more apparent than initiative. The pottery is monochrome, hand-made and clumsy, though fairly ambitious in form Debased amulets of Egyptian derivation were cherished, and seals denote intercourse with Syrian or Babylonian regions The beads, on the other hand, contain Eastern as well as East Mediterranean elements, and should, when expertly examined, yield their quota of evidence to an interesting story

An exhibition of the finds will be held at the Fitzwilliam Museum, Cambridge, by the courtesy of the director, Mr Louis Clarke, during the meeting of the British Association in August, and will form the first authenticated group of archæological material from the Hadhramaut obtained in excavation

The expedition was primarily made possible by the generosity of Lord Wakefield, to whom archæologists must be under a debt of gratitude for the acquisition of entirely new data, and it received also invaluable support from the Royal Geographical Society, from Mr. Louis Clarke on behalf of his Museum, and from the Ashmolean Museum, Oxford Our thanks, moreover, would be incomplete without acknowledgments to the International Federation of University Women, from which Miss Gardner holds a senior science fellowship enabling her to join the expedition; and finally to Mr. Ingrams, First Political Officer to the Hadhramaut, and to Mrs Ingrams for their cordiality and kindness.

Modern Views in Physics

International Conference

THE International Institute of Intellectual Co-operation is an organ of the League of Nations which at intervals arranges small conferences of experts in various subjects. In the past it has given its main attention to educational, historical and archæological subjects, but recently it has extended into science; for example, not long ago it organized a small conference in Paris on phytohormones, another at Neuchâtel, on the molecular and atomic weights of gases, a third one in Prague, dealing with the publication of ancient scientific manuscripts. It recently embarked on a larger scheme by inviting about thirty physicists to meet in Warsaw for the purpose of discussing the philosophy of physics. The meeting took place on May 29–June 2 under the presidency of Prof. Bialobrzeski; as hosts there were Profs. Rubinowicz, Szczeniowski, Weissenhof, Wertenstein and Wiśniewski, and the following guests accepted invitations: Profs. E. Bauer, Niels Bohr, L. Brillouin, L. de Broglie, C. G. Darwin, Sir Arthur Eddington, R. H. Fowler, G. Gamow, S. Goudsmit, E. Hylleraas, O. Klein, H. A. Kramers, L. de Kronig, P. Langevin, C. Moeller, J. von Neumann, F. Perrin, L. Rosenfeld, E. P. Wigner.

Reports had been prepared in advance by a number of the members to serve as bases for the discussions, and a great deal of profitable argument ensued. The detailed discussions will be printed later by the Institute, and until they appear it is not possible to give more than a very rough impression of the proceedings. The reports were furnished by Bohr on the indeterminacy of quantum mechanics, by L. de Broglie on the relations of quanta and relativity, by Brillouin on the individuality of the elementary particles, by Eddington on the relations of quanta to cosmology, by Milne on his cosmology, by Klein on field theory and by Langevin on the relation of positivism to physics. Heisenberg was also to have made a report on the limits of applicability of our present mechanics in connexion with particles of great energy, but he was unable to attend and his place was taken by Kramers, who has been in close touch with his ideas and, among other interesting things, told us what Heisenberg would have said if he had been there.

It will be seen that the subjects divide roughly into two parts, connected respectively with the foundations of physics and with the recent work on the various kinds of elementary particles. With regard to the foundations, such discussions are of great value in helping to summarize present opinion, but when we consider what that opinion is, it is difficult not to feel rather pessimistic. The enormous triumphs of the quantum theory have all been in the branches and scarcely any in the roots. Difficulties connected with such things as radiation theory and the self-energy of the electron remain much what they have long been, and it is scarcely too much to say that if this conference had been held in 1930 the chief difference would have been that the catalogue of abortive attempts would have been shorter. Indeed the situation was summarized by Kramers in the words: The quantum theory has been very like other victories; you smile for months and then weep for years. The inexpert listener would have concluded from the discussions that the quantum theory is a poor thing and would have wondered why anyone believed in it, forgetting that on such occasions it is the points of difficulty that are considered and that no time is wasted over the very much larger field where there is a consensus of agreement.

It would not be easy to describe what was said about the fundamental difficulties, because from the nature of things the ideas of the speakers are not in clear shape, but there did seem to emerge one real divergence of opinion between what may be roughly called the mathematical minds and the physical. The mathematician tends to attack the problem of foundations by setting down a scheme for the whole universe; it has to accommodate all the necessary characters, relativity, exclusion principle and so on—making use of any technical methods, matrices, wave-functions or double quantization, that suit the author's taste—and he then tries to specialize his scheme so as to deal with the limited problems that the experimenter studies. The opposite view is taken by others, led by Bohr, who insist that nothing can be grasped by the human mind except in classical terms, so that there is always a classical basis—of fields of force, barriers, slits, etc.—underlying every problem of quantum mechanics; the quantal system moves under these controls, and though it may be possible to enlarge the system so as to include more and more particles quantally, it is never possible to go to the limit and include the whole universe. This does seem a real divergence of opinion, and, if the second view is right, the various attempts at world structure of the first type are necessarily doomed to failure.

Some of the most interesting discussions were connected with more technical matters, on which positive results may be attained Thus Brillouin reviewed the present state of our knowledge of the elementary particles , this is nowadays quite a long list as it includes along with the older ones the photon, the neutrino and the heavy electron or 'yukon', as it has been called after Yukawa who first, and before the experimental discovery, studied some of its possibilities The discussion was largely concerned with the relation of spin to the statistics which each particle should obey It appeared that though this is governed by certain rules, so that half spins go with Fermi statistics and whole with Einstein, yet there is a complete lack of proof for the necessity of this connexion Then Eddington gave an account of his theory of electrons and protons, and had to defend his position against criticism from many sides Milne was not there and his report was read but not discussed

The work of the conference was not so heavy but that we had opportunities for seeing the sights of Warsaw, and several brilliant entertainments were given by our Polish hosts, including a luncheon party, where we were entertained by the President of the Republic in the Castle of Warsaw It is noteworthy that in Poland, more than in most countries, a scientific career may lead to high political office, for until the cares of State engrossed his whole attention, the President was himself a physicist, and the Minister of Education, who entertained us at dinner, was, and in his spare time still is, a physical chemist At the end of the conference many of the visitors paid a visit to the beautiful city of Cracow with its historic university Altogether, from both the social and the intellectual side, the meeting was agreed by everyone to have been a great success and the guests carried away most pleasant recollections of their visit

C G DARWIN

Obituary Notices

Mr. W M Mordey

MR W M MORDEY, the eminent consulting engineer, died suddenly at his home in Warlingham, Surrey, on July 1, at the age of eighty two years He was one of the best known electricians, and besides his professional work did valuable research work He was president of the Institution of Electrical Engineers in 1908 and was made an honorary M I E E in 1932

Mordey was born at Donnywell, in the County of Durham, in March 1856 and was the second son of J G Mordey, whose father was an eminent surgeon and had been several times Mayor of Sunderland At the early age of fourteen years he entered the P O Telegraph Service when it had just taken over the telegraphs from the companies A few years later when stationed at Bradford he held classes under the South Kensington regime In 1881 he left the P O service and went to the Brush Company's works at Lambeth He was soon advanced to the responsible position of chief of the test room and became electrical designer in general He did valuable work in developing compound winding for dynamos He gave convincing proofs of the practicability of running alternators in parallel which then became a practical instead of merely a theoretical operation At that time the Mordey alternator was the best parallel running alternator on the market The 'Victoria brush' dynamo designed by Mordey was almost in general use for many years especially for ship lighting He established again t high authority that a good dynamo is also a good motor When working on transformers he studied the magnetic ageing of the iron, and with the assistance of Messrs Sankey succeeded in getting made the material 'stalloy' which was relatively free from many of the ordinary defects Mordey accepted no theory until it had been practically tested and testing meant to him measuring

One of his inventions when he was with the Brush Company was the invention of a dust filled fuse which 'blew' safely on 2,000 volts, alternating current, and was one of the earliest of arc extinguishing fuses

Mordey left the Brush Company in 1895 and set up as a consulting engineer When R A Dawbarn joined him the firm was called Mordey and Dawbarn They carried out some important works in South Africa and South America In his presidential address in 1908 he vindicated the English electrical engineering industry from the criticism that it lagged behind some other countries

Mordey took a leading part in the committee which the Council of the Institution of Electrical Engineers appointed in 1908 to find a suitable building in which to hold its meetings At that time the meetings were held in the lecture hall of the Institution of Civil Engineers which was kindly lent to them The committee decided almost at once to purchase the Medical Examination Hall of the Royal Colleges of Physicians and Surgeons which was then on the market The purchase was effected for £50,000 on a seventy six years lease Since then the membership of the Institution has increased nearly three times, a fact to which Mordey referred with pride a few years ago

Mordey discovered a curious effect produced when certain finely divided minerals were placed in an alternating magnetic field The particles repelled one another and by suitable apparatus he was able to apply the phenomenon to the separation of ores

His earliest published account of these experiments was read at a meeting of the South African Institute of Electrical Engineers at Johannesburg on December 16, 1921 His full statement and his explanation of the effects were given in his Friday evening discourse at the Royal Institution on May 18, 1923

For many years, Mordey was a member of the Council of the Institution of Electrical Engineers and being very sociable he used to stay to many of the Council dinners His criticisms of the papers read were frank, but his remarks were often very helpful He was a member of the Athenæum and of the Alpine Club He loved to talk about mountaineering in Switzerland and climbing the snow-clad hills of Scotland in winter time to the astonishment of resident farmers The profession and the industry have greatly benefited by his work

Mordey was fond of good music and was a member of the Bach choir for many years The early death of his first wife leaving him an only daughter was a great blow His daughter married Major E O Henrici, but after having a family she died comparatively young Another blow to him was the death of his partner Dawbarn He has left many friends who will sadly miss him A R

THE death has recently occurred of Dr Ragnar Rydberg, lecturer in physics in the University of Stockholm at the early age of thirty six years Dr Rydberg's scientific career was mainly devoted to the field of band spectroscopy, from which his beautiful methods of graphical constructions based on extensive spectroscopic data were developed His dissertation Uber Neubildung und Zerfall zweiatomiger Molekule (Stockholm, 1934) also included valuable discussions on problems regarding pre-dissociation phenomena in discharges under different conditions

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WE regret to announce the following deaths

Dr B T Galloway, pathologist in the Bureau of Plant Industry of the U S Department of Agriculture, on June 13 aged seventy four years

Dr A E H Tutton, F R S, formerly H M Inspector of Schools (Technological Branch), Board of Education and a leading authority on chemical and physical crystallography on July 14 aged seventy three years

News and Views

Prof. M N Saha, F R S.

AFTER nearly fifteen years of service in the University of Allahabad, Prof M N Saha is returning to his Alma Mater, the University of Calcutta, as Palit professor of physics The first occupant of this chair, the gift of a rich Calcutta lawyer to the University, was Sir C V Raman (1918 32), and he was succeeded in 1932 by Prof D M Bose (1932 37) who is now director of the Bose Research Institute founded by his uncle, the late Sir J C Bose Prof Saha graduated from the University of Calcutta in 1915 in applied mathematics, and in 1917 became lecturer in physics in the newly founded University College of Science Between 1917 and 1921, he published a number of papers in the *Philosophical Magazine* and other journals on the application of the special theory of relativity to electrodynamics, on selective radiation pressure and its application to astrophysics, and the theory of thermal ionization of elements The grant of a foreign scholarship by the University of Calcutta enabled him to visit England in 1920–21, and to work in the laboratory of Prof A Fowler at the Imperial College of Science and Technology He was thus enabled to give the finishing touches to his paper "On the Physical Theory of Stellar Spectra" which was published by the Royal Society in 1921, and is now regarded as a work of highest importance in astrophysics When, two years later, the University of Allahabad was just then passing from an examining to a teaching university, Saha accepted the chair of physics there and was called upon to frame the courses of teaching, organize the laboratory, and initiate research work He succeeded in creating a fine school of teaching and research under great handicaps and in infecting his colleagues with enthusiasm, resulting in important contributions to knowledge Students trained by him have already achieved great distinction, among them being Prof D S Kothari (Delhi) and Dr R C Mozumdar in astrophysics, Dr N K Sur in meteorology Dr G R Toshniwal in ionospheric research, and Dr P K Kichlu (Lahore) in spectroscopy

BESIDES research and teaching, Prof Saha has taken a leading part in the organization of scientific life in India In 1931, he was instrumental in founding an Academy of Sciences for the Provinces of Agra and Oudh In his presidential address to the Indian Science Congress in 1934, he advocated the establishment of a National Academy of Sciences for India on the lines of the Royal Society of London This led to the foundation of the National Institute of Sciences (composed of 150 senior scientific workers in India) at Calcutta, of which Sir Lewis Fermor was the first president In 1937, Saha succeeded Sir H Couchmann, the surveyor general, as president of the Institute and was able to obtain a grant for it from the Central Government In 1935 he founded the journal *Science and Culture* with the view of educating his countrymen about the relations of science to national life in India Through its editorials and articles, he has been advocating that large scale industrialization is the only solution of India's problems of poverty, unemployment and defence, and has directed the attention of the public to the necessity of nationalization of India's power resources, to the usefulness of research institutes on power, plant industry, and to the creation of national councils of industrial and scientific research His radical views and straightforward criticisms have not rendered him a *persona grata* either with the British officials who constitute the Central Government or with the Congress, but they are gradually finding acceptance with the public

Mr T A Joyce, O B E.

THE approaching retirement, to take effect early in August, is announced of Thomas Athol Joyce, deputy keeper in charge of the Sub Department of Ethnography of the British Museum (Bloomsbury) Mr Joyce was educated at Dulwich and Hertford College, Oxford He was appointed in 1902 to the staff of the British Museum in the Department of British and Medieval Antiquities and Ethnography, of which Mr (later Sir) Charles Hercules Read was then keeper Mr Joyce during the Great War was attached to the War Office on the General Staff (Intelligence), attaining the honorary rank of captain, and being awarded the O B E in 1918 In 1921, he was appointed deputy keeper of his department, and on its reorganization was placed in charge of the Sub Department of Ethnography in 1932 In his departmental work, he had specialized in the ethnography of the peoples of Africa and the antiquities of America His three books on the archæology of South America, Mexico and Central America, appearing between 1912 and 1916, in which the evidence available up to that time was analysed critically, secured his position as an authority among scholars in both the Old World and the New Consequently Mr Joyce was inevitably chosen to lead the expeditions sent by the British Museum to British Honduras in 1925 and succeeding years up to 1931, to excavate the ruined Mayan cities of that region In addition to a large number of contributions to the publications of learned societies and the more serious of the journals devoted to the arts, such as the *Connoisseur*, Mr Joyce was the author in collaboration with Mr E Torday, of ' Les Bushongo" (1910), of a valuable little book on Mayan Art (1927) and of the official guide to the ethnographical collections of the British Museum (1910) He held office as honorary secretary of the Royal Anthropological Institute in 1903–13, for two terms as vice president, and as president (1931–33), and was president of the Anthropological Section of the British Association in 1934

Memorial to Dr. W. J. S. Lockyer

ON July 16, at the Norman Lockyer Observatory, Sidmouth, a memorial was unveiled to the late Dr W J S Lockyer, who was director of the Observatory, in succession to his father Sir Norman Lockyer from 1920 until his death in 1936 The unveiling was performed by Sir Francis McClean, a personal friend of Dr Lockyer, well acquainted with the latter s manifold activities, such as photography and aeronautics in addition to his astronomical work Sir Robert Mond took the chair, and a speech was also made by Sir Richard Gregory who, after paying tribute to Dr Lockyer s memory, spoke about the foundation and present position of the Observatory The memorial (subscribed for by friends of the late director) consists first of a panel with a portrait of Dr Lockyer in the centre surrounded by smaller portraits of those friends who have assisted in the administration and organization of the Observatory during his term of office Beneath this panel is a cabinet containing Sir Norman Lockyer s insignia and other records of his life and work As the subscriptions were more than sufficient to supply these two articles the balance was put towards the new Oxford' recording microphotometer (mentioned in NATURE of July 16 p 108), which thus forms a part of the memorial, very suitably recognizing Lockyer s astronomical work at the Observatory Half the cost of the microphotometer is being met by Sir Robert Mond and the other half by subscriptions to the memorial and from Observatory funds The instrument is now completed and installed so that the Observatory s equipment for measuring spectra is now brought up to the level of the principal observatories in Great Britain and other countries

Record Non-Stop Formation Flight

LEAVING Cranwell at 4 15 a m on Thursday July 7, four Vickers Wellesley aircraft, fitted with Bristol Pegasus engines and Rotol constant speed airscrews, flew non stop for 32 hours They arrived at Ismailia, Egypt, next day at 12 10 p m , having covered a distance of 4,300 miles at an average ground speed of 135 m p h This achievement, which was part of the development work of the Long Range Unit of the Royal Air Force, is the longest non stop formation flight ever accomplished A flight of this nature is an extreme test of the absolute reliability of the engines The Pegasus engines employed were the medium supercharged type, specially developed for economy of fuel consumption They have to be capable of running continuously on very weak mixtures, which increases the flame temperatures in the cylinders, so that the pistons, valves, plugs, etc , are subjected to abnormally high thermal stresses The average height during the flight was about 10,000 feet, which sets up a difficult combination of high engine gas temperatures and low air density on one hand and operation at very low power in a cold atmosphere on the other It is a tribute to the design, manufacture, and maintenance of these engines that they stood up to the exacting conditions of this flight, giving a continuous performance of more than a thousand horse-power for little more than a thousand pounds weight

'Round-the-World' Flight in Northern Latitude

Mr Howard Hughes, with Messrs Connor and Thurlow, navigators, Stoddart, radio operator, and Lund, engineer, landed at New York on July 14, at 7 37 B S T after having flown a circuit of the earth in the northern hemisphere, well above latitude

(*Continued on page* 167)

NATURE

SUPPLEMENT

Vol 142 SATURDAY, JULY 23, 1938 No 3586

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 166

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Ultracentrifugal Examination of Serum from the Lower Classes of Vertebrates

SOME time ago, a systematic investigation of the sedimentation constants of the respiratory proteins throughout the animal kingdom was carried out in this laboratory[1] with the view of finding possible relations between biological kinship and the properties of respiratory proteins

For the vertebrates, the following results were arrived at Hæmoglobin of practically the same sedimentation constant 4 4 (all sedimentation constants are given in units of 10^{-13}) corresponding to a molecular weight of 68,000 was found in the five higher classes, namely, Mammalia Aves Reptilia Amphibia Pisces A respiratory protein of the erythrocruorin type, known to occur in invertebrates and possessing a sedimentation constant of 2 0 corresponding to a molecular weight of 17,000, a quarter that of hæmoglobin was met with in the lowest vertebrate class Cyclostomata

A comparative study of serum from the various classes of the vertebrates was planned in order to discover whether the regularities found for the respiratory proteins would be reflected in the properties of the serum proteins For various reasons, this investigation was postponed until recently

The sera of various mammals (man horse cow pig and rabbit) have been subjected to detailed investigation by means of the ultracentrifugal method[2] In diluted sera, two principal components with sedimentation constants, s 4 5 and 7 1, were found, corresponding to an albumin of molecular weight $M = 69{,}000$ and to a globulin of $M - 160\,000$, respectively A higher globulin component of $s - 18$ and M of about six times that of normal globulin often occurred

The serum of Aves (hen) give the same general sedimentation diagram as that found for the mammals[3] We have recently made some preliminary runs on sera from the classes Reptilia, Amphibia, Pisces and Cyclostomata with the following results The sedimentation diagram shows in the case of Reptilia (snake), Amphibia (frog) and Pisces (*Abramis brama*) the existence of a component corresponding to the albumin of the higher vertebrates and two components which probably correspond to the globulins The serum from Cyclostomata (*Lampetra fluviatilis*) however is definitely different A component of s 3 5 and another of s 12 predominate The former probably has a molecular weight about half that of the serum albumin of the higher vertebrates

The measurements carried out so far seem to indicate therefore that on the whole the protein components in the sera from Mammalia, Aves Reptilia Amphibia and Pisces are similar with regard to molecular state while those from Cyclostomata differ considerably in this respect

A more detailed account of the investigation will be given elsewhere

THE SVEDBERG
KJELL ANDERSSON

Institute of Physical Chemistry
University Uppsala
June 14

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[1] Svedberg T and Hedenius A *Biol Bull* **66** 191 (1934) Svedberg T NATURE **139** 1060 (1937)

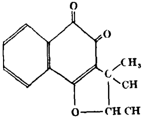
[2] Mutzenbecker P von *Biochem Z* **266** 226 250 259 (1933) McFarlane A S *Biochem J* **29**, 660 (1935) Heidelberger M and Pedersen K O *J Exp Med* **65** 393 (1937) Pedersen K O unpublished data

[3] Pentimalli F and Pedersen K O unpublished data

A New Natural Colouring Matter of the Naphthalene Group

S SIDDIQUI has recently described[1] the isolation of three new colouring matters, occurring together as a reddish dust on the leaves of *Didymocarpus pedicellata* In view of this publication, we now place on record the preliminary results of work in progress on the constitution of a colouring matter different from, but perhaps related to, Siddiqui s, and occurring as a deposit on the leaves and inflorescences of *Streptocarpus Dunnii* Mast , a member of a genus closely related to *Didymocarpus*[2]

The new pigment for which we propose the name *dunnione* crystallizes in orange red needles m p 98 99° from light petroleum or water and has the molecular formula $C_{15}H_{14}O_3$ Its physical and chemical properties and the results of degradative experiments including the formation of phthalic acid in oxidation processes show it to be a β naphtha quinone derivative The third oxygen atom is neither hydroxylic nor ketonic and the behaviour of dunnione towards alkalis indicates that the oxygen atom is a member of an easily ruptured chromane or coumarane ring Acidification of the alkaline solution obtained under certain conditions does not regenerate dunnione but a new substance which is probably an α naphthaquinone derivative The formation of acetaldehyde by oxidation with alkaline hydrogen peroxide and the amount of acetic acid (1 6 mol) produced on oxidation with chromic acid suggest that dunnione is 2 3 3 trimethyl 6 7 benzocoumarane 4 5 quinone (I) or the isomeride with the gem dimethyl group directly attached to oxygen



(I)

This is supported by the close agreement of the properties of dunnione and 2 3 dimethyl 6 7 benzocoumarane 4 5 quinone which has been synthesized by Fieser[3]

A more complete account of this investigation will be published elsewhere

J R PRICE

John Innes Horticultural Institution
Merton London S W 20

R ROBINSON

Dyson Perrins Laboratory
Oxford

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[1] J Indian Chem Soc 14 703 (1937)

[2] Cf Robinson and Robinson Biochem J 28 1718 (1934)

[3] J Amer Chem Soc 49 857 (1927)

Hæmocuprein, a Copper-Protein Compound of Red Blood Corpuscles

THAT copper is present in human blood has been known since 1875[1] Its concentrations in the red blood corpuscles and serum of man and different animals at different ages, under normal and pathological conditions, have been estimated by several workers[2 3] Very little has been known however as to the state in which the copper is present in the blood

The object of this investigation was to ascertain whether the copper present in the red blood corpuscles of mammals is free as an inorganic salt or is combined with an organic substance

The mere fact that the copper cannot be removed from a solution of plasmolysed red blood corpuscles by a very prolonged dialysis makes the possibility of its presence in the form of an inorganic salt very doubtful That this copper is bound to a protein we are now able to demonstrate by isolating from the red blood corpuscles of the ox a pure crystalline copper protein compound

The main steps of isolation and purification of this compound are as follows Red blood corpuscles of ox after a thorough washing with salt solution are plasmolysed with distilled water and treated with an alcohol chloroform mixture The hæmoglobin free solution which is filtered off contains most of the copper present in the corpuscles This solution is treated with lead acetate the precipitate being eluted with alkaline phosphate dialysed and the impurities removed with tricalcium phosphate The clear solution is then precipitated with acetone dissolved in water fractionated by adsorption on alumina Cγ and dialysed The clear and distinctly bluish solution thus obtained on treating with alcohol becomes opalescent and on standing in the cold yields within a short time bluish crystals of a copper protein compound These crystals easily settle down forming a distinctly blue sediment The analysis of the crystals shows 14 35 per cent nitrogen 1 12 per cent sulphur and 0 34 per cent copper

The copper protein compound thus obtained for which we propose the name of *hæmocuprein* forms a fourth organic copper compound known in living organisms Of the three other compounds hæmocyanine and polyphenol oxidase are copper protein compounds while turacin is a copper uroporphyrin compound

We have found that in serum also the copper is present as a blue copper protein compound very similar to hæmocuprein Its identity with the latter will however be ascertained when this compound will be isolated in a pure state

A more detailed account of the purification properties and relationship of hæmocuprein to the copper of serum and tissues will be published elsewhere

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[1] Porter J A Principles of Chemistry (New York 1875) 393 (from Sachs A et al 1935)

[2] Elvehjem C A Physiol Rev 15 471 (1935) contains extensive literature

[3] Sachs A Levine V E and Fabian A A Arch Internal Medic 55 227 (1935)

A Hæmoglobin from Bile Pigment

WHEN a solution of hæmoglobin and ascorbic acid in alkaline phosphate or in phosphate buffer of *p*H 7 6 is exposed to air at 20° for 48 hours the solution shows an absorption band in the red (at about 674 mμ) On reduction by hyposulphite, this band is replaced by a strong band at 629 mμ[1] By denaturation of the globin by alkali or pyridine, a hæmochromogen with an absorption band at 619 mμ is obtained The latter is identical with the α pseudohæmoglobin of Barkan and Schales[2]), in the preparation of these authors the denaturation is caused by the strong alkalinity of the cyanide solution

At higher temperatures the conversion of hæmoglobin to these substances is much more rapid but the oxidation of the prosthetic group is accompanied by a progressive oxidative denaturation of the globin part of the molecule This causes at first the formation of an alkali soluble green precipitate and ultimately of alkali insoluble compounds In such products[3] the prosthetic group becomes condensed into the denatured protein so that it can no longer be removed. Splitting with amyl alcohol and mineral acids results in pigments still containing peptide residues.

We have been able to remove the prosthetic group from the undenatured compound and to isolate the iron free compound in the pure state. The solution displaying the band at 629 mμ is precipitated by ammonium sulphate and the precipitate is digested with a mixture of two parts of ethyl acetate and one part of glacial acetic acid. This solution is diluted with ether, washed and filtered. It contains some protohæmatin, but no longer the hæmatin which gives the hæmochromogen with the band at 619 mμ. One per cent hydrochloric acid extracts biliverdin hydrochloride, while a weakly basic biliviolin is extracted by 25 per cent hydrochloric acid. From the first extract we have prepared crystalline *biliverdin* and *biliverdin dimethyl ester* and have identified the latter with an ester prepared from bilirubin by melting point and mixed melting point (216° F. on the copper block), crystal forms and other properties. The nature of the splitting products and the readiness with which iron is split off under conditions in which no trace of porphyrin or bile pigment is obtained from crystalline hæmin, prove that the prosthetic group of the new hæmoglobin is a bile pigment iron compound, closely related to verdohæmatin[4] while the fact that its hæmochromogen differs from verdohæmochromogen shows that it is not verdohæmatin. The name choleglobin is suggested for the new hybrid hæmoglobin, and the name cholehæmochromogen for its hæmochromogen.

At present we are unable to say in which way the prosthetic groups of choleglobin and of verdohæmochromogen differ in constitution. Choleglobin is readily obtained by the action of dilute hydrogen peroxide on a solution of hæmoglobin containing ascorbic acid; hydrogen peroxide thus plays a part in the formation of choleglobin similar to that in the formation of verdohæmochromogens from hæmochromogens[5], but the qualitative influence of the globin in the constitution of the prosthetic group arising from hæm on oxidation is remarkable.

It is of interest to compare the properties of the new hybrid hæmoglobin with those of hæmoglobin. It appears to unite with oxygen and with carbon monoxide reversibly. The compound with the band in the red appears to be oxycholeglobin, since it can be transformed into choleglobin by evacuation even after removal of all reducing substances by dialysis, and since it is reformed by aeration. Carbon monoxide choleglobin and carbon monoxide cholehæmochromogen possess the same absorption band (at 629 mμ), as do carbon monoxide hæmoglobin and carbon monoxide hæmochromogen, while they differ in their stability to oxygen. Whereas carbon monoxide cholehæmochromogen is readily decomposed on aeration, carbon monoxide choleglobin is only slowly converted to oxycholeglobin by oxygen. Incidentally, these observations prove again the identity of the prosthetic group in choleglobin and cholehæmochromogen. It is expected, however, that the carbon monoxide choleglobin band should coincide with that of reduced choleglobin. This fact complicates the investigation of the reaction of choleglobin with carbon monoxide, but the study of the conditions under which the band at 629 mμ appears in the absence and in the presence of carbon monoxide has satisfied us that carbon monoxide choleglobin exists.

A small amount of biliviolin is formed when oxygenated laked horse or sheep corpuscles are subjected to the treatment with the ethyl acetate glacial acetic acid mixture, while a somewhat larger amount of biliverdin is formed when the digestion mixture is added to the exhausted solution of laked corpuscles under nitrogen. While these experiments support the claim of Barkan and Schales that bile pigment hæmatin compounds occur in erythrocytes, we have been unable to find evidence for the presence of choleglobin in erythrocytes although our experiments show that choleglobin is very readily formed from hæmoglobin. Its absorption band at 629 mμ (shifted to 619 mμ on denaturation) becomes visible on addition of hyposulphite to oxygenated laked erythrocytes, but on reduction by evacuation or by hyposulphite in the absence of oxygen only a band in the red (at about 660 mμ) can be seen in addition to the band of reduced hæmoglobin (cf. also ref. [1]). The band in the red is not shifted on denaturation by pyridine, but it is abolished by oxygen or by carbon monoxide. It may therefore belong to the bile pigment hæmatin compound present in the erythrocytes, and to judge from its position it may be that of a verdohæmatin compound. These experiments, while still leaving undecided the exact nature of the hæmatin compound contained in bile pigment, leave little doubt that such compounds are intermediates in the breakdown of hæmoglobin.

The work described above has been carried out with a grant from the National Health and Medical Research Council of Australia.

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[1] First observed by Lemberg, R., and Wyndham, R. A., *J. and Proc. Roy. Soc. New South Wales*, **70**, 347 (1937).

[2] Barkan, G., and Schales, O., *Z. physiol. Chem.*, **248**, 96 (1937).

[3] Anderson, A. B., and Hart, P. D'A., *J. Path. Bact.*, **39**, 465 (1934). Edlbacher, S., and Segesser, A. v., *Naturwiss.*, **25**, 461 (1937).

[4] Lemberg, R., *Biochem. J.*, **29**, 1322 (1935).

[5] Lemberg, R., Cortis-Jones, B., and Norrie, M., *Biochem. J.*, **32**, 149, 171 (1938).

Isolation of a Flavin-Protein Compound from Milk

WE have been able to prepare a flavin protein compound from cow's milk by the following procedure: (1) half saturation with ammonium sulphate of the whey of rennin treated milk; (2) ether extraction of the dried precipitate; (3) reprecipitation by 33 per cent saturation of the solution of the redissolved precipitate with ammonium sulphate at *p*H 4·0 and 0°; (4) elimination of the fraction insoluble in 25 per cent saturated ammonium sulphate at *p*H 4·0 and in presence of 10 per cent alcohol; (5) adsorption on and elution from alumina Cγ[1] followed by ultrafiltration and further fractionation with ammonium sulphate.

The orange yellow powder so obtained in a yield of about 1 gm. from 30 litres of milk dissolves to form a clear aqueous solution. The orange colour is discharged by addition of hyposulphite and restored by shaking with air. The absorption spectrum shows a broad band in the visible with a peak at 460–465 mμ. By treatment with 75 per cent methanol the coloured prosthetic group can be split off from the colourless protein. A solution of the prosthetic group shows the typical greenish fluorescence of flavin and also the reversible reduction with hyposulphite The absorption spectrum is practically identical with that of riboflavin[2] (peaks of the three absorption bands at 270 360 and 445 mμ respectively) The fact that the prosthetic group is insoluble in benzyl alcohol indicates that it is not riboflavin but more likely the corresponding phosphorylated compound[3]

Milk flavoprotein was found to catalyse the oxidation of reduced coenzyme I (prepared by reduction either with dehydrogenase systems or with hyposulphite) by carriers such as methylene blue, riboflavinphosphate and cytochrome *c* Calculation showed that in presence of a large excess of reduced coenzyme I each molecule of milk flavoprotein catalysed the oxidation by methylene blue of about a thousand molecules of reduced coenzyme per minute at 38° A positive catalytic effect was observed with as little as 0 02 γ flavin equivalent per *ml*

In the course of its catalysis milk flavoprotein did not appear to undergo a cycle of reduction and oxidation This consideration leads us to believe that milk flavoprotein acts catalytically not by serving as an intermediary between reduced coenzyme and the carrier but rather by forming a complex with the reductant and the oxidant and thereby facilitating the transfer of hydrogen

Since our best preparations contain only 0 06 per cent flavin contrasted to 0 6 per cent in the purest preparations of yeast flavoprotein the possibility still exists that the catalytic effects observed may be due to some persistent colourless impurity However the parallelism between catalytic activity and concentration of flavoprotein makes the impurity hypothesis unlikely

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[1] Weygand and Stocker *Hoppe Seyl Z* **247** 167 (193)
[2] Kuhn *et al* *Ber* **66** 1037 (1933)
[3] Emmerie NATURE **141** 416 (1938)

A New Enzyme of the Glycosidase Type

I SHOULD like to report the occurrence of what appears to be a new enzyme of the glycosidase type

This ferment which is readily prepared from celery seed using Tauber s technique [1] hydrolyses naringin the bitter glycosidic principle of grape fruit (*Citrus decumana*) *in vitro* at 37° and *p*H 7 The products are the insoluble aglycone naringenin (or naringetol) in crystalline aggregates belonging to the hexagonal system (I mention this because I have seen no reference to its crystalline form and have myself only succeeded in producing the amorphous form together with glucose and rhamnose by acid hydrolysis of naringin) and in addition a seemingly new disaccharide That this latter is not rutinose (β 1 rhamnopyranosido 6 *d* glucopyranose) follows from the work of Rabaté [2] whose results I have confirmed namely, that rhamnodiastase the enzyme which removes rutinose from its glycosides, will not decompose naringin Further since repeated attempts to hydrolyse naringin with emulsin have failed, it is probable that the disaccharide is akin to rutinose but has an α instead of a β linkage between its constituent sugars, or the only alternative, that it is glucosidorhamnose the aglycone linkage being through rhamnose instead of glucose

It is hoped to establish this definitely later on and meanwhile it is interesting to record yet another instance of the occurrence together in the same species but not necessarily in the same organ of substrate and enzyme which latter can be prepared from the leaves of the tree *Citrus decumana* again using Tauber s method The enzyme is absent from the rag peel and seeds of the fruit but occurs in small amount immediately between the flavedo and albedo where very possibly it plays some part in ripening since it is known that the bitterness then decreases in the fruit

It would seem therefore that this represents the first occasion on which naringin has been hydrolysed by an enzyme *in vitro* and possibly this new enzyme can be employed to study further the metabolism of rhamnosides in plants

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[1] Tauber *J Biol Chem* **99** 257 (1932)
[2] Rabaté *Bull Soc Chim Biol* **17** 314 (1935)

Quantitative Measurement of Vitamin B_1 by the Thiochrome Reaction

IT has been known to us for more than a year that there is a large discrepancy between the results of biological vitamin B_1 assay and of determination of aneurin by the original method of Jansen[1] when both methods are applied to animal tissues We did not like to report on these observations before having succeeded in determining vitamin B_1 quantitatively by the thiochrome method Immediately after the publication of a paper by M A Pyke[2] however it was clear to us that he had estimated only a very small part of the total amount of vitamin B_1 actually present in the animal tissues investigated Dr Pyke s letter in NATURE of June 25 p 1141 prompts us to make the following remarks

Westenbrink and Jansen[3] described the determination of the two forms of vitamin B_1 known with certainty up to this moment aneurin and cocarboxylase or aneurin pyrophosphoric acid separately by means of the thiochrome method at the meeting of the Dutch Society of Physiology and Pharmacology of April 2, 1938 This method is based on the fact that thiochrome formed from aneurin is extracted quantitatively from the aqueous reaction mixture by isobutanol whilst the thiochrome pyrophosphoric acid formed from cocarboxylase remains quantitatively in the aqueous layer[4]

Since that time we have applied this method to various animal tissues When the tissues are finely minced and suspended in water and vitamin B_1 is absorbed on franconite at *p*H 3 the aqueous and isobutanol layers both show a blue fluorescence even without oxidation by ferricyanide In most cases this blank fluorescence is even stronger than the fluorescence observed after oxidation of the vitamin by ferricyanide However the blank fluorescence may be reduced to a very small remainder by digesting the tissue proteins by pepsin previous to the adsorption of the vitamin on franconite

After this observation we were able to carry out aneurin and cocarboxylase determinations in animal tissues Certainly the method is still capable of improvement but it was sufficiently accurate already to provide the following results

The aneurin content of animal tissues is very small as compared to their cocarboxylase content for example, normal rat's tissues liver 7–13 μgm cocarboxylase, less than 2 μgm aneurin, muscle 1 5 5 μgm cocarboxylase less than 0 5 μgm aneurin, kidney, 11 μgm cocarboxylase 0 5 μgm aneurin, brain, 6 μgm cocarboxylase less than 0 3 μgm aneurin The results obtained with normal pigeon s tissues were essentially the same Tissues of rats which had lived for three weeks on a diet free from vitamin B_1 only contain a very small amount of this vitamin, ten minutes after subcutaneous injection of a large amount of aneurin however, liver and kidney contained again a large amount of cocarboxylase besides an abnormally high amount of aneurin No increased amount of aneurin was observed in muscle and brain, hence injection of aneurin does not flood the whole organism with this substance

These investigations are fully described in a paper to be published in *Enzymologia*

We are much indebted to Prof K Lohmann of Berlin who kindly sent a specimen of crystalline cocarboxylase to Prof B C P Jansen director of this laboratory, whom we wish to thank for his interest in our work

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[1] Jansen B C P *Rec Trav chim* **55** 1046 (1936) see for application on urine and aneurin metabolism problems Westenbrink H G K and Goudsmit J *Rec Trav chim* **56** 803 (193) *Nederl Tijdschrift Geneeskunde* **81**, 2632 4056 (193) **82** 18 1076 (1938) *Arch Néerl Physiol* **22** 319 (1937) **23** (in the Press)

[2] *Biochem J* **31** 1958 (1937)

[3] Westenbrink H G K and Jansen B C P *Acta brev neerl* **8** 119 (1938)

[4] See also Kinnersley H W and Peters R A *Biochem J* **32** 697 (1938)

Occurrence of Acetylcholine in Nervous Tissue of Crustaceans and its Effect on the Crab Heart

CONTRARY to the belief of certain investigators[1] [2] acetylcholine occurs in some tissues of decapod crustaceans in considerable amounts Trichloracetic acid extracts of leg nerves and ventral ganglia of *Carcinus* indicate a difference in the distribution of acetylcholine in these two tissues which is in close agreement with the distribution of choline esterase in the ventral ganglia and longitudinal commissures of the lobster, *Homarus* In this form it has been shown[3] [4] that two to four times as much choline esterase is present in the ventral ganglia as in the rest of the cord, which consists of fibres, with few if any, nerve endings In *Carcinus* there is approximately five times as much acetylcholine in the ventral ganglia as in the leg nerves

Studies of neuromuscular transmission in crabs[5] indicate that acetylcholine is probably not the mediator between nerves and skeletal muscle in these animals It has been found, however, to have a marked effect on the heart, and its action is the reverse of that on the vertebrate heart In low concentrations it increases the rate of beat of the isolated heart of *Carcinus* and *Maia*, and in high concentrations it produces tetanus and systolic stoppage The active material from 0 1 mgm of ventral ganglion or 0 5 mgm of leg nerve, per cubic centimetre of perfusion fluid, is usually sufficient to increase to more than double the frequency of beat of the isolated heart

Since adrenalin and acetylcholine both accelerate the decapod heart when administered in small doses, it is possible that the accelerator nerves to the heart normally produce one of these substances

A more detailed account of this work which was done at the Marine Biological Laboratory, Plymouth, and the Zoological Laboratory Cambridge, will appear elsewhere

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[1] Bacq Z M C R Soc Biol Paris **120** 217 (1935)

[2] Bacq Z M Proc Roy Soc B **123** see p 418 of Discussion on the Transmission of Excitation (1937)

[3] Marnay A and Nachmansohn D C R Soc Biol Paris **125** 1005 (193)

[4] Nachmansohn D C R Soc Biol Paris **126** 783 (1937)

[5] Katz B J Physiol **87** 14 (1936)

Dormant Life of Tumour Cells in the Animal Body

WORKING with transplantations of Ehrlich mouse carcinoma (belonging to a strain cultivated *in vitro* in this Institute for nearly twelve years) we observed that tumours developed in general after two to four weeks These experiments were carried out on ordinary commercial white mice all of male sex The body weight was 13 20 gm In several cases we found however that tumours developed 6 weeks and even 8 10, 12 and 16 weeks after the inoculation of the carcinoma cells

These findings seem to be of interest in regard to The theory of the developmental physiology of malignant tumours recently put forward by A Fischer[1] From his experiments Fischer has drawn the following conclusion The cancer cell may already be present in the body and needs only what may be termed a realization factor in order to develop into a malignant tumour Such a factor may be, according to Fischer old age, chronic proliferative activity influence of hormones etc Our observations that cancer cells may lie dormant for a long period of time before they manifest themselves as a tumour, seems to support the theory of Fischer

The observation of a latent life of tumour cells for a period up to 16 weeks in the body of white mice may be significant in consideration of the fact that it amounts to one sixth of the whole life of a mouse In comparison with the duration of human life, it would mean a period of dormant life of tumour cells of ten years a period which is in very good agreement with our experience of the development of X ray carcinoma

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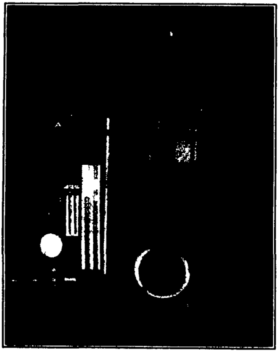
[1] Fischer A Amer J Cancer **31** 1 (1937)

A Simple Respirometer for Small Animals

IN the course of some work carried on in this laboratory it became necessary to devise an apparatus that would measure oxygen consumption during the early life of the mouse Most of the available methods are either elaborate in technique and equipment or ill adapted for use with small animals However, a constant pressure type of respirometer, after the principle used by Winterstein and later described by

Dixon[1] has been successfully adapted to the problem and might well be given wider application Materials for its construction are readily available and it is so sensitive that determinations may be made over very short periods—½-4 minutes Mice are seldom absolutely quiet for longer periods, and so this sensitivity is almost a necessity when working with these animals

The constant pressure respirometer has not been widely used although its simple theory makes calculations extremely easy and calibration unnecessary It consists of a chamber and a recorder The carbon dioxide is absorbed by some suitable agent and the decrease in pressure resulting from consumption of oxygen is recorded on a sensitive manometer Mercury is forced into a calibrated pipette connected in the system until the manometer again records atmospheric pressure The amount of mercury entering the pipette in a given time can be read off directly and is equal to the volume of oxygen at the recorded temperature and pressure consumed by the organism The volume is then corrected to N T P



SIMPLE ANIMAL RESPIROMETER

The temperature of the chamber must be maintained accurately by a water bath thermostat and though the air in the recorder need not be at the same it must be kept at a constant temperature (recorded by thermometer *C*) It is convenient to maintain the room and water bath at the same temperature, for the animal can then be easily adapted in the room and readings taken soon after the respirometer is placed in the bath

The recording apparatus is arranged so that readings may be made at convenient time intervals until 3 c c of oxygen have been consumed Dry air is then sucked through the chamber for several minutes to restore the oxygen pressure As this air must be at the same temperature as the bath it is passed through an immersed copper coil before entering the chamber The loss of 3 c c of oxygen will not change the amount in the chamber by more than 1 2 per cent and such small changes in the partial pressure of oxygen have been shown to have little effect on oxygen consumption All readings are made in the 1 c c pipette *G* the mercury being controlled by the 1 c c syringe *E* As soon as the air in this pipette is exhausted, the mercury is lowered gradually, while 1 c c of air is drawn over at constant pressure from the 5 c c pipette *F* The mercury in *F* is controlled by syringe *D* This process is carefully carried out during a determination so no time is lost Manometer *B* contains kerosene stained with Sudan III The three way stop cock *A* allows the connexion of the chamber the recorder and the outside while equilibrium is attained and the isolation of the chamber and recorder during a determination The stop watch *H* is placed on the recorder for convenience Two or more chambers may be used with one recorder

The chamber of the respirometer is a 350 c c thin walled glass crystallizing dish fitted between two brass plates the top made water tight by a rubber gasket The chamber is protected by a sponge rubber base A round wire frame fitted with wire screening and having a diameter 1 5 in less than the chamber is placed inside The space between it and the glass wall is filled with fine mesh soda lime Concentrated sulphuric acid placed in a small vial absorbs moisture A hole is left in the wire net so that movements may be watched Within the chamber is placed a wire cage containing the animal The size of this cage depends upon the animal and should allow free movements though confined to a small space Cotton placed beneath the cage adds to the animal s comfort and absorbs excreta

The brass top is furnished with three outlets The central one contains a shaft with a propeller serving to keep the air of the chamber in motion The bearing if well greased through a small cup on the side will easily hold the slight differences in pressure which are allowed to exist during a determination A small flexible shaft or steel spring allows connexion with a motor, the speed of which can be carefully controlled through a rheostat 150 200 rev per min is sufficient and will not disturb the animal, but the speed used should first be shown to produce air currents small enough to have no effect upon the manometer

Another outlet provided with a stop cock leads to a suction pump which serves to ventilate the chamber Connexion to the recorder is by means of a second stop cock which can also connect the chamber through the copper coil to the outside The incoming air is dried with calcium chloride before it enters the coil

Readings for convenient intervals are taken until a sufficient number of checks give the experimenter confidence that he is dealing with a true basal state Movements usually produce enough heat to expand the gas in the chamber and affect the manometer so there is little chance of including the readings obtained during periods of movement in the final average

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[1] Dixon Manometric Methods (1934)

Substitution of Cysteine for Protohæmin as the 'X' Factor for Growth of *H. influenzæ*

THE indispensability of iron in the form of protohæmin, the so called 'X' factor, to the growth of *H influenzæ* has long been an accepted fact Recently, the Lwoffs observed that the oxygen consumption of suspensions of this organism containing minimal amounts of hæmin is remarkably increased by the addition of small quantities of this compound Accordingly, they concluded that the 'X' factor functions by supplying, to the cell, material from which it can synthesize a catalytic respiratory system comprising cytochrome *C* and possibly cytochrome oxidase, peroxidase and catalase, although no direct evidence was advanced for the latter[1] If there is a correlation between the necessity of the hæmin for growth and its ability to promote oxygen consumption, it should be possible to grow the influenza bacillus by replacing the iron complexes with any other system which is capable of inducing oxygen consumption Since reversible oxidation reduction systems of suitable potential can function as efficient respiratory catalysts[2], we set out to determine the effect of these systems on the growth of *H influenzæ*

Those dye systems, within the potential range which has been demonstrated to be most effective in respiratory catalysis, failed to support growth when added to a basic medium to which adequate amounts of 'V' (yeast extract) were added Moreover, they actually inhibited growth even in the presence of the minimal amounts of protohæmin found necessary to support serial transfer (10^{-6} gm /c c) This inhibition was traced to the accumulation of hydrogen peroxide resulting from the activity of the supplementary dye catalyst

Since cysteine is effective in protecting cells from the inhibitory activity of peroxide[3], it should thus protect the organism from the inhibitory action of the dyes Experiments proved this to be the case Furthermore, cysteine plus suitable dyes effectively replaced hæmin as a growth requirement, and this combination supported growth in successive serial transfers Moreover, cysteine alone was found to be capable of permitting serial growth Whereas in the absence of hæmin, the sulphhydryl compound was required for aerobic growth, its presence was unnecessary for anaerobic growth This confirms the results of Anderson[4] who found that only the 'V' factor is required under anaerobic conditions

Since anaerobic growth can occur, it is evident that oxygen consumption is not essential for multiplication Further, since respiratory catalysts (dyes) alone cannot support growth, it is obvious that the 'X' factor cannot be replaced by a system which functions solely as a respiratory mechanism However, since cysteine alone can replace hæmin, and, in the latter's absence, is necessary for aerobic but not for anaerobic growth, it becomes probable that the sole necessary function of either of those substances is to provide the organism with a mechanism for protection against hydrogen peroxide, formed under aerobic conditions through the activity of a non hæmin respiratory system Thus, *H influenzæ*, in the absence of the 'X' factor, is physiologically similar to *E coli* in the presence of cyanide and methylene blue[5], since both organisms, under these conditions, possess mechanisms for the formation of peroxide but none for its destruction The role of hæmin is to supply this missing mechanism in the form of catalase. These experiments do not deny the role of hæmin in promoting respiration, but merely point out that such a function is unnecessary and incidental to its principal action

The foregoing results will be presented in more detail elsewhere

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[1] Lwoff A and Lwoff M *Ann Inst Pasteur* **59** 129 (1937)
[2] Barron E S G and Hoffman L A *J Gen Physiol* **13** 483 (1930)
[3] Quastel J H and Wooldridge W R *Biochem J* **23** 115 (1929)
[4] Anderson L R *Amer J Hyg* **13** 164 (1931)
[5] Broh Kahn R H and Mirsky I A *J Bact* **35** 455 (1938)

Composition of the Aerial Insect Fauna up to 300 ft.

IN a recent letter in NATURE (April 2) on the aerial drift of insects up to 2,000 ft , Hardy and Milne make reference to the intensive study of such drift at lower levels by flying 3 ft diameter nets simultaneously (usually for 3 hours round about midday) at heights of 277 ft 177 ft and 10 ft , on each of three masts placed along a 5/6 mile frontage at the Beam Wireless Station, Tetney, North Lincolnshire A brief note of the principal findings may be of interest

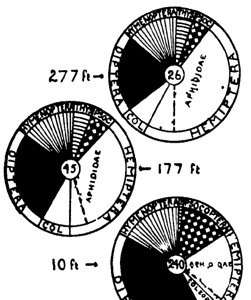
Thirty one series of collections were made from March until November during 1934 and 1935 yielding 2,896, 4,740 and 15 659 insects belonging to 166, 197 and 298 species at the top, middle and bottom heights respectively, a total of 23,295 insects of 421 species Most were winged adults of small size , but a number of nymphs (Hemiptera) and true apterous forms (Collembola and Psocoptera), in addition to 134 spiders (20 species) and parts of plants (31 species) were taken Species of seven genera made up more than 50 per cent of the numbers collected *Brevicoryne brassicæ* L (cabbage aphis) (3,334 individuals), *Sciara* spp (2,484), *Pterodela pedicularia* L (2,357), *Oscinis* spp (frit flies) (1 708), *Aphidius* spp (1,522) *Leptocera* spp (967), *Limothrips cerealium* Hal and *denticornis* Hal (corn thrips) (402)

The average 'density of insect population', defined as the number of insects in one million cubic feet of air, declined with height, so that 75 per cent of the total population was below 100 ft Diptera was the most numerous order up to that height and Hemiptera above Aphididæ were the dominant family at all heights The average composition of the fauna at each height is shown in the accompanying diagram

The distribution of population across the front was even although local aggregations occurred in nets, especially at ground level, often owing to the close proximity of host plants upwind The greatest numbers and variety occurred during the months of June and September, when insects are most active in breeding and dispersal.

The most favourable conditions for the maximum numbers in the air varied from family to family, but in general the greatest numbers of all insects occurred at relative humidities below 59 per cent, at surface wind velocities below 9 m p h. and at temperatures above 64° F the latter factor exercising most control

In addition to the pests already mentioned others also taken up to 277 ft were *Myzus* spp *Anuraphis padi* L (leaf curling plum aphis) *Kakothrips robustus* Uzel (pea thrips) *Cicadula sexnotata* Fall *Psyllia mali* Schmidt (apple sucker) *Macrosiphum granarium* Kby (grain aphis) *Anuraphis roseus* Baker (rosy apple aphis) *Phyllotreta undulata* Kutz and *Chaetocnema concinna* Mm (flea beetles) *Sitona lineata* L (pea and bean weevil) *Apion flavipes* Pk (clover seed weevil) *Chlorops taeniopus* Mg (gout fly) *Tipula paludosa* Mg (cranefly) and many others in small numbers to a total of 44 species



AVERAGE COMPOSITION OF THE AERIAL FAUNA AT 277 FT 177 FT AND 10 FT THE AVERAGE DENSITY OF POPULATION IS SHOWN AT THE CENTRE OF EACH DIAGRAM

The presence of large numbers of insects in the air throughout the greater part of the year indicates the important part played by wind carriage in their dispersal The observations also invite speculation as to the efficiency of ground quarantines in preventing the widespread distribution of insect pests

The work was initiated by Prof A C Hardy and carried out by me under his direction during part of the tenure of an agricultural research scholarship of the Ministry of Agriculture and Fisheries A full report will be published elsewhere

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June 18

A New Test Plant for Potato Virus Y

HITHERTO the most convenient test for the presence of potato virus Y (*Solanum* virus 2) has been by sap inoculation to tobacco and no plant has been recorded on which the virus produces local lesions visible without decolorizing the leaf and staining with iodine While investigating the host range of potato viruses on solanaceous plants it was recently found that virus Y induces abundant brown circular local lesions about ten days after inoculation to leaves of *Lycium barbarum* seedlings When these lesions are very numerous they are followed by wilting and abscission of the inoculated leaves but no systemic infection of the plant results The latter fact was confirmed both by inoculation to tobacco from the non inoculated portion of the *Lycium* plant and by grafting it to healthy potato varieties highly susceptible to virus Y The characteristic local lesions resulted from inoculation with standard virus Y with a slightly different strain recovered from *Schizanthus*[1] and with virus HY II[2] and were freely induced by strains of Y no longer readily sap inoculable to tobacco Sap from Y infected potato tobacco and *Schizanthus* plants proved equally effective

No other virus so far tested has induced a similar reaction although faint local rings may result from inoculation of *Lycium* with necrotic strains of viruses X and B No visible lesions result from inoculation with weak strains of X or with potato viruses A F G and the virus of cucumber mosaic A rather bright yellow mottling of the leaves follows infection with tomato aucuba mosaic and this virus was readily recovered from the inoculated leaves There is no evidence of systemic infection of *Lycium* with any of the above viruses Inoculation to *Lycium* cannot be used to separate virus Y from a mixture of X and Y The effect of virus A on *Lycium* was tested by inoculation from an infected potato plant a host from which it is not readily sap transmissible the other viruses were taken from infected tobacco plants

It is possible that the reaction may prove of value as a test for virus Y, especially when that virus is present in plants other than tobacco

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[1] Salaman R N NATURE 139 924 (193)

[2] Hamilton M A *Annals of Applied Biology* 19 550 567 (1932)

The Florisbad and Taungs Skulls

GOOD wine needs no bush nevertheless South African anthropologists are very grateful to Sir Arthur Keith for his unfailing interest in their work and particularly for his recent note on the Florisbad skull[1] It is as Sir Arthur says an outstanding landmark in human palæontology and well worthy of sharing attention with Rhodesian man But just as there is little agreement about the exact position of the latter in the human scale so the status of Florisbad man is not yet settled

Sir Arthur takes the same view as one South African school and regards Florisbad man as the successor of Rhodesian man and the immediate forerunner of Boskop man There is a good deal to be said for the first part of this contention as the brow ridges of the Florisbad skull are only a little less massive and they have only a slightly shorter span than the Rhodesian torus I find it difficult, however to link this feature with the vertical forehead of the Boskop skull as the doyen of British anatomists has gone on to do

Elsewhere[2] I have elaborated the thesis that Florisbad man is of lower rank than Rhodesian man, and that he is an African variant of the Neanderthal race of Europe This view is supported by the fact that as regards his cranium and brain cast he is *morphologically identical to the type* Neanderthals of Europe On the other hand I admit that his face although more massive and prognathous than in any of the Neanderthals, has a deep sapient dip in it beneath the cheek bones We must not let ourselves be carried away, however, by the idea that there was only the one European race of Neanderthals His characteristic Moustierian culture, which has as close an association with this physical type as any known culture has with human form is very widespread over the world, and I myself have picked up several Moustierian points on the veld bearing all the hall marks of the very special technique employed in making these stone implements It is therefore a really very significant argument in favour of my view, when I state that the stone implements found associated with the skull in the Florisbad zone present a typical Moustierian facies[3] Seeing that we have no objection to accepting the Neanderthaloid Australian Bushman as one of the races of *Homo sapiens*, there can be no valid reason for rejecting a slightly sapient South African Neanderthal as a member of this latter species provided it can be shown that the major facts of his anatomy point that way

In any discussion of human morphology the question arises as to what characters are to have most stress laid on them and as to what is to be our final criterion of advancement or retardation in the human scale We have to decide whether it is to be the cranium with the underlying brain or the teeth and jaws which go to make the face that we are to rely most upon There are enough data now to show that anthropologists cannot have it both ways The Piltdown discovery put an end to the face as a criterion, for no one regards this type as anything but a man, in spite of his chimpanzee like jaw and teeth The same applies to the latest discovery of the adult *Australopithecus*[4] Notwithstanding his human type of dentition, more human in some respects than that of both Piltdown and Peking man, Broom sums him up as 'a chimpanzee with human teeth" In doing so, Broom is tacitly laying stress on the brain of *Australopithecus*, which he seems still to assume to be that of a chimpanzee, as so many other distinguished anthropologists have already done For my part I do not consider the brain of the Taungs infant to be that of a chimpanzee In a recent comparison which I have made between the brain cast of this fossil and the brain and brain cast of a chimpanzee of the same age I have been impressed by the great difference between them In Fig 1 I show how the linear contour of the cerebrum and cerebellum of the Taungs infant outstrips that of this chimpanzee The surface of the brain cast of the former shows an equally striking superiority in the size and salience of its convolutions over that of the latter The comparison I have drawn is not an isolated one and in Fig 2, I demonstrate how much more advanced the brain of the Taungs infant is beyond that of a slightly older chimpanzee, which it exceeds in bulk by 50 per cent I have made other comparisons which show that the brain of the infant *Australopithecus* outclasses that of a gorilla of the same age, and that the mental endowment of this tiny creature can quite hold its own with even that of a huge adult gorilla

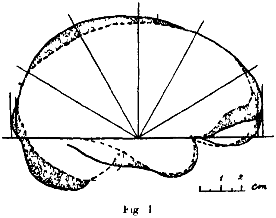

Fig 1

CONTOUR OF THE TAUNGS ENDOCAST SUPERIMPOSED ON THAT OF A CHIMPANZEE OF THE SAME AGE THE STIPPLED AREAS INDICATE THE EXTENT TO WHICH THE FORMER EXCEEDS THE LATTER IN SIZE

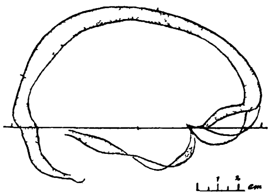

Fig 2

CONTOUR OF THE ENDOCAST OF *Australopithecus africanus* SUPERIMPOSED ON ONE OF A CHIMPANZEE WITH A CRANIAL CAPACITY OF 335 C C THIS CHIMPANZEE WAS A YEAR OLDER THAN THE TAUNGS INFANT, YET ITS BRAIN WAS INFERIOR TO THE EXTENT INDICATED BY THE STIPPLED AREA

The most noticeable advance in the brain of *Australopithecus africanus* is in the region behind the bregma (vertex), in the same place as all the main subsequent human advances have been made His superiority over the chimpanzee in the cerebellar region is also very striking With such knowledge of cerebral localization as we already have, it is fairly safe to interpret this parietal enlargement of the association area, located behind the sensory and motor areas for the leg, and this cerebellar hypertrophy as being expressive of the human divorcement of the legs from the hands From now on, the limbs had separate functions to perform and new machinery for their independent co ordination Arboreal habits were good enough to make a four handed primate out of something else, but it took the open veld to make the first human toddler, now properly on his legs and free to use his hands for better handiwork—and occasional mischief Even if we discount his human dentition entirely, which it would be rash to do, this surely is an upward step

It seems to me, therefore, that many pronouncements regarding this unique South African fossil will have to be revised, and in fact that we cannot do better than go back to Dart's first classical description of it as published in NATURE of February 7, 1925

M R DRENNAN

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June 22.

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[1] NATURE, 141, 1010 (June 4, 1938)

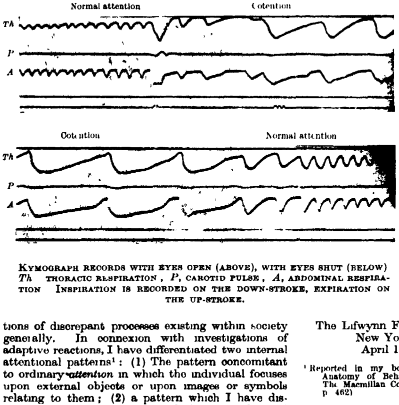
[2] Drennan, M R, "The Florisbad Skull and Brain Cast", *Trans Roy Soc S A*, 25, Pt 1 (1937)

[3] Dreyer, T F, "The Archæology of the Florisbad Deposits", *Arch Navorsing van die Nasionale Museum*, 1, Agste stuk Bloemfontein (1938)

[4] NATURE, 141, 828 (May 7, 1938)

Kymograph Studies of Physiological (Respiratory) Concomitants in Two Types of Attentional Adaptation

THE group or phylobiological researches which I have carried out in the field of behaviour-disorders indicate that the neuroses and psychoses are aggravations of discrepant processes existing within society generally. In connexion with investigations of adaptive reactions, I have differentiated two internal attentional patterns[1]: (1) The pattern concomitant to ordinary *attention* in which the individual focuses upon external objects or upon images or symbols relating to them; (2) a pattern which I have distinguished as *cotention*, in which the individual focuses upon tensions located predominantly in the region of the eyes or in the segment of the symbolic activity



KYMOGRAPH RECORDS WITH EYES OPEN (ABOVE), WITH EYES SHUT (BELOW) *Th* THORACIC RESPIRATION, *P*, CAROTID PULSE, *A*, ABDOMINAL RESPIRATION INSPIRATION IS RECORDED ON THE DOWN-STROKE, EXPIRATION ON THE UP-STROKE.

The second pattern precludes the usual play of phantasies and the customary affects and strivings commonly adhering to mental imagery. Instead there is sensed the organism's generalized tensions as contrasted with the more specifically localized tensions of the symbolic segment The competitiveness and self-concern characteristic alike of so-called normal and neurotic attitudes are eliminated, and there occurs a re-centring of interest which gives precedence to internally motivated, phyletically co-ordinated trends. Physiological (neuromuscular) modifications related to the organism's phantasy sphere have thus been differentiated from physiological modifications concomitant to the organism's direct relation to environmental reality

Recent instrumental experimentation shows that the pattern of cotention is characterized by a scarcity of eye- and lid-movements and by specific changes of respiration, namely, (*a*) a markedly decreased frequency, (*b*) an increased amplitude of the respiratory movements, and (*c*) in certain subjects a decreased inspiration-expiration ratio. The respiratory curve, as obtained by thoracic and abdominal pneumographs, was recorded by the wax paper kymograph devised by Volkmann and Gerbrands (Harvard). The diminution in frequency was from a normal average of 12 8 to an average of 4 2 respirations per minute during cotention

It was possible to differentiate these respiratory alterations sharply from other slight modifications occurring under varying conditions of mental rest or activity The respiratory changes may be considered as part manifestations of the two types of attentional adaptation They set in immediately with the altered attention, they occur automatically, and they are not affected by opening or closing the eyes

The differentiation of the two forms of attention is of special interest in relation to the problem of behaviour disorders Under conditions of cotention, symbolic projections possessing the emotionally coloured content characteristic of neurotic reactions are automatically arrested The cotentive reaction may be brought about by training Experimentation with respiratory changes is being continued in the laboratory of the Lifwynn Foundation, and other physiological patterns which underlie the two types of attentional adaptation are being investigated

TRIGANT BURROW
(Scientific Director.)

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April 18

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[1] Reported in my book, 'The Biology of Human Conflict—An Anatomy of Behavior, Individual and Social" (New York The Macmillan Company, 1937) (see NATURE, March 12, 1938, p 462)

Chromosome Structure

IT was recently shown[1] that the somatic chromosomes of *Trillium* are composed of four strands intertwined in pairs at metaphase, while in anaphase and telophase they contain two spirally twined threads.

Recent cytological investigations of *Crocus sativus* (saffron) yield further crucial evidence regarding chromosome structure. This cultivated form is triploid, having 24 somatic chromosomes From preparations of root tips, three of these chromosomes are seen in anaphase (Fig 1*a*) to have a satellite attached to their long arm As this material was fixed in Navashin, the split in the chromosomes does not show at this stage, and the satellites also appear as single structures These satellites, as well as the chromosome, are, however clearly seen in early telophase (Fig 1*b*) to be double

By a special staining method recently devised[2] it has been possible to stain the chromosomes and the nucleolus differentially, so that the nucleolus can be picked out at its very beginning in telophase in contrast with the chromatin, and the thread attaching the satellite to the chromosome can be shown to be composed of chromatin By a special method of mordanting the chromosomes are stained red with Feulgen and the nucleolus light green This staining method has also been applied to root tip smears[3] making possible an investigation of the precise relationships between nucleolus, satellite, connecting thread and chromosome in various plant genera during both the somatic and the meiotic divisions

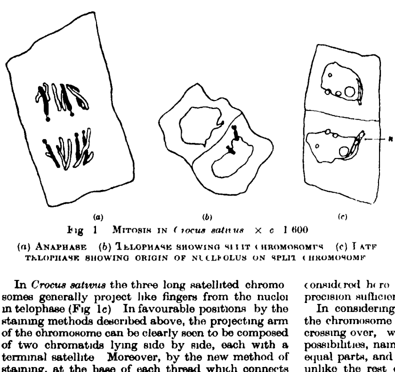

Fig 1 MITOSIS IN *Crocus sativus* × c 1 600

(*a*) ANAPHASE (*b*) TELOPHASE SHOWING SPLIT CHROMOSOMES (*c*) LATE TELOPHASE SHOWING ORIGIN OF NUCLEOLUS ON SPLIT CHROMOSOME

In *Crocus sativus* the three long satellited chromosomes generally project like fingers from the nuclei in telophase (Fig 1*c*) In favourable positions by the staining methods described above, the projecting arm of the chromosome can be clearly seen to be composed of two chromatids lying side by side, each with a terminal satellite Moreover, by the new method of staining, at the base of each thread which connects the satellite to the (red) split chromosome can be seen a minute green granule which represents the beginning of the nucleolus Each nucleolus thus arises as two bodies close together, one on each of the twin threads of a telophase chromosome, showing conclusively the double structure of the chromosome at this time As these nucleolar rudiments grow, they shortly fuse into one globular body, which then grows to the full sized nucleolus of the resting nucleus

It may be pointed out that Dearing[4] has shown essentially the same thing in the salamander *Amblystoma*, the telophase chromosomes being double and the nucleolus arising from the satellited chromosome as two granules, one on each chromatid The present method of staining, by which the nucleolar material is green while the chromatin is red, makes it impossible to mistake the beginnings of the nucleolus for chromomeres

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[1] Gates R R NATURE **140** 1013 (1937)

[2] Semmens C S and Bhaduri P N A New Method for Differential Staining of the Nucleolus *Stain Tech* (In the Press)

[3] Bhaduri P N, Root tip Smear Technique and the Differential Staining of the Nucleolus *J Roy Micro Soc* (In the Press)

[4] *J Morph* **56** 157–179 (1934)

Distribution of Crossing-Over in the Chromosomes of *Drosophila*

FROM an analysis of crossing over in *Drosophila melanogaster*, I was led to certain conclusions concerning the distribution of the chiasmata, or points of exchange along the cytological chromosomes[1] In particular I noted that the centromere or spindle attachment showed certain peculiar relations to the regional frequency of crossing over, and I advanced the hypothesis of a time sequence in the occurrence of chiasmata (moving away from the centromere) to account for these observations

This has recently been challenged by Charles[2] in an analysis of crossing over in the X chromosome of *Drosophila* He finds that crossing over has certain similar relations with the attachment end and with the free end of this chromosome He concludes that the observed phenomena could be explained as well or better, by relating the frequency of crossing over to both ends jointly Such a relation he says would account for all the evidence that I have adduced for the special relation to the spindle attachment He also proposes certain alternative hypotheses which, however will not be considered here as they are not formulated with a precision sufficient to allow of prediction

In considering Charles's claim that both ends of the chromosome play a part in the determination of crossing over, we must distinguish between two possibilities, namely, that they play equal or nearly equal parts, and that they both behave in a manner unlike the rest of the chromosomes but that their roles are not the same The former would appear to be the alternative advocated by Charles This, however, cannot be true, as it allows of no explanation of the special properties of the attachment region in the effects of age, temperature and similar agencies on variations in crossing over Nor does it allow of an explanation of the findings of Sturtevant and Beadle[3] with regard to the effect on crossing over in the *X* chromosome of heterozygosity for the Delta 49 inversion These authors observed that in such a system crossing over is considerably more affected, in the regions of normal sequence, distal to the inversion than in similar regions proximal to the inversion Finally Charles's own figures, notably his Fig 1, show asymmetry of the crossing over frequency distribution along the salivary chromosome, though this type of map (as compared with the mitotic map which I consider to be more suitable for such studies) would tend to minimize such asymmetry Similar skewness is to be observed from a number of other sets of data published by various authors Thus we may exclude the possibility that the attached and free ends have precisely similar properties in crossing over

In considering the alternative that both ends of the chromosome have properties unlike those of the central regions, but that the two ends do not behave alike, we are in effect discussing my original conclusion A terminal region may be expected *a priori* to behave differently from the central regions if only because it is an end But the different behaviour of the two ends is not to be anticipated in such a way, and inasmuch as the attachment end differs very markedly from all other regions, we must endeavour to account for its behaviour by giving it a special role in the process of crossing over This I attempted to do by the hypothesis of the time sequence in chiasma formation The virtues or shortcomings of this hypothesis as an explanation of the observed unique behaviour of the attachment region cannot be considered here, but new data, bearing on the question, will be discussed elsewhere in detail

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[1] Mather K J *Genet* **33** 207 35 (1936)
[2] Charles D R J *Genet* **36** 103 26 (1938)
[3] Sturtevant A H and Beadle G W, *Genetics* **21** 554 604 (1936)

Control of a Species-Difference by Means of a Difference in an Inductor

Hitherto, experimental analyses of species differences by the use of xenoplastic transplantations have shown that the distinguishing characteristics are inherent in the tissues themselves This is especially true when one considers organs which owe their differentiation to induction from other parts The inductor of one species, although able to produce an effect on tissues of another species, acts only as a release mechanism calling forth certain potencies without impressing the characteristics of its own species on the reacting system

Xenoplastic transplantations between two species of *Drosophila* have yielded a different result The adult testes of *D pseudoobscura* are approximately ellipsoids, while those of *D azteca* are tubes wound up in form of a spiral of about one and a half turns Larval testes of both species are very short ellipsoids They attain adult shape after having become attached to the vasa efferentia, which originate independently of them Dobzhansky[1], in an analysis of gynandromorphs in *D simulans*, has pointed out that the spiral form of the testes in this species is probably due to some organizing influence exerted by the vas, as the testes, in spite of increase in volume, remain ellipsoidal if not attached to a duct This has been confirmed by numerous transplantation experiments involving five other species[2]

In order to test whether this 'induction' of adult form is of the nature of a release mechanism, to which the gonads respond according to their genetic constitution, reciprocal transplantations of larval gonads between *D pseudoobscura* and *D azteca* were made The shape of the implants was studied after the metamorphosis of the operated animals into adults It was found that the 'genetically spiral testes of *D azteca* assume an elongated ellipsoidal form if attached to a vas of *D pseudoobscura* and that the genetically ellipsoidal testes of *D pseudoobscura* grow into a spiral if attached to a vas of *D azteca* Here then, we are confronted with a case in which the structure of an organ of one species has been determined by a specific organizing influence exerted by tissue of another species The fundamental difference in testis shape between *D pseudoobscura* and *D azteca* is not a result of the genetic differences of these organs, but depends rather upon a difference in the constitution of the inductor, the vas efferens

The contrast between this and former results with xenoplastic induction loses some of its sharpness if we consider the probable nature of the organizing action on the shape of the testes Here we are not dealing with the induction of tissue differentiation, since the testis is already histologically differentiated, but with the distribution of growth processes A testis probably assumes a spiral form as the result of unequal growth in the length on two opposite sides of its surrounding membrane, while an ellipsoidal testis has undergone growth of equal intensity for all regions at any given level of its periphery It is suggested therefore, as a working hypothesis that the control of testis shape in these *Drosophila* species is the result of some growth influencing principle unequally distributed over the proximal parts of the vasa of *D azteca* as contrasted with a symmetrical distribution of such a principle in *D pseudoobscura*

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June 9

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[1] Dobzhansky Th *Roux's Archiv* **123** 719 746 (1931)
[2] Stern C and Hadorn E *Amer Natur* **72** 42 52 (1938) also unpublished data

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Neutral Particles in Cosmic Radiation

A number of cosmic ray experiments seem to indicate the existence of a non ionizing penetrating radiation which is capable of producing charged secondaries and showers Barnóthy and Forró[1] have found that at a depth of 800 m water-equivalent, practically the whole ionization is due to shower particles and not to single ionizing rays From this fact they concluded that the shower producing radiation must be non ionizing, and owing to its high penetrating power they proposed to identify it with neutrinos

In a more conclusive way the existence of a neutral penetrating radiation is shown by the experiments of Maass[2] He measured the absorption of single cosmic ray particles by a counter telescope placing an iron block of varying thickness (A) between the counters and (B) above the top counter The difference of the number of coincidences $(B) - (A)$ must obviously be due to ionizing secondaries produced in the iron by a non ionizing radiation[3] The curve $(B)-(A)$ has a maximum at a thickness of 30 cm iron For higher thicknesses the curve decreases very slowly corresponding to an absorption of the primary neutral radiation The absorption coefficient ($\sim 9 \times 10^{-3}$ cm^{-1} iron) is practically the same as that of the charged penetrating component, which is now known to consist of heavy electrons The absorption coefficient of the charged secondary particles ($\sim 8 \times 10^{-2}$ cm^{-1} iron) is though about ten times larger than that of the primary neutral radiation still far smaller than that of ordinary electrons We therefore assume that the secondary particles are relatively slow heavy electrons

The fact that the absorption of the primaries is very similar to that of the heavy electrons suggests that they are of a similar nature Indeed it seems to be impossible to identify them with any other known neutral radiation Neutrons would have a much smaller penetrating power and there is no process known by which neutrinos could produce heavy electrons in sufficient large numbers We therefore think that we have to deal in these experiments with *the neutral counterpart of the heavy electron* for which we propose the name *neutretto*

The existence of such a particle has indeed been made very probable by recent theories of the nuclear forces[4] In these theories the heavy electron is made responsible for the exchange forces between a proton and a neutron The fact that the forces between two protons seem to be equal to those between a proton and a neutron requires the existence of a neutral particle which has the same mass and similar other properties as the heavy electron It has also been shown by Kemmer[5] that assuming equality of all the nuclear forces the neutral particle can be included in the theory in a very simple and natural way According to this theory, the behaviour of a neutretto would be very similar to that of a heavy electron Apart from those processes in which the charge is involved directly (ionization emission of light) the neutretto would give rise to all the same types of showers which heavy electrons can produce as discussed in a recent paper by one of us (W H)[6]

In particular a neutretto (denoted by Y°) can be transformed into a heavy electron $Y\pm$ during a collision with a proton (P) or neutron (N) and vice versa

$$Y^\circ + N \rightleftarrows P + Y^- \text{ or } Y^\circ + P \rightleftarrows N + Y^+ \qquad (1)$$

For an energy of the order 10^8 e v the theory leads to a cross section which would allow a neutretto or a heavy electron to travel a distance of the order 5 cm lead, 7 cm iron or half a metre water before such a transformation takes place[6] For higher energies, however, the processes (1) are replaced by the production of showers consisting of heavy electrons created in a single multiple process for example,

$$Y^\circ + P \rightarrow N + Y^+ + Y^- + Y^+ \text{ etc} \qquad (2)$$

The mean kinetic energy of the particles created in such a process is of the order of a few times the rest energy ($mc^2 \sim 10^8$ e v) For a given energy of the primary particle the mean number of shower particles is therefore also determined The cross section for the occurrence of such a process cannot however be deduced from the theory but the experiments show that it decreases with increasing energy thus leading to a high penetrating power of the heavy electron and neutretto

The experiments discussed above are quite consistent with these ideas In particular the curve obtained by Maass can easily be understood by the production of heavy electrons by neutrettos according to (1) and (2) The energy and penetrating power of the secondary heavy electrons to be expected in this theory (~ 7 cm iron) are just of the order obtained experimentally (~ 12 cm iron)

We think it likely that the neutretto is responsible for the majority of processes ascribed to neutral penetrating particles in cosmic radiation although of course the participation of neutrons or neutrinos cannot be excluded

N ARLEY
W HEITLER

H H Wills Physical Laboratory
University of Bristol
June 15

[1] Barnóthy and Forró *Z Phys* **104** 744 (1936)

[2] Maass *Ann Phys* v **27** 5 7 (1936)

[3] Prof Blackett has kindly pointed out to us that a certain part of this difference may be due to scattering This question can only be settled by further experiments

[4] Yukawa Sakata and Taketani *Proc Phys Math Soc Japan* **20** 319 (1938) Fröhlich Heitler and Kemmer *Proc Roy Soc* A **166** 1 4 (1938

[5] Kemmer *Proc Camb Phil Soc* (In the Press

[6] Heitler *Proc Roy Soc* (in the Press)

Viscosity of Air and the Electronic Charge

I SHOULD like to be allowed to make two comments on the recent communication in NATURE of Dr C B Banerjea and B Pattanaik[1]—a letter giving the preliminary results of what is evidently a very accurate determination of the viscosity of air

First the generally accepted X ray value of the electronic charge is $4\cdot803 \times 10^{-10}$ E S U – not $4\cdot807 \times 10^{-10}$ Secondly there are now available the results of three independent and extended series of measurements on oil drops namely (1) the pioneer work of Millikan (2) the more recent work of Bäcklin and Flemberg[2] and (3) the very recent work of Ishida Fukushima and Suetsugu[3]

It is of considerable interest to combine the results of these three measurements with the value of the viscosity of air obtained by Harrington[4] in 1916 (the value used by Millikan) and with the more recent values of other workers and to calculate the resulting values of e

The values of the viscosity are (all in 10^{-7} poise and reduced to 23 C)

(*a*)	1822·6	(*d*)	1833·3
(*b*)	1834·8	(*e*)	1830·3
(*c*)	1829·2		

(*a*) is Harrington's value[4] (*b*) is the mean of two almost identical values obtained independently by Bond[5] and Kellstrom[6] (*c*) is due to Houston[7] (*d*) to Banerjea and Pattanaik[1] and (*e*) to Rigden[8] The results of the calculations are tabulated below e being given in 10^{-10} E S U

Oil drop Viscosity	(1) Millikan	( ) B and F	(3) I F and S
(*a*)	*4·770*	4·[illegible]52	*4·806*
(*b*)	4·818	*4·800*	4·854
(*c*)	4·796	4·7[illegible]8	4·832
(*d*)	4·81	4·[illegible]94	4·848
(*e*)	4·80[illegible]	4·[illegible]82	4·836
Means	4·[illegible]99	4·781	4·835

Mean of all sets together 4·8[illegible]5
(Italic values of e are those given by the authors)

Possibly the only justifiable conclusion to be drawn from all this is that the oil drop method (because of the many difficulties and uncertainties in its application) is not suitable for the exact determination of e It is of interest, however, to note that of the three available sets of oil drop measurements Millikan's work now appears to be in by far the best agreement with the X ray results In fact if we leave out Harrington's value for the viscosity (which seems certainly to be too low), and use the mean of the remaining values, Millikan's measurements give $e = 4\ 806 \times 10^{-10}$ E S U If we also omit Bond's and Kellström's values, which seem likely to be too high—that is, if we only use the most recent three measurements of the viscosity—Millikan's value becomes $4\ 803 \times 10^{-10}$—in exact agreement with the X ray measurements

Queen Mary College H R ROBINSON
(University of London), E 1
June 11

[1] Banerjea and Pattanaik NATURE **141** 1016 (June 4 1938)

[2] Bäcklin and Flemberg NATURE **137** 655 (1936)

[3] Ishida Fukushima and Suetsugu *Sci Pap Inst Phys Chem Res Tokyo* **709** 57 (1937)

[4] Harrington *Phys Rev* **8** 738 (1916)

[5] Bond NATURE **137** 1031 (1936) *Proc Phys Soc* **49** 205 (1937)

[6] Kellström NATURE **136** 682 (1935) *Phys Rev* **50** 190 (1936) Houston *Phys Rev* **52** 751 (1937)

[7] Rig l n NATURE **141** 82 (1938) *Phil Mag* **25** 961 (June 1938)

Waves Associated with Moving Corpuscles

BY appropriate general treatment, it may be shown that solutions involving the path time are invariant that is can exist in any set of space co ordinates Starting then with the solution for the electron velocity ripple in terms of the transit half angle[1] it may be shown, by analogy with van der Pol's treatment of waves in *n* dimensions[2], that this ripple satisfies certain conditions The most important of these is that the ripple satisfies a five dimensional wave equation, the wave velocity being that of the particle, provided the frequency of the ripple is such that $\theta \gg \sqrt{2}$, where θ is the transit half angle ($= \omega\tau/2$) It will be convenient to regard this ripple as that part of the particle vibration which corresponds to free, as distinct from forced, oscillation The factor ½ must be associated with the fifth dimension as follows

$$\theta = \omega\tau/2 = \omega(t-t_1)/2 = \omega r_5/c_5$$

where c_5 is the velocity appropriate to the waves

I have confirmed that when no weight factor is involved the result of integrating transit time solutions over all possible values of θ (that is from θ = 0 to θ = ∞) leaves the four dimensional solution that would have been obtained had the transit time been taken as negligible Thus (i_c = electron convection current i = total current density (ripples)

$$[i_c]_t = ie^{i\omega t}\int_{\theta=0}^{\theta=\infty} \Upsilon_2\,(2i\theta)\,di\theta = ie^{i\omega t}\left|\frac{e^{2i\theta}-1}{2i\theta}\right|_0^{\infty} = ie^{i\omega t}$$

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[1] Benham W F *Phil Mag* **5** 648 (March 1928)

[2] van der Pol B *Physica* **3** 385 392 (June 1936)

A Useful Statistical Test

THE method described below gives a useful criterion of the significance of the difference between an observed and a hypothetical frequency distribution Since it provides an exact test, it is particularly useful in the case of small samples, in which the expectation in some frequency classes may be very small It is only applicable when the number of possible samples containing the same number of observations as the observed sample is determinable The test answers the question Is this a reasonably likely sample to be obtained in a random draw ? It does not give the proportion of less likely samples which may be expected to arise, as does the χ^2 test

Let us suppose that the hypothetical population shows the following proportional frequencies in four classes

$$\tfrac{1}{8},\ \tfrac{3}{8},\ \tfrac{3}{8},\ \tfrac{1}{8},$$

the total being 8

The number (N) of possible samples of n with r frequency classes is given by

$${}_rH_n \text{ or } \frac{(r+n-1)!}{(r-1)!\ n!}$$

Thus the number of possible samples of 8 in 4 classes is

$$\frac{11!}{3!\ 8!}, \text{ or } 165$$

Clearly the average probability of the samples is $1/N$ or $1/165$ An observed sample having average probability cannot, of course, be considered as an unlikely sample to arise Half the average probability has been found to separate samples at about the 5 per cent point agreeing closely with χ^2 ($p = 0\ 05$) in cases where both tests are applicable It is only necessary therefore, to express p, the probability of an observed sample, as a fraction of $1/N$, considering the sample as unlikely to have arisen from the hypothetical population if Np is less than 0 5

For example, is a sample of eight having the frequencies 3 1 1, 3, likely to have arisen as a random sample from the population specified above ? $N = 165$, and p is given as a term in the multinomial distribution Thus

$$Np = 165 \times \frac{8!}{3!\ 1!\ 1!\ 3!}\ (\tfrac{1}{8})^3(\tfrac{3}{8})^1(\tfrac{3}{8})^1(\tfrac{1}{8})^3 \quad < 0\ 1$$

The sample is therefore very unlikely to have arisen as a random sample from the hypothetical population

The change in the number of possible samples with a change in r corresponds to a change in the number of degrees of freedom with the χ^2 test Other restrictions on variation such as the use of a calculated mean or standard deviation, do not change the number of possible samples at all in the same way This suggests that restriction in the χ^2 distribution is much more accurately allowed for by degrees of freedom in the case of differences in the numbers of frequency classes, than it is with restrictions imposed by the use of calculated statistics in specification of hypothetical populations

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June 22

Passivity of Iron to Natural Waters

THE passivity of iron has been known for more than a century, but until recently interest has mainly been directed to treatments which render iron inert to copper salts such treatments do not necessarily prevent rusting by natural waters Three sets of observations in this laboratory have indicated how passivity to such waters might be obtained (1) The film present on iron rendered passive in chromate appears to be the air formed film with its weakest places fortified with chromium oxide[1], a 'patchwork' is not ideal for protection (2) The coarser the grinding of an iron surface, the longer the time needed to produce passivity[2] (3) Susceptibility to corrosion, as judged by statistical studies, varies from spot to spot and is influenced by chemical character[3]

These facts have suggested (*a*) preliminary abrasion followed by (*b*) the etching away of the shattered metal which is difficult to render passive, and finally (*c*) treatment in a solution containing chlorides and chromates in amounts adjusted to eat away specially susceptible spots whilst leaving the remainder passive (On pure iron, where there are no chemically different spots, chloride free chromate gives almost equally good results)

After such treatment specimens of iron or mild steel, 1 8 cm square have been preserved in various natural waters, and have only produced a rusty colour in the water after periods of the order of 100 times those required with untreated metal Thus soft moor land water which becomes rusty after about an hour s contact with untreated metal remains clear for several days if the metal has first been treated harder waters from chalk sources which acquire a rusty tint within a day from untreated metal have remained unchanged for some months in contact with treated metal But the expectation of escaping corrosion decreases with the specimen size and, although encouraging, the observations are not thought to possess immediate technical importance especially as the treatment does not prevent rusting by a polluted atmosphere

The behaviour of the passive iron to scratching is very interesting Iron covered with a *visible* oxide scale by heating and scratched locally before immersion often suffers intensified corrosion since the oxide scale acts as cathode of a cell which concentrates anodic attack on the small area of exposed metal but a specimen of iron rendered passive and then engraved with a scratch in the Mears Ward machine[4] (66 tons/sq in), has remained in Cambridge water for three months without appreciable change (similar iron not rendered passive produces rust within a day) A possible explanation—suggested by studying films transferred to celluloid, as described elsewhere[5]—is that, whilst the engraving of a scratch line causes a *thick* film to crack off, exposing the iron it tends to press a *very thin* film down into the groove, so that the metal remains largely covered Some interruption of the film is certainly unavoidable, but this will not necessarily cause corrosion if the interruptions are very small, since the anodic current density may then reach the value needed to restore passivity the largest gap which can be tolerated will depend on the composition of the water

U R Evans

Metallurgical Laboratories
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June 23

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[1] Hoar T P and Evans U R *J Chem Soc* 2476 (1932)

[2] Evans U R *J Chem Soc* 1030 (1927)

[3] Mears R B Carnegie Scholarship Memoirs **24** 69 (1935) Compare C E Homer Iron and Steel Inst Corr Comm 2nd Report 225 (1934)

[4] Mears R B and Ward E D *J Soc Chem Ind* **53** 382T (1934)

[5] Evans U R Iron and Steel Inst Corr Comm 5th Report 225 (1938)

Negative Thixotropy

Aqueous solutions of ammonium oleate are strongly elastic If given a rotary motion and then allowed to come to rest, the rotation is in part retraced before they do so In 1926, Hatschek and Jane[1] examined these solutions in a Couette type viscometer They found, *inter alia*, that when the outer cylinder was rotated at a constant angular velocity, the torque on the inner one, after a short period of normal magnitude increased to an irregularly fluctuating value many times greater After a period of rest the behaviour was repeated It appeared that a gelatinous structure was actually built up by the process of shear, and dissipated again at rest The subsequent discovery[2] that the anomalous increase of torque was associated with the onset of turbulence distracted attention[3] from this first conclusion It seems probable however that the turbulence itself also anomalous and of abnormal appearance[3], was another result of the structure built up rather than the direct cause of the increased torque

Solutions of many of the newer paraffin chain salts also show the phenomenon of elastic recoil, and in more pronounced degree, and similar behaviour in the Couette viscometer The observations now referred to were made mostly on a 0 02 per cent solution of the copper salt of cetyl phenyl ether sulphonic acid at 80- 90° C

A very simple experiment demonstrates what may be called the negatively thixotropic behaviour A slow stream of air bubbles of suitable size is introduced at the bottom of a large beaker full of solution They rise in normal manner and in normal time (for water) if the solution is undisturbed If the solution is now gently stirred round their upward course takes many times as long and is extremely irregular The bubbles frequently collect in small clusters and whether single or in clusters, they are seen to halt at or be diverted round invisible barriers About a minute after the stirring is stopped the normal behaviour is almost completely restored

Further evidence is found in experiments on flow through plugs of fibrous material, for example, glass wool, cotton wool or (at 60°) wool felt If a pressure difference is applied suddenly, after a period of complete rest the flow is at first about as rapid as with water but quickly falls to a steady value only a small fraction of that obtaining initially Pressure differences in excess of a somewhat critical value cause permanent rapid flow The smaller the applied pressure difference the smaller is the volume passed before the limiting slow flow is reached and after attainment of this limiting flow in one direction immediate reversal of the pressure difference (keeping its magnitude the same) simply reverses the flow at the limiting value the initial rapid stage being eliminated

G S Hartley

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[1] Hatschek E and Jane R S *Koll Z* **38** 33 (1926)

[2] Andrade E N da C and Lewis J W *Koll Z* **38** 260 (1926)

[3] Hatschek E *Koll Z* **38** 2 9 (1926)

Crystal Structure of Succinic Acid

The cell dimensions of the low temperature form of succinic acid have been found to be $a = 5$ 10 $b = 8$ 88, $c = 7$ 61 A $\beta = 133°$ 37 , in agreement with those found by Yardley[1] with other choice of c axis—and Dupré la Tour[2] The space group is $C_{2h}^5 - P2_1/a$ The cell contains two molecules , as the general atomic position of the space group $P2_1/a$ is 4, this leads to the conclusion that the molecule has a centre of symmetry

The crystal shows pronounced fibre cleavage along the c axis, this being also the direction of the largest refraction index These facts indicate that the molecule lies along the c axis the length of which 7 61 A is in accordance with this assumption To find the azimuth round this axis a Patterson analysis of the [001] projection was made this shows a relatively narrow ridge going through the origin and making an angle of about 37° with the b axis This ridge will correspond to inter atomic distances in the molecule which is accordingly approximately flat, lying in a plane through the c axis and intersecting the a b plane along the direction shown by the ridge A second hump of greater dimensions in the middle of the projection can be interpreted as caused by the inter molecular distances As the details of the Patterson analysis were not very clear owing to many distances overlapping it was not possible to derive further information from it

Several models were found to be possible on geo metric grounds Only one of these models gave reasonable agreement with the intensities of the reflections *hkO* *hOl* and *Okl* On the basis of this model Fourier analyses of the projections [100] and [010] were made The resulting parameters are

	x	*y*	*z*
C_1	0 021	0 036	0 258
C_2	0 056	0 067	0 081
O_1	− 0 133	−0 080	0 253
O_2	0 167	0 142	0 422

The distances between the C atoms were found to be 1 52 and 1 51 A in accordance with the standard distance 1 54 A for the single aliphatic bond In this respect, succinic acid differs strikingly from oxalic acid where the C C bond is found to be considerably shortened by the influence of the carboxyl group[3] The C C bonds include an angle of about 110°

The calculated C O distances are 1 28 and 1 31 A O O in the same molecule is 2 28 A the distance between oxygen atoms of different molecules is 2 65 A

The details of the structure and of its determina tion will be published elsewhere

(The late) H J VERWEEL
CAROLINA H MACGILLAVRY

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June 25

[1] Yardley K Proc Roy Soc A **105** 451 (1924)

[2] la Tour Dupré E C R Acad Sci Paris **193** 180 (1931)

[3] Robertson J M and Woodward I J Chem Soc 1817 (1936)

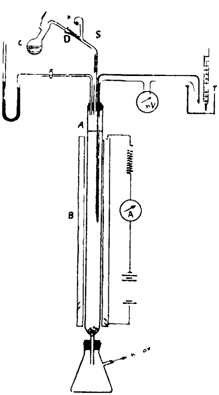
A New Method of Resolving a Racemic Compound

WE have recently developed a new method of resolving a racemic compound by selective adsorption and the results we have obtained already published in the *Praktika* of the Academy of Athens (April 1938) agree in the main with similar experiments of G M Henderson and Dr H Gordon Rule[1]

The method is based upon the different degree of adsorption which an optically asymmetric crystal as *d* or *l* quartz shows, for the two antipodes The result of this selective adsorption is that when a *d l* solution is passed through a Tswett column its *d* and *l* components are separated and located at different heights.

We used quartz powder prepared from *d* and *l* quartz crystals as the asymmetric adsorbing medium and a solution of tri ethylenediamine chromichloride ((Cr en_3) Cl_3 + 3½ H_2O) as the racemic compound We have chosen this compound because of its great molecular rotation power which is 3 000° for 5890 *A*

The apparatus employed is shown in the figure below After activating the adsorbing medium by heating in vacuum we let the racemic solution pass through the column *A* of the quartz powder by breaking the glass end S by the metal sphere *K* and tipping up the vessel *C* thus avoiding contact with any grease



Then we examined the filtrate in the polarimeter and the solutions obtained by successive elutions of the adsorbed salt by 85 per cent alcohol As the accompanying table indicates, the solutions obtained show optical activity By using *d* quartz the first elutions are dextro rotatory and the next solutions are lævo rotatory By using *l* quartz the opposite occurs This indicates that the asymmetric quartz surface adsorbs more strongly the antipode of the opposite sign

OPTICAL ACTIVITY OF SUCCESSIVE ELUTED SOLUTIONS

Adsorbing medium	I	II	III	IV	V
l quartz	0 023	0 041	0 020	0 108	
l quartz	0 058	0 121	0 018	0 046	+0 034
d quartz	+0 023	0 020	0 0[illegible]0		

It is easily shown by a thermodynamic cycle that the selective adsorption of the antipodes by optically asymmetric surfaces can be reduced to a difference in the heat of formation of the adsorbed antipode molecule from adsorbed atoms on the asymmetrical quartz

These experiments throw a new light on the problem of the genesis of the first substance with optical activity It is possible that this substance was formed by many successive adsorptions and elutions of a racemic compound on optically asymmetric surfaces of minerals

Experiments are in progress with the object of extending the research to other substances the details of which will be published elsewhere

G Karagunis
G Coumoulos

Laboratory of Physical Chemistry
University of Athens
May 28

Nature 141 917 (May 21 1938)

WE are greatly interested to read of the success obtained by Prof Karagunis and G Coumoulos in effecting a partial resolution of a complex chromium salt by the use of active quartz Following up the work of Tsuchida, Kobayashi and Nakamura[1] upon the detection of a racemic inorganic complex by immersing powdered active quartz in its solution we have also been examining the possibility of extending these results by the use of quartz columns in conjunction with inorganic as well as organic complexes

G M Henderson
H Gordon Reif

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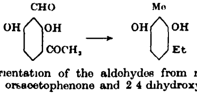
[1] *Chem Soc Japan* **56** 1339 (1935)

Modified Gattermann Reaction Synthesis of Hydroxy-Formyl-Phenyl-Ketones

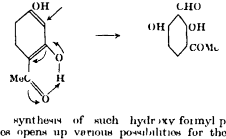
ONE of the authors (R C S) with Laiwalla has previously shown that methyl β resorsylate does not undergo the Gattermann reaction under the usual conditions, that is, in the presence of zinc chloride in ether or in the presence of aluminium chloride in benzene , the reaction takes place readily, however in the presence of anhydrous aluminium chloride dissolved in dry ether, with the formation of the aldehydo ester, methyl 2 4 dihydroxy 3 formyl benzoate[1]

We now find that polyhydroxy phenolic ketones also give aldehydes in high yields under the condition of Shah and Laiwalla s modified Gattermann reaction[1] the formyl group entering (when possible) the usually inaccessible *Y* position in the resorcinol nucleus Thus resacetophenone gives 2 4 dihydroxy 3 formyl acetophenone, the constitution of which is established by its reduction by the Clemmensen method to 4 ethyl 2 methyl resorcinol of Robinson and Shah[2]

Orsacetophenone, 2 acetyl resorcinol, 2 4 dihydroxy benzophenone and phloracetophenone afford similarly 2 4 dihydroxy 6 methyl 3 formyl acetophenone, 2 6 dihydroxy 5 formyl acetophenone, 2 4 dihydroxy 3 formyl benzophenone and 2 4 6 trihydroxy 3 formyl acetophenone respectively



The orientation of the aldehydes from resacetophenone, orsacetophenone and 2 4 dihydroxy benzophenone in which the formyl group enters the 3 position instead of the usual 5 position is of interest These results are best explained on the view that the chelation between the hydroxyl and the acetyl group stabilizes the double bonds in the resorcinol nucleus , the carbon atom in the 3 position which is united by a double bond to the carbon atom bearing the 4 hydroxyl group is thus the point of attack (*cf* W Baker[3])



The synthesis of such hydroxy formyl phenyl ketones opens up various possibilities for the synthesis of heterocyclic compounds containing oxygen in the ring like coumarino *Y* pyrones furo chromones etc which are being explored

A detailed account of the above investigation will shortly be submitted to the Chemical Society

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[1] Shah and Laiwalla *Current Science* 197 (1936)

[2] Robinson and Shah *J Chem Soc* 1494 (1934)

[3] Baker W *J Chem Soc* 1684 (1934)

Long-distance Radio Reception and the E-Region of the Ionosphere

MR ALEXANDER A McKENZIE of the Mount Washington Observatory has reported a well marked case of the long distance reception of amateur 56 60 megacycle signals which occurs occasionally at this time of year A letter from him reads in part We started listening about 1930 E S T (June 5 1938) and listened continuously until about 2045 During the whole time long distance signals were fading in and out fairly rapidly with extremely audible volume at the start for instance of a call letter group and absolute silence before the group was completed

Mr McKenzie, on Mount Washington, heard twelve Middle Western stations, and reports a supplementary list of seven other stations which were being called by various amateur stations in the New England area With two exceptions which may be ascribed to faulty identification the stations heard in New England appear to have been closely grouped about a point somewhat south of Chicago The minimum and maximum distances involved are 780 and 960 miles the mean being 880 miles

Continuous records of the heights of reflections from the ionosphere are made at Cruft Laboratory at a frequency of 3 5 megacycles On the night in question, remarkably strong abnormal *E* region reflections were observed from 1912 to 2035 E S T , the number of multiple reflections varying from four to six At 2035 the reflection began to decrease in intensity, and it disappeared completely at 2050. The apparent height of reflection was 120 ± 3 km. throughout the period

We may identify the long distance transmissions as being caused by extremely high ionization in the *E* region and, from the observed height and distance, deduce a minimum ionization density which must have obtained on this occasion The angle of incidence of the transmitted rays upon the *E* layer was such that the critical frequency for normal incidence must have been slightly more than one fourth of the transmission frequency, or about 15 megacycles This corresponds to a density of free electrons of about 2 8 $\times 10^6$ per cm^3, or their equivalent in heavy ions Too little is known of the effective recombination coefficients at such heights to permit the calculation of the corresponding energy density On the assumption, however, that the highest frequency normally reflected from the *E* region is about four megacycles we may say that the ionization producing energy on this occasion was about 200 times that due to ultra violet light at noon on a summer day

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June 13

Enhancement of the Sodium *D* Lines in the Twilight Sky Light

Prof J Cabannes, Prof J Dufay and J Gauzit[1] state that the twilight enhancement of the yellow radiation of the night sky announced by me[2] was previously observed by Currie and Edwards at Chesterfield (Canada) during the International Polar Year, 1932 33 To support their opinion, they give a short quotation from a paper published in 1936 by the Canadian physicists[3] The complete sentence should have been quoted , it is as follows

The fairly uniform intensity of 5940 during moon light irrespective of the intensities of the green line and the negative bands, indicates that it is due to a luminescence distinct from that of the aurora and is probably the radiation 5893 A observed by Vegard and Tonsberg in the night sky light

Thus the band around 5940 A appeared to Currie and Edwards remarkably constant during the moon light periods It is only upon this observation that they based their suggestion However, if it is quite certain that the band at 5940 does not belong to the auroral spectrum, it is no less certain on account of its aspect and evolution, that it cannot be identified with the sky line 5893 A Currie and Edwards also state "It appeared to be a broad, diffuse band extending from about 6000 A to 5800 A with a mean wave length of 5940 A This broad and diffuse appearance (200 A) cannot be that of an atomic line or narrow doublet On the contrary, it can be explained very exactly by the spectral sensitivity of the plates (Ilford Soft Gradation), which offer a sharp and strong maximum exactly in this region, and by admitting that the so called band near 5940 A originates from the continuous spectrum of the moonlight In fact, the intense yellow band obtained by Currie and Edwards remains absolutely invisible when the auroral spectrum is photographed, with full moon, on another type of plate (Agfa I S S) Taking into account some supplementary arguments, developed in another paper[4], it seems beyond doubt that the yellow sky radiation 5893 A was never observed by Currie and Edwards It is thus clear that their work gave me no information or suggestion likely to guide me in the discovery of the yellow fluorescence or resonance of the twilight sky

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NATURE **141** 1054 (1938)
[2] NATURE **141** 788 (1938)
[3] *Terr Mag* **41** 265 (1936)
[4] *C R* **206** 1137 (1938)

Use of Non-Conservative Properties of Sea Water to Physical Oceanographical Problems*

IN applying the eddy diffusion equation to the non conservative properties of sea water (as distinguished from the conservative properties, the concentrations of which change only as a result of physical processes) a knowledge of the time rates of change in their concentrations (as a result of the biological activity in the water mass) is required Thus, the form of the equation expressing the effect of vertical turbulence alone on a non conservative property, such as oxygen would be

$$\frac{d\alpha}{dt} \quad A \frac{\partial^2 \alpha}{\partial t^2} - C,$$

where, for dissolved oxygen α the term C would represent the rate of oxygen consumption due to the biological activity in the water mass The consumption of oxygen in the sea as a means of disguising the oxygen transport by turbulence is frequently strikingly brought out at the depths of the oxygen minimum concentration where regardless of enrichment by eddy diffusion oxygen concentration actually decreases in the downstream direction due to the greater rate of oxygen consumption

Information on the rate of oxygen consumption in the depths of the ocean basins is confined chiefly to results obtained for the mid Atlantic between latitudes 0° and 30° N , where the mean annual oxygen consumption at mid depths was placed at approximately 0 42 c c per litre and that in the deeper water at approximately 0 10 c c per litre Use has been made of the former value in calculating the magnitude of the vertical eddy coefficient at mid depths (at depth of the minimum oxygen concentration) in the Caribbean basin , where, with certain assumptions, the gain and loss of oxygen in the downstream direction could be formulated, thus

$$Ct = O_1 - O_2 + A \frac{\partial^2 O}{\partial t^2} t$$

where Ct represents the amount of oxygen consumed in the downstream direction by biological activity as the water layer (at the depth of the minimum oxygen concentration) moved, during the time, t, from position 1 to position 2 , $A \frac{\partial^2 O}{\partial t^2} t$, the amount of dissolved oxygen gained as a result of vertical turbulence during the same time (effects due to lateral turbulence are neglected) , and $O_1 - O_2$, the observed difference in oxygen concentration (at the depth of the minimum oxygen concentration) between positions 1 and 2 The combination of this equation with a similar one involving the conservative property (salinity) at adjacent depths gave two equations which were solved simultaneously for the values of *A* and *t*.

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* Contribution No 181 from the Woods Hole Oceanographic Institution

Substances dissolved in sea water the concentrations of which are altered by biological activity are useful in investigations of its circulation when used either as simple identifying properties or in combination with a conservative property; in such cases it is frequently not necessary to know the rate of the biochemical change of concentration. Particularly useful combinations of conservative and non-conservative properties, such as oxygen and salinity, or oxygen and temperature, may under certain defined conditions be used to trace movements and mixing of water masses and to supplement the results of circulation as calculated from the Bjerknes circulation theorem. The oxygen-salinity or oxygen-temperature relationship has its counterpart in the temperature-salinity relationship (originated by Helland-Hansen), but differs in that the latter strictly conservative relationship is chiefly useful in interpreting combinations of water masses of distinctly different physical properties, whereas the combination of conservative and non-conservative properties may be used advantageously in investigating characteristics of a water mass of marked homogeneity. The latter relationship recently used in an investigation of the water (between approximate depths of 200 and 1,200 metres) in the Caribbean Sea region made it possible to trace the movements and mixing of water masses entering the passages from the open Atlantic and to bring out certain details not clearly indicated by the temperature-salinity relationship.

H. R. Seiwell.

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June 14.

Effect of Addition of Calcium on the Biological Value of the Proteins of Indian Diets

During our investigations[1] on the biological value of the proteins of typical Indian diets, it was found that the proteins of the Madras diet gave a biological value of 44 at 10 per cent protein level, though rice with a biological value of about 83 formed the major item of the diet. In the course of an informal discussion with Dr. W. R. Aykroyd, director of the Nutrition Laboratories, Coonoor, he suggested that the low biological value might be due to a low content of calcium in the diet. Experiments were conducted with addition of calcium in the form of calcium carbonate to the Madras diet. Results are given below.

CALCIUM IN DIET 0·124 PER CENT

Rat No.	Initial weight (gm.)	Final weight (gm.)	Digestibility (%)	Biological value (%)	Average
1	130	134	59	34	44
2	115	123	65	45	
3	165	169	61	45	
4	123	130	64	44	
5	114	119	66	45	
6	94	103	69	52	

CALCIUM IN DIET 0·124 PER CENT + 2 PER CENT CALCIUM CARBONATE

Rat No.	Initial weight (gm.)	Final weight (gm.)	Digestibility (%)	Biological value (%)	Average
1	105	109	86	66	76
2	102	107	93	81	
3	109	125	85	71	
4	105	114	87	81	
5	94	99	90	79	
6	122	130	92	78	

Examination of the above results reveals that the biological value of the proteins of the Madras diet increases from 44 to 76, and the digestibility from 64 to 89 on the addition of calcium to the diet, even though the calcium content in the Madras diet is just enough according to Sherman's accepted standard for an adequate diet. The low biological value in the first table might be due to the non-availability of calcium in the diet. Further work to confirm the above observation is in progress.

V. Ranganathan.
Y. V. S. Rau.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.
June 13.

[1] Contributions to the Study of the Biological Value of the Proteins of Typical Indian Diets. I. Biological Value of the Proteins of Madras, Bombay (Parsi) and Punjab Diets (sent to the *Indian Journal of Medical Research*).

Biological Fixation of Nitrogen

The oxime which is formed in the root nodules during the nitrogen fixation of legume bacteria[1] has at last been isolated and characterized. The oxime precipitates according to Foreman's method, which fact already indicates it to be the oxime of a dicarbonic acid. Extracting the oxime with ether, we succeeded in preparing the copper salt from it. The analysis of this salt showed that the compound is the oxime of oxalacetic acid. Thus the formation of aspartic acid in the biological fixation of nitrogen via the oxime of oxalacetic acid has been finally confirmed.

Artturi I. Virtanen.
T. Laine.

Biochemical Institute,
Helsinki.
June 25.

[1] Nature, 141, 748 (1938).

Electric Lines of Force

When a piece of cotton wool is placed on one of the charged spheres of a Wimshurst machine, it is immediately repelled and following the lines of force in the air, proceeds to the oppositely charged sphere. This is the usual method of demonstrating the phenomenon, but it is not always easily controlled.

I have recently been trying substitutes for the cotton wool, amongst them the down of birds. The down was furnished by my budgerigar. I find that the down attached to the base of the feathers which the bird pulls out answers the purpose admirably. A piece of this placed on a charged sphere, gradually takes up the charge, the fine points of the immature feather standing out, and finally leaps across the four or five inches of air separating the two charged spheres. If the spheres are not highly charged it may be as long as five seconds or so before the repulsion takes place.

The way the charge is taken up is extremely interesting and worth projecting on a screen. The down is a poor conductor with many fine points. I think this explains its peculiar behaviour.

The electric lines of force are well shown by this method as it is possible to have two or three pieces of down going to and fro at the same time.

J. Baxenden.

Sir John Cass Technical Institute,
Jewry Street,
Aldgate, E.C.3.
June 9.

Points from Foregoing Letters

FROM the rate of sedimentation (in an ultracentrifuge) of the serum proteins of various vertebrate animals Prof The Svedberg and K Andersson infer that the serum proteins of mammals reptiles birds amphibians and fishes are very much alike as regards molecular weight but differ from those present in the serum of Cyclostomata (lampreys)

A new dye dunnione found as a deposit on leaves and flowers of *Streptocarpus Dunnii* is described by J R Price and Prof R Robinson It crystallizes in orange red needles has the molecular formula $C_{15}H_{14}O_3$ and belongs to the naphthalene group

The copper found in human blood occurs in the form of a copper protein compound according to Dr T Mann and Prof D Keilin who announce that they have isolated from the red blood corpuscles of the ox a pure crystalline compound (hæmocuprein) containing 1 12 per cent sulphur and 0 34 per cent copper

A new hybrid hæmoglobin (choleglobin) formed by special treatment of hæmoglobin ascorbic acid solution is described by Dr R Lemberg J W Legge and W H Lockwood The new compound like hæmoglobin combines reversibly with oxygen and carbon monoxide but the non protein part of its molecule is a bile pigment closely related to verdohæmatin

H S Corran and Dr D E Green describe the isolation from cow s milk of a flavin protein compound which catalyses the oxidation of reduced coenzyme I by carriers The mechanism of the catalysis does not seem to involve alternate reduction and oxidation of the flavin moiety

A new enzyme which hydrolyses naringin the bitter glycosidic principle of grape fruit may be readily obtained from celery according to Dr D H Hall It also occurs in the grape fruit itself between the flavedo and albedo where it probably helps to reduce the bitterness of the fruit on ripening

Dr H G K Westenbrink and Dr J Goudsmit have determined by a modified thiochrome method the relative amounts of the two forms of vitamin B_1 (aneurin and cocarboxylase) in various organs of the rat and find that the aneurin content is small compared with carboxylase

Dr J H Welsh states that the acetylcholine found in the nervous tissue of the crab has upon the heart of that animal an effect opposite to that upon the human heart namely it increases the rate of beat

T L Snyder and R H Broh Kahn find that cysteine can replace hæmin as the X factor enabling *H influenzæ* to grow and consider that its function is to provide the organism with a mechanism for protection against the hydrogen peroxide formed in the presence of air

Diagrams showing the average density of population and the composition of the insect fauna at heights of 277 ft 177 ft and 10 ft above an area of agricultural land in Lincolnshire is submitted by J A Freeman The greatest numbers and variety occurred during the months of June and September and the most favourable conditions were high temperature, low humidity and wind velocity A list of the more common pest species taken up to 277 ft is given and the economic importance of their presence is discussed with reference to ground quarantines

Dr R W G Dennis observes that the potato virus Y induces brown circular local lesions in the leaves of *Lycium barbarum* seedlings and suggests that this reaction may prove of value as a new test for the Y virus

For several years Dr T Burrow and his associates of the Lifwynn Foundation have been experimenting with differences in physiological reaction according (1) as behaviour is motivated naturally by the organism as a whole or (2) as it is prompted by secondary part components giving rise to neurotic phantasies and related behaviour disorders

Diagrams of chromosomes from the root tip cells of the saffron during mitosis are submitted by Prof R R Gates and G N Pathak in which the double structure of the chromosomes is rendered evident by the presence of satellites The authors state that by means of a new method which stains the chromatin red and the nucleolar material green the origin of the nucleolus from the split chromosomes can readily be followed

Curt Stern states that he has shown by means of transplantations of testes between two species of *Drosophila* that the distinguishing characteristics in testicular shape are induced by a difference in the male ducts

The non ionizing penetrating radiation producing cosmic ray secondaries and showers is considered by N Arley and Dr W Heitler to be a neutral body corresponding to the heavy electron The authors suggest for a new entity which has a mass intermediate between the neutron and the neutrino the name neutretto and discuss its likely properties in the light of present theories

Prof H R Robinson points out that when the most recent values of the coefficient of viscosity of air are used Millikan s oil drop value of the electronic charge comes into almost exact agreement with the X ray value namely 4 803 × 10^{10} E S U

Starting with the solution for the electron velocity ripple in terms of the transit half angle W E Benham points out that the ripple satisfies a five dimensional wave equation

Dr U R Evans describes a treatment which renders iron relatively inert to ordinary waters the time taken to produce rustiness being sometimes 100 times that needed by untreated iron in the same water The protective film is invisible and the engraving of a scratch line after treatment does not necessarily lead to rusting probably because it presses down the film into the groove

Solutions of the copper salt of cetyl phenyl ether sulphonic acid and other salts of the newer paraffin chain series show elastic behaviour similar to that of ammonium oleate solution when they are set in motion According to Dr G S Hartley this is the opposite of thixotropic behaviour and has been explained by Hatschek as due to the formation of amicroscopic structure by the process of shear

H A and Dr R C Shah have formulated polyhydroxy phenols by a modified Gattermann reaction The 3 substitution is explicable on the assumption of the stabilization of the double bonds in the nucleus by the chelation between the hydroxyl and the acetyl groups

40° N., following a course New York Paris Moscow — Omsk — Yakutsk (Siberia) — Fairbanks (Alaska)—Minneapolis—New York. They covered a distance of 14,874 miles in 3 days 19 hours 17 minutes. Their actual flying time was 71 hours 4 minutes at an average speed of 209 miles an hour. They followed a somewhat similar route to that taken by the late Wiley Post, the American aviator, who established a record of 7 days 18 hours 49 minutes for a flight of 15,250 miles in 1933. Their machine was a Lockheed 14 monoplane powered by two 875 horse power Wright Cyclone engines with Hamilton constant speed airscrews. Normally this type is a 14 seater air liner carrying 12 passengers and 2 crew. While this is a meritorious performance having been completed in only seven stages it is not a record for long distance non stop flight. The longest hop was New York Paris, a distance of 3 641 miles.

SUCH a performance pays tribute principally to the technical improvements that have added to the reliability of the engines and the rapid strides that have been made recently in the methods of and aids to, aerial navigation. It is significant of the development of this side of aviation that even in the less developed parts of Siberia there were sufficient aerodromes and radio organization to allow of a choice of landing grounds after being given reports upon their condition while flying towards them. The extra carrying capacity consequent upon developments in aerodynamic knowledge plays its part in allowing various aids to flying and navigating to be carried, and also making it possible to have cabin accommodation sufficiently large for the crew to move about and to carry out their duties without undue strain. In one instance, in Siberia during this flight it is reported that they even had room to carry an extra supply of more than 500 lb. of oil, as it was reported that the particular grade that the engines needed would not be available at the next stop. It is interesting to note that the engines used on this flight are of the same type as those fitted to the Lockheed aircraft recently ordered by the British Government.

'Aryans' in Italy

NATIONALIST doctrine in Italy hitherto has had the appearance of avoiding pronouncement upon theories of race. It has relied rather on fostering the totalitarian spirit upon imperial tradition with a consequent orientation to archæological research for which the learned world is duly grateful to the personal interest of the Duce. Now, however it is said to be time that the Italians frankly professed themselves to be racist. A group of university professors, it is reported (*The Times*, July 15) working under the auspices of the Ministry of Popular Culture, has drawn up a pronouncement appearing in the *Giornale d'Italia* of July 14, in which is stated what is to be regarded henceforth as the orthodox view of racial doctrine as applied to Italy. This statement has the merit that it recognizes that the idea of race is a purely biological concept, with which history language and religion have nothing to do. It claims that the present population of Italy is in its majority Aryan few elements of the pre Aryan races remaining and no immigration of populations capable of influencing the racial physiognomy of the nation having taken place since the Lombardic invasion. The forty four million of inhabitants of Italy to-day it is maintained are for the most part descended from families which have been established there for at least a thousand years. While this may be conceded but only so far as it goes the inference that the Italian race—a term which in itself begs the question can thus be regarded as a pure race is perhaps less readily to be accepted. The corollary that racism in Italy ought to be essentially Italian with an Aryan Nordic direction is a hard saying, only partially intelligible, especially in view of the repudiation of linguistic evidence in the light of the evident desire to dissociate the Italians from other members of the Mediterranean racial group by emphasizing its purely European characteristics as marking it off from all extra European races. This view would ignore or deny any trace of kinship between the Mediterranean strain in the Italian and that in the peoples of North Africa Arabia, and Palestine. This would seem to require a somewhat drastic re interpretation of the facts.

The Deutsche Orient-Gesellschaft

A NOTICE from the Deutsche Orient Gesellschaft, of which the following is a translation, has reached its members, including British subjects and honorary members. To the Members of the German Orient Society. To ensure the continuance of the German Orient Society, the Executive Committee must, in accordance with Paragraph 8 Section d of the Constitution give those members who rank as Jews in the sense of the Nuremberg Laws to understand that they must announce their resignation from the German Orient Society within 14 days.' The notice is signed by Dr. F. Schmidt Ott (vice president) and Dr. W. Andrae (secretary) of the Society. Though the Society has been compelled by the policy of the Government to take this step of asking Jews to resign, the wording of the announcement is altogether unworthy of a scientific body and is particularly unpardonable when sent to members who are not Germans.

THE Deutsche Orient Gesellschaft was formed in 1898, mainly under the inspiration of Prof. Friedrich Delitzsch, a Jew in the sense of the Nuremberg laws. The main aims of the Society were to excavate ancient sites and survey ancient monuments in the Near East and Egypt. Three great sites in Iraq have been carefully examined over a long series of years—Babylon, Ashur and Uruk—and many other smaller sites sounded. In Egypt, excellent work was done at el Amarna and on the sepulchral monument of Sahu Re. Surveys of Ukhaidhir, the ancient synagogues of Palestine and Islamic monuments in India were perhaps the most important contribution to these subjects. Regular "Mitteilungen" kept subscribers informed of progress. Final reports, and most important publications of the texts found were included in the "Wissenschaftliche Veröffentlichungen" These undertakings were generously supported in Germany by such men as the late Dr. Simon, and foreign subscribers were numerous For forty years the Deutsche Orient Gesellschaft has held a leading place among societies of its kind, always insisting on a high standard of work in the field and the study not always attained by others Sir Robert Mond was one of the foreign members who received the letter asking for his resignation and he informs us that he has answered, "that since your Council has unanimously decided to cease to be a scientific society, he no longer desires to be associated with it"

Archæological Exploration in South-West Arabia

In another column of this issue of Nature (see p 140) a preliminary account is given by Miss G Caton-Thompson of the geological and archæological results of the Lord Wakefield Expedition of Exploration in South-West Arabia, upon which she recently accompanied Miss E W Gardner, the geologist, and Miss Freya Stark, whose adventurous journeying in Arabia on a previous occasion will be fresh in the memory of readers. Miss Caton-Thompson, whose present record amplifies in detail the archæological and geological references of Miss Stark's account of the expedition in *The Times* of July 18–21, is far from being a novice in archæological exploration in conditions similar to those of her recent experience With Miss Gardner as her geological colleague, she has investigated the evidences of early civilizations in the Faiyum and the Kharga oasis, while in Southern Rhodesia she has attacked, and, most archæologists would agree, has solved the problem of the Zimbabwe In venturing with her colleagues into the rarely penetrated Hadhramaut she has initiated the archæological investigation of a problem, or group of problems, which has fascinated historian and geographer ever since the explorations in southern Arabia of Niebuhr in 1761–64 and of Halévy and Glaser more than a century later revealed in their collection of inscriptions the existence there of civilizations going back possibly so far as nearly a thousand years before Christ Yet the archæological record has remained virtually blank, and although the great frankincense route from India to the eastern Mediterranean through southern Arabia traversed country known to the ancient world of Sumer, Akkad and ancient Egypt, it may be, in the third millennium B C , nothing is known with certainty of the cultures and relations of those civilizations. Minaean, Sabaean, Himyaritic, and the like, which Miss Caton-Thompson, wisely, for the moment accepts collectively as pre-Islamic. The work of Miss Gardner and herself in the Hadhramaut has laid securely the foundations for the study of a group of problems which recent development in the pre- and protohistoric archæology of western Asia and Africa suggests may be one of the most important strategic points in future research.

Excavations at Lachish, 1937-8

The interesting collection of antiquities from Tell Duweir, the ancient Lachish, in Palestine, on view at the Wellcome Research Institute, Euston Road, London, N.W 1, from July 7 until July 29 bears eloquent testimony to the organization of detail by the leader of the expedition, the late Mr J. L Starkey, which enabled the members of the Wellcome-Marston Archæological Research Expedition to carry on without interruption after his murder on January 10 last By that time the expedition had already arrived as near a solution as is likely to be possible of the problem of the great shaft, 80 ft by 70 ft by 80 ft deep, at the south east corner of the Tell upon which investigation was engaged at the close of last season. Tunnels driven along the sides at the bottom and up to the centre show that this great seventh century work was never completed, but that it was probably intended for a reservoir similar to that at Gezer Excavation of the Bronze Age temple has now been completed down to bed rock, two pieces of evidence leading to redatings.

The early temple is now shown to be considerably earlier than was believed, a remarkable large polychrome pot with painted metopes, showing beautiful representations of ibex, ibis and tunny fish, being placed in a class of pottery dated by Mr W A. Heurtley at about 1550 B C ; while a small faience plaque of Amenhotep III was found in such a position as to place it beyond question that the building of the second temple falls within the reign of that monarch. Two Nineteenth Dynasty pottery sarcophagi, the first found at Lachish, in the form of 'slipper' coffins, have lids moulded to represent the features of the deceased, while a third bears an inscription in hieroglyph which is unique. It is by a scribe evidently unfamiliar with hieroglyphic writing, and although not yet fully interpreted, is in a formula which is not Egyptian Early Bronze Age caves, dating at about 2500 B C , showed evidence of occupation, as well as contracted burials In one cave, of the Late Bronze Age, which in Judæan times had been used as a stable, was found a number of unfired pots which pointed to this having been a potter's workshop, while nearby in another cave was his stock in trade In a pit were pivoted stones which may have served as fly-wheels for the turn-table, while red and yellow ochre for painting, bowls for mixing the paints, pebbles and shells for polishing and burnishing, were part of the equipment. The interesting schoolboy scribing giving the order of the first four letters of the Judæo-Phenician script was found under the Jewish Palace steps the day the expedition ceased work.

Archæological Research in Greece

Among recent excavations and research in Greece recorded in the Annual of the British School of Archæology at Athens (35, Session 1934–35), first place in interest and importance is taken by the work of the School in Ithaca. Mr. W. A. Heurtley, who was in charge, describes the results of the excavation of the Helladic settlement at Pelikáta, which Leake and others have identified with the home of Odysseus as described by Homer. Pelikáta is a hill or spur linked on one side with the central peak of the island, and sloping down to the sea in a series of terraces on its three other sides. Thus commanding three bays, and having a flat top, it was, as Mr Heurtley points out, an admirable site for a primitive community interested in trade or piracy or both. Virtually no trace of buildings remained when investigation began, but there were vestiges of the wall which had enclosed the promontory. Excavations on the site yielded evidence of an early Helladic settlement, which on the evidence of the pottery, Mr Heurtley concludes, reached the island in Early Helladic II from Corinthia, and afterwards received an accession in a new element in the population, which Minyan ware indicates to have come from the south of Thessaly as its immediate place of origin, with an ultimate derivation from Bronze Age Macedonia.

THE date of the original occupation of Pelikáta is placed at about 2200 B C, the settlement then being a simple affair—a wall of rough stone blocks surrounding a group of houses with rubble walls and roofs of reeds daubed with mud situated on top of the hill. These people buried their dead, or rather the bones of their dead in *pithoi* or jars which, possibly, were placed below the floors of the houses. The settlement came to an end at about the time which tradition assigns to the Trojan wars, and thus, Mr Heurtley remarks, those who hold on other grounds that Pelikáta is to be identified as the site of the palace of Odysseus now have some archæological evidence to support their contention. A cave containing stratified deposits on the north east of the bay of Polis was excavated by Miss Sylvia Benton and showed evidence of occupation from pre Mycenæan times to the first century A D. It was a shrine at which various deities were worshipped, but its local importance seems to have been due to a connexion with Odysseus, for which there is evidence in an inscription on a female mask.

Garden Plants of Proved Excellence

THE Council of the Royal Horticultural Society established, in 1922, an Award of Garden Merit as a hall mark upon the horticultural worth, hardiness and beauty of particular plants. Notes and descriptions of species which have attained to this particular quality have been published from time to time in the Society's *Journal*, but it was a welcome decision of the Council to publish the collected awards during the past fifteen years in a separate volume ("Some Good Garden Plants", by F J Chittenden. London from the Society's Offices, Vincent Square S W 1 1938 4*s* net) The plants described therein have mostly been grown in the Royal Horticultural Society's gardens at Wisley, and are all well known to the Garden Committee. A horticultural description, cultural notes, and suggestions for suitable garden grouping, are appended for each of the 225 species or varieties, and the most suitable soil types are mentioned. References are also given to plates in the *Botanical Magazine*, when the plant has been so figured. Some kinds, as *Lilium regale*, *Dicentra spectabilis*, *Primula denticulata*, *Daphne mezereum* and *Clematis montana* are already well established in favour, other species have recently been introduced to culture from plant collecting expeditions, whilst yet others are improvements of very common plants. *Ulex europaeus flore pleno* is a double variety of the common gorse, *Caltha palustris plena* is a dignified form of the wild marsh marigold, and three improved varieties of the common lilac are described. An alphabetical arrangement assists quick reference, whilst an index divided into annuals, bulbous plants, herbaceous perennials, rock plants, shrubs, small trees, wall and climbing plants and water plants enables the gardener to find his way easily among these aristocrats of the garden.

Child Psychology for Parents

WE have received a copy of an address delivered recently to the parents' association of a school well known for its pioneer work in the field of organized practical training for citizenship. The address is noteworthy if only as a too rare example of effort towards parent teacher co operation. The author, Dr Oswald Schwarz, sought to demonstrate what he described as one of the greatest discoveries of modern psychology—that the foundations of happiness in later life as well as of all troubles, difficulties, problems and abnormalities, are almost invariably laid in the first few years of our childhood. The only real problem in education is, he holds, the problem of an aim in life and its solution is to be sought in evoking and fostering an attitude of respect, or 'the appreciation of the inherent value of everything existing just because it exists'. He shares, apparently, with Whitehead the notion of actuality as in its essence a process, involving, on the mental side a weaving of reception and anticipation into an end to which its indwelling Eros urges the soul as to the realization of ideal perfection. To the objection that such philosophical ideas do not work with children he answers that he knows from fairly wide personal experience that most boys from the age of sixteen years onwards are not only able to conceive these ideas but that they grasp them eagerly as if they had long waited for them", which accords with Whitehead's "youth is peculiarly liable to the vision of that Peace which is the harmony of the soul's activities with ideal aims that lie beyond any personal satisfaction.

The Brotherton Collection of the University of Leeds

THE second annual report of the Brotherton Collection Committee refers to the considerable interest in the Brotherton Collection which is available for the use of the University of Leeds staff, students, research scholars and the public. The numerous exhibitions which have been arranged, including technical exhibitions for the Process Block makers' Society, Printers' Guild, the Technical Institute, and the Society of Chemical Industry, have attracted some 2,300 visitors. Detail work such as lighting and heating adjustments, painting and additional fittings which was incomplete at the opening of the Library in October 1936, was completed by the end of the Easter vacation Good progress was made with the catalogue and cross reference index The income of the Library is limited to about £1,250 per annum and the accounts show a balance in hand of £96 8s Particulars of gifts and additions during the year and of the regulations governing access to the Collection are included

British Scientific and Technical Books

THE second edition of the Select List of Standard British Scientific and Technical Books has been prepared by the Association of Special Libraries and Information Bureaux, at the request of the British Council (ASLIB, 31 Museum Street, London, W C 1 Price 2s to Book List Subscribers, 2s 6d to others 1s to members of ASLIB or the Library Association) In the preparation of the list, the Book List Committee consulted authorities upon every subject, so that the books may be justly regarded as representative of existing works in science and technology now available from British publishers About three hundred books are included in the list, which is subdivided into twenty three sections Sections on agriculture and on medicine and surgery have been added in the revised edition A list of publisher's addresses and a subject index are appended

Beit Fellowships for Scientific Research

THE following Beit fellowships for scientific research tenable at the Imperial College of Science and Technology during the Academic Year 1938 39, have recently been awarded extensions of fellowships already satisfactorily held for one year to D W Goodall, for research on the physiology of the tomato plant, under the direction of Prof F G Gregory, H A C McKay, for investigations of chemical problems by the radioactive indicator method, under the direction of Prof H V A Briscoe, A K Powell, for research on parasitic wasps, in particular that of *Microbracon hebetor*, under the direction of Prof J W Munro New fellowships tenable for one year but renewable for a second have been awarded to J L O G Michiels (Royal College of Science), for research on the positions and widths of the energy levels of atomic nuclei by means of experiments on the capture of slow neutrons by various elements, under the direction of Prof G P Thomson, E J Harris (Royal College of Science), for research on hydrocarbon oxidation and the reactions of peroxides with reference to carbon processes, under the direction of Prof A C G Egerton

Announcements

DR MONTAGU TRAVERS MORGAN, medical officer of the Ministry of Health, has recently been appointed medical officer of health of the Port of London by the London Corporation

AN exhibition dealing with the prevention of industrial eye diseases was opened at the Royal Eye Hospital, London, on June 22 by the Earl of Athlone Part of the exhibition is to remain in the hospital as a permanent museum

AN intensive course in industrial hygiene and medicine will be held at the University of Birmingham on September 12 23 Further information can be obtained from Dr H E Collier Department of Industrial Hygiene and Medicine The University, Birmingham

THE Minister of Justice in Portugal has transformed the Department of Criminal Anthropology, Experimental Psychology and Civil Identification into an Institute of Criminology on modern and strictly scientific lines under the direction of Dr Luiz de Piña

A CONFERENCE on Plant and Animal Communities will be held at the Biological Laboratory Cold Spring Harbor Long Island, New York on August 29 September 2 Three general papers will be read and six will be read on association concepts and four on animal aggregations These will be followed by discussion the whole of which will eventually be published in the *American Midland Naturalist* (**20**, No 1, January 1939) Further information can be obtained from the Director of the Laboratory

THERE has recently come to hand No 1 of vol 8 of the *Bulletin of the Fan Memorial Institute of Biology*, Zoological Series This journal is published by the Institute at Peiping (Peking) and the present issue bears the date March April, 1938 It is gratifying to note that notwithstanding the present disturbed conditions in China, it is possible for scientific work to be carried out The present number covers a variety of zoological subjects and the contributions are written in the English language by Chinese investigators, each article being accompanied by short Chinese abstracts The illustrations are well reproduced and of a high standard

FROM the Nottingham University College Appointments Board we have received an attractive brochure giving an outline of courses offered, a list of entrance and other scholarships and some notes on careers open to college graduates The faculty of applied science includes departments of civil, mechanical and electrical engineering, mining and fuels, textiles and a school of architecture For some years, every student of engineering who has satisfactorily completed his course at the College has obtained a post, and there are said to be more posts available than students to fill them The Nottingham coalfields provide facilities to students for experience in up to date methods Students of the large and well equipped textiles department also are said to obtain positions readily with very good prospects in hosiery and yarn manufacturing firms, textile testing and research institutions and dyeing and finishing firms

Research Items

Milk and Nutrition

AN interim report to the Milk Nutrition Committee on 'The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children has been published by the National Institute for Research in Dairying The report deals with the data obtained of height and weight at the first and last examinations of a series extending over a year, made on 6 099 school children in Luton Wolverhampton Burton on Trent Renfrewshire and Huddersfield The children were divided into four groups, the first (control) groups received biscuits the second $\frac{1}{3}$ pint of pasteurized milk the third $\frac{2}{3}$ pint of pasteurized milk and the fourth $\frac{2}{3}$ pint of raw milk as daily supplements to their home diets The groups receiving milk showed greater increments in height and weight than those receiving biscuits, and in the case of the children receiving $\frac{2}{3}$ pint of milk increases of 4–6 per cent in height and 9 10 per cent in weight over the control groups were found The response to milk supplements of children initially classed as 'well nourished, appeared to be better than in children of a lower standard of nutrition This may be due to the utilization of the milk in making good structural deficiencies before it begins to affect growth No significant differences could be detected between the effects of raw and of pasteurized milk

Nutrition in an African People

NOTES of observations on the Elmolo of Lake Rudolf, East Africa, made by the late Dr W S Dyson and written up by Dr V E Fuchs his colleague on the Lake Rudolf–Rift Valley Expedition (*J Roy Anthrop Inst*, **67**, 2, 1937), afford material for comparison with the condition of the people when first encountered by Count Teleki and Lieutenant (now Admiral) von Hohnel in 1888 since when nothing has been written about them The contrast suggests that intensive study of the effects of an unsuitable diet on a previously healthy people and of the changed conditions in their mode of life would be of no little interest It was recorded at the time of their discovery that they were approximately five hundred in number In 1934, the number of men, women and children was given as eighty nine only The Elmolo were reputed to be poor members of three surrounding tribes, whose mode of life had been modified by extreme poverty They live principally on fish, varied by occasional flesh of hippopotamus, crocodile and turtle Formerly they were able to obtain a little grain by working, but Abyssinian raids cut them off from their grain supply The only drinking water is from the lake, and as this is deficient in calcium carbonate, there is a calcium deficiency in their diet, which may have some connexion with the universal deformity of the hips from which they suffer This has the appearance of rickets, taking the form of an outward and forward bowing of the tibia It occurs both in adults and in a lesser degree among the children The men suffer more than the women, possibly owing to their more active life The anterior edge of the tibia in many appears to be thickened and rounded, a feature that might be associated with a gradual bending of the bone, causing distortion The pains in the legs from which they suffer they treat with a burning ember placed on a piece of goat skin and held on the limb until it burns through to the flesh

Racial Characters in Jews of Cochin

THERE are in Cochin two groups of Jews White and Black with a third obviously of mixed origin, the Brown all claiming to be descended from Jews who migrated from Palestine on the destruction of the Temple by Hadrian in A D 70 Both groups are in theory endogamous, and the White Jews have evidently maintained their segregation inter marrying closely over a prolonged period while the Black Jews there is evidence to show have introduced low caste Indian women into their community An investigation of the blood groups and the physical characters of the White and Black Jews by Dr Eileen W Macfarlane (*J Roy Asiat Soc Bengal Letters* **3** 1 1937) though dealing with rather limited numbers elucidates several points of historical and sociological interest The distributions of the blood groups in the three Jewish communities are completely dissimilar but the data for the Brown group are disregarded as there are so few The White Jews show a preponderance of Group *A*, due to the very high degree of interbreeding A comparison shows that 1 is high in Jewish communities in the Near East The Black Jews show an even more unusually high percentage of Group *O* Similar high percentages have been recorded only in very ancient races such as the Australians and Amerinds, but there is a similar high percentage among the low castes and outcastes of Ernakulam, among whom the Black Jews have lived for hundreds of years and from whom they have taken wives and concubines Thus evidence from blood groups and physical characters shows that the claims which each Jewish community makes about itself combined with what each says of the other are probably true The White Jews preserve a Near East and European Semitic strain with no Indian admixture while the Black Jews are the descendants of mixed Semitic and native Malayali ancestors

Eelworm Disease of Wheat

EELWORM disease of wheat was first recorded in Egypt in 1919 but considering its distribution at that time it is probable that it had existed in the country some years before In 1926 the areas attacked had increased sufficiently to warrant the need for Government control measures, and although these were successful locally, widespread outbreaks of a severe nature occurred in 1932 A more thorough investigation into the disease, its means of spread and methods for its control were accordingly made, and are now described by G Howard Jones and Abd El Ghani Seif El Nasr Eff (Bull 180, Technical and Scientific Service Ministry of Agriculture, Egypt) From a knowledge of the life history of this eelworm (*Anguillulina tritici*), the almost exclusive means of spread of the disease is from seed containing a mixture of the characteristic hard galls, which form in the ears of attacked plants Under the moist conditions of germination larvæ, which immediately attach the surrounding wheat seedlings, are liberated from these galls. Control measures, therefore, amount to ensuring that seed is free from galls before sowing. Hot water steeping, though successful, is regarded as impracticable on the large scale. The same disadvantage applies to the flotation treatment in which galls can be separated from seed by the difference in their specific gravity in 20 per cent brine. Mechanical cleaning by means of indented cylinders or "trieurs", gave the best results. These machines effect separation by differences in shape, rather than by size or weight, and were found to give an efficiency of more than 97 per cent when used for cleaning eelworm-infected seed.

Angiosperm Embryo Sacs

P. MAHESHWARI (*New Phyt.*, 36, No. 5, 1937) has published a review of the variations occurring in the angiosperm embryo sac. The data recorded represent a considerable search in the literature, and the facts are presented in a more generalized form than in K. Schnarf's "Vergleichende Embryologie der Angiospermen". The method of describing the embryo sacs as monosporic, bisporic or tetrasporic according to the time of origin of the embryo sac relative to the two divisions (reduction division), normally occurring in the megaspore mother cell, is useful for classification purposes. The data contribute little towards the elucidation of the problem of the homologies of the angiosperm embryo sac. Reports from some recent workers that the synergids are derived from one nucleus and the ovum and upper polar nucleus from a second, tend to favour the first part of Porsch's view that the two synergids, ovum and upper polar nucleus, represent one archegonium, but there seems little evidence that the remaining nuclei represent a second archegonium.

Downy Mildew of the Antirrhinum

THE antirrhinum plant, which seems to have largely overcome the menace of attack by its specific rust fungus, has recently been threatened by another fungal parasite, closely allied to *Peronospora antirrhini*. The new attack occurred in Sussex, and Mr. D. E. Green has recently described it (*J. Roy. Hort. Soc.*, 63, Pt. 4, 159–165, April 1938). Symptoms are of the downy-mildew type; infected plants are dwarfed, and the shoots appear somewhat bunched, whilst mealy white patches occur upon the under-sides of the leaves. Conidia and oospores are described; but little more can be said about the disease, for, having regard to the serious nature of attacks in other countries, the Ministry of Agriculture requested, and accomplished, the total destruction of all plants infected in Sussex.

Alaska Earthquake of July 22, 1937

MR. E. H. BRAMHALL has recently given a brief account of this important earthquake in central Alaska (*Bull. Seis. Soc. Amer.*, 28, 71, 1938). Though the country is sparsely inhabited, it was found possible to trace the boundary of the disturbed area, and to show that it contained about 300,000 square miles and that its centre lay near Salcha and probably a few miles to the east of that town. During a flight made over the central region on July 24, what appeared to be a narrow path, about ten miles long and running north and south, was seen a few miles beyond Salcha, but its nature could not be definitely settled. The epicentre of this earthquake thus lay more than 300 miles to the north-west of that of the great earthquake of September 10, 1899, and the shock does not seem to have been felt so far as Yakutat Bay, the central region of the earlier earthquake.

Geology of British Graham Land

SOME indication of the geological results of Mr. J. Rymill's British Graham Land Expedition, 1934–37, are noted by Mr. W. L. S. Fleming in an article in the *Geographical Journal* of June. Geological work was confined mainly to the coast where outcrops could be reached. Only a few specimens were obtained from the interior of Graham Land. With the exception of part of Alexander I Island, the area showed igneous and metamorphic types. Granites and granodorites occupy a large area in West Graham Land, but volcanic rocks are also common. It is clear that the homology with the Andean cordilleras of South America applies to South Graham Land as well as North Graham Land. The eastern coast of Alexander I Island, except perhaps the extreme north, consists of limestones, calcareous grits and shales. Invertebrate and plant fossils were found, but though they were too fragmentary to be identified they seem to resemble, at least as regards the plant remains, specimens obtained many years ago by Dr. O. Nordenskjöld from the Jurassic beds of Hope Bay on the east of Graham Land. This was the only island off the west coast of Graham Land containing unmetamorphosed stratified rocks. All others examined proved to be of the same formation as Graham Land.

Structure of Hailstones

MR. R. P. JOHNSON, of the Research Laboratory, General Electric Co., Schenectady, New York, has sent an account of a fall of broken hailstones in a thunderstorm that visited Washington, D.C., shortly after noon on April 29, 1938. The shapes of these stones and their stratification showed plainly that they were fragments of larger spherical stones about 30 mm in diameter, in which clear and cloudy layers had alternated about every 2 mm. Photographs which appeared in newspapers of the stones that fell elsewhere in this storm showed that these were spherical, and that they damaged greenhouses and the roofs of automobiles. It was concluded that where fracture took place it was at a high level, for the pieces, which ranged up to 15 mm in size, appeared to have terminal velocities suited to their sizes. They did not break on striking the pavement. The absence of layers of clear and cloudy ice built on to each fragment seemed to prove that the stones were fractured below the region where they were formed. The remarkable fact that all the stones were broken at the place of observation, while two miles away only complete stones fell, suggested to Mr. J. Schremp (another of the research engineers of the G.E.C.) that the shattering was caused by a pressure wave that was set up by a bolt of lightning that passed near to them as they fell. These observations are a valuable contribution to the known facts about hailstones that mathematicians who seek to explain their formation must take into account.

New Case of Chemi-luminescence

J. H. HELBERGER reports an interesting new example of chemi-luminescence (*Naturwiss.*, 26, 316, 1938). When the complex magnesium salt of phthalocyanine is added in small quantities at a time to gently boiling tetralin an intense red glow is observed.

The glow remains for a few minutes The process can be repeated until further additions of the compound fail to produce the glow, and the magnesium phthalocyanine dissolves normally with its green colour If now benzoyl peroxide or hydrogen peroxide is added to the liquid in small quantity, or if air is passed through the boiling liquid once more glows It appears, therefore, that peroxides present in commercial tetralin are responsible for the chemiluminescence Other magnesium complexes (for example, the magnesium compound of tetrabenzoporphin) and zinc complexes (for example, those of phthalocyanine tetrabenzoporphin and mesoporphyrin) also give the red glow, but not with such great intensity The copper and iron complexes and the free pigments do not show the effect The phenomenon may prove of interest in connexion with the problem of assimilation

Frosting of Aeroplane Wings

Two dangers of modern air transport are fog and frost deposits on the wings The risk of airport landing in a fog has been practically eliminated by the use of radio beam direction finders and now according to the *Beama Journal* of June two French engineers, MM Rideau and Ducret, have invented a method of de icing the wings by the application of electric currents The main difficulty lay in finding resistances which could be made pliable enough to cover curved surfaces without diminishing the value of the resistance Satisfactory results have been obtained by spraying a colloidal dope composed of a volatile solution, which contains in suspension laminated graphite of low conductivity on the wings The surface was first insulated from the rest of the plane by means of a layer of treated paper Selected portions of the wings were then covered by protecting strips and the remaining surface sprayed with the dope After the wing surface had been covered with the resistant solution the protecting strips were removed and along them by means of a pistol sprayer metallic particles were sprayed to form continuous bands for distributing the electric current As a final protection the whole surface to be treated was painted over with a coating of varnish On the basis of laboratory tests it is claimed that in an aeroplane of 15 metres wing span, normal speed 300 kilometres per hour, the band to which the de icing system should be applied need not be wider than 20 centimetres If the plane were provided with a four kilowatt generator, ice deposit could be prevented up to fog temperatures of 5° C below zero With temperatures 5°, 10° or 15° C below zero it should be possible to detach ice in 50, 90 or 130 seconds respectively

Production of Hydrocarbon Oils from Industrial Gases

DR W W MYDDLETON, in a paper read to the Institute of Fuel on May 12, described the above process developed by Messrs Synthetic Oils, Ltd The chief difference between this and other processes lies in limiting the hydrogenation reaction which leads to conversion of the first product of synthesis (primary' oil) so that motor spirit and Diesel oil are produced without the aid of a cracking plant , at the same time a considerable quantity of material is available for the production of lubricating and transformer oils Also, with this process, it has not been found necessary to adjust the ratio of carbon monoxide to hydrogen in the gas Suitable gas can therefore be obtained from a majority of solid fuels and one plant can handle widely different types The need for coke ovens or supplementary water gas plant is thus entirely eliminated A commercial plant capable of producing 136 180 gallons per day of synthetic oil is in course of erection at Bedlay Colliery near Glasgow, and the results of first trials are awaited with considerable interest

Construction of a Schmidt Camera

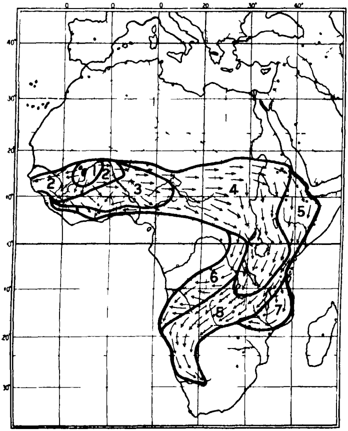
MESSRS H W and L A Cox have recently published a paper with the above title (*J Brit Ast Ass* 48 8 June 1938) which briefly describes the principle of the Schmidt camera and then provides very full details of their own camera constructed on similar lines The grinding of the spherical mirror and also the method for testing the short focus sphere, are described and then follows an account of the making of the correcting lens and the procedure for testing its accuracy Many other details are supplied which will be very useful to those interested in celestial photography and in the construction of a similar instrument and it will repay them to study the paper carefully if they are to avoid numerous pitfalls and difficulties Photographs taken show that the coma is satisfactorily corrected and that the star images over the negative are small Although a slight amount of astigmatism appears at times, as this is probably due to uneven film inferior following, or possibly small distortion in the mountings, it is possible to correct this blemish later

Colour Temperature Variations of Stars

W M H Greaves and E Martin have published a paper entitled Colour Temperature Variations of γ Cassiopeiæ and the Problem of the Yellow B Type Stars in which they give the gradients measured from plates taken in 1926 27 and also the gradients derived from the more recent plates taken in 1936 37, of the above star (*Mon Not Roy Astro Soc* 98 6 , April 1938) The remarkable increase in brightness during 1936 was accompanied by a decrease of colour temperature and a strengthening of the intensities of the emission lines and the same phenomenon took place between the autumns of 1936 and 1937 The change of colour temperature places γ Cassiopeiæ in the category of yellow B type stars to which group Hertzsprung directed attention in 1923 The problem of this type of stars is discussed and the objections to certain theories are briefly stated Previously it was pointed out that the colour temperatures appear to be correlated with the intensities of the interstellar *K* line the low temperature stars having strong interstellar lines, and selective absorption or scattering in interstellar space was suggested as the cause of the reddening effect (*Mon Not Roy Astro Soc* , 89, 125) Gerasimovič criticized this view and showed that some of the stars of the group under discussion were characterized by enhanced emission or diminished absorption on the ultra violet side of the Balmer series limit, and concluded that the low colour temperatures were intrinsically connected with the more luminous stars of B type The subject has been investigated by others, and it is probable that not only is there a reddening due to selective space absorption, but in addition, there is a reddening effect which is intrinsic in the stars and which is associated with the development of line emission Further research on both theoretical and observational lines is desirable

Fourth International Locust Conference

THE International Locust Conferences are held at intervals of two to three years in order to take stock of the progress made in anti-locust research in different countries and to discuss the plans for further concerted action. The Fourth Conference took place at Cairo two years ago, in April 1936, but a full account of its proceedings has appeared only recently*.



SPREAD OF THE AFRICAN MIGRATORY LOCUST

The outbreak originated in 1928 in areas marked by two spots in zone 1, which was invaded during the first year. Zones 2, 3, 4, etc. represent the expansion of the invasion in each of the following years up to 1934. Arrows indicate the main directions of migration.

The Conference proved the world-wide interest in the locust problem, since twenty-three countries were represented (as against thirteen which took part in the Third Conference held in London in 1934), and more than fifty communications were made. The statistical data on the losses caused by locusts in some of the countries were of great interest; the United States reported losses during the ten-year period 1925–34 amounting to about 245 million dollars, and Canada to about 36 millions, while more than 4·5 millions were spent on control in the first named country, and nearly 3·5 millions in the second. Even more staggering figures were presented by the Union of South Africa, where two years of invasion by the red locust cost the country £943,500. Similar statistics collected for all countries suffering from locusts would undoubtedly show that this pest well deserves the attention recently paid to devising better means of controlling it. The Conference entrusted the Imperial Institute of Entomology with the regular collection of such statistical data in future.

The central problem discussed by the Conference was that of the recent progress in the study of the phases in locusts and its practical application. It was agreed that the phenomenon of phase transformation provides a trustworthy basis on which to frame a sound policy for the prevention of outbreaks of locusts and grasshoppers. With regard to the African migratory locust (*Locusta migratoria migratorioides* R. and F.), the data obtained as the result of international investigations centred at the Imperial Institute of Entomology were particularly convincing, since the present invasion has been shown to originate in very restricted areas in the inundation zone of the Middle Niger in the French Sudan. This happened about the year 1928, and in seven years nearly the whole of tropical Africa was overrun by swarms, as is shown in the accompanying map. This evidence induced the Conference to recommend to the Governments of the countries concerned to enter into discussion on the ways and means for the establishment of a permanent organization for the prevention of invasions of this locust in future, by keeping its outbreak areas under expert supervision and by suppressing all incipient swarms. A similar state of affairs was found to exist with regard to the two other African locusts, the red locust (*Nomadacris septemfasciata* Serv.) and the desert locust (*Schistocerca gregaria* Forsk.), although the investigations on those species were at that time not sufficiently advanced for practical steps to be taken.

Another outstanding event of the Cairo Conference was the discussion of the problem as to what extent such activities as agriculture and grazing affect the distribution and mass appearance of locusts and grasshoppers. It was commonly believed, even by some entomologists, that these insects constitute a danger only in the countries with a low level of agriculture, and that their outbreaks become less severe as the country is more highly developed. The evidence presented, particularly by the delegates from North America, led the Conference to the conclusion that, on the contrary, in the case of many species of locusts and grasshoppers, their excessive multiplication and spread have been furthered rather than hindered by man's activities. Therefore, no hope can be entertained for the locust and grasshopper problem becoming less acute merely as a result of a general development of a country. The Conference suggested that particular attention should be paid in all future investigations to the influence on the life and ecology of locusts and grasshoppers of the various forms of human activity such as agriculture, pastoral activity, deforestation, grass fires, etc.

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* Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. 96+51 appendixes. (Cairo: Government Press, 1937.)

All the aspects of the general theory of locust outbreaks and most of the regional problems were discussed by the Conference, which embodied the results of discussions in twenty-five resolutions and four recommendations based on the facts presented in the papers printed as appendixes to the proceedings forming a large volume of nearly 500 pages.

The next, the Fifth International Locust Conference, will be held at Brussels in August this year.

B. P. U.

Numerical Changes in the German Student Body

By Dr. E. Y. Hartshorne, jun., Tutor in Sociology, Harvard University

OFFICIAL figures for the student body in the German Reich are available up to and including the academic year 1936–37. Frequent alteration in methods of classification and description have obscured the nature of some of the changes and make it difficult and sometimes impossible to interpret them. Only the less equivocal figures are here discussed. For the academic years 1932–33, 1933–34 and 1934–35, these are taken from the official *Deutsche Hochschulstatistik*, vols. 10–14, for 1935–36 from the official *Die Deutschen Hochschulen* vol. 1 (vol. 2 for 1936–37 either has not appeared or is inaccessible in the United States and Great Britain), for 1936–37 from the *Statistisches Jahrbuch für das Deutsche Reich* of 1937. There is reason to believe that the tendencies described below have continued in the academic year 1937–38.

In what follows there are included as students all registered as such, except (*a*) auditors, that is, those not committed to any definite course or examination, and (*b*) foreign students, except where specially indicated.

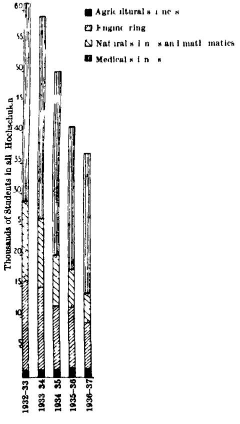
The decrease in the number of students is largely, but not entirely, conditioned by National Socialist policy. There are three obvious factors which have produced a fall in numbers. First, the number of young men in the German population of an age to enter the universities has probably fallen somewhat during these years. Secondly, since 1934 a limit has been set to the numbers admissible to a university education. Thirdly, Jews and so-called 'non-Aryans' have been practically excluded and the proportion of women students has been nominally fixed. The decrease, however, has been much sharper than can be explained by the action of these factors alone.

TABLE 1. NUMBERS OF STUDENTS IN ALL GERMAN *Hochschulen* (UNIVERSITIES, COLLEGES OF ENGINEERING, MINING AND AGRICULTURE, AND SCHOOLS FOR TEACHERS AND FOR CATHOLIC THEOLOGY)

Winter Term	Men	Women	Both
1932–33	97 576	18 578	116 154
1933–34	91 263	15 501	106 764
1934–35	76 961	12 132	89 093
1935–36	70 462	10 976	81 438
1936–37	57 672	9 410	67 082

Thus in the winter term of 1936–37 the total number of students was only 57·8 per cent of the number enrolled before the National Socialist seizure of power in 1933. "Coming events cast their shadows before", since in the academic year 1932–33 this decline had already begun.

In the field of science the accompanying graph shows the development of enrolment for the major groups: (1) agriculture, (2) engineering, (3) natural sciences with mathematics and (4) medical sciences.* The sharp decline of entry in the last three of these practical fields is puzzling. It is easily intelligible that the National Socialist emphasis on increased production from native soil should have raised the number in the agricultural sciences (1,356 in 1932–33 to 1,477 in 1936–37) and also have raised the proportion of students of agriculture to the total entry of students (from 1·2 to 2·2 per cent).



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* In the category of medical sciences are here included dentistry, veterinary surgery and pharmacy.

The numbers here involved are small But it will surprise most readers that there should be a loss, both absolute and relative, in the number of students in the great departments of engineering and of the natural sciences The number of students in certain science subjects are given in Table 2

TABLE 2 STUDENTS OF SCIENCES OTHER THAN MEDICAL

Winter Term	Engineering	Mathematics with Natural Sciences	Chemistry only
1932-33	14,477	12,951	3 543
1933-34	13,452	10,852	3,504
1934-35	10 310	7,943	3 006
1935-36	9 293	6,493	2,696
1936-37	7,649	4,616	2,058
Percentage change (1932 33 100)	52 9	35 6	58 0

Rearmament has naturally increased opportunities for the employment of highly trained engineers, chemists, etc Nevertheless, the flight from university education in these subjects is unmistakable There are no reliable statistics to show the extent to which the great engineering and chemical concerns are training men on their own account and thus replacing the universities but, for certain departments of science, it is difficult to believe that they can provide courses that are adequate substitutes for those in universities The greater part of the loss in numbers in these subjects, as in the general student body, is probably related to the more numerous and more tempting opportunities and the greater prestige of the expanding fighting services

A peculiar position is occupied by the medical sciences These show a large relative increase, though a considerable absolute fall, in the enrolment While the total number of students in all fields fell in 1936-37 to 57 8 per cent of the number in 1932-33, in the medical field it fell only to 70 2 per cent. In 1932-33, of every hundred students, 27·9 were entered for medical courses By 1936-37 the percentage of medical students had risen to 33·9 of the whole student body, as shown in Table 3 The factors at the back of these changes are complex and would need special discussion

TABLE 3 STUDENTS ON MEDICAL SCIENCES

Winter Term	Total	Percentage of Whole Student Body
1932-33	32,437	27 9
1933-34	33,482	-
1934-35	30,123	—
1935-36	28,383	—
1936 37	22,797	33 9
Percentage change (1932-33 – 100)	70 2	

Unexpected results are yielded by the subjects of 'race science' and pre history, on which very great emphasis is laid in schools and in the general educational system So far as the universities are concerned, these special fields have neither enlisted more than a very small number of native students nor have they attracted any foreign students. For "Vorgeschichte" there were only 59 native and no foreign students, and for "Rassenkunde" there were only 47 natives and one foreign student in 1934-35. After that academic year the numbers of students for these subjects disappear from the available statistics

In fields other than those of the sciences we note the changes shown in Table 4

TABLE 4 STUDENTS IN NON-SCIENTIFIC FIELDS

	1932 33	1936-37.	Percentage of 1932 33 enrolment
Ancient languages	1,225	307	25 1
Modern languages	3,589	842	23 4
Germanistik	3,636	1,540	42 4
Architecture	2,378	1,120	47 1
Journalism	208	353	169 7
Catholic theology	4,208	4,775	113 5
Protestant theology	6 588	2 583	39 2
Education	5 831	8,317	142 5

In 'Education' the number of women is practically stationary The increase in that department has been almost entirely of men It is perhaps explained by the need for 'leaders' in various youth movements

Foreign students are numerically unimportant though they are significant in other ways The numbers of foreign students have been fairly maintained for agriculture (97 5 per cent) and chemistry (94 3 per cent) There have been moderate falls in engineering (to 86 2 per cent) and architecture (to 80·3 per cent) There are much greater falls in law and social sciences (to 65 6 per cent), medicine (to 55 2 per cent), ancient languages (to 42 6 per cent) and 'Education' (to so low as 12 7 per cent) The fall in the total number of foreign students is from 6,693 in 1932-33 to 4,768 in 1936 37. The latter figure is 71 4 per cent of the former which is less change than might perhaps have been anticipated The published figures do not permit us to determine the countries of origin of foreign students We can say, however, that there has been a significant fall in English speaking American students (from 817 to 418, that is, to 51 1 per cent) and a significant rise in Spanish- and Portuguese speaking American students (from 102 to 165, that is, to 161 8 per cent)

Of all the major fields the greatest absolute loss has been in law and the social sciences. Yet despite this loss the Nationalist Socialist interpretation of these subjects is attracting the attention of certain foreign students as the figures in Table 5 show

TABLE 5 STUDENTS OF LAW AND SOCIAL SCIENCES

Winter Term	German Reich Students	Foreign Students
1932-33	24,161	1070
1933-34	20,363	669
1934-35	15,291	621
1935-36	12,617	651
1936-37	9,680	702
Percentage change (1932-33 = 100)	40 1	65 6

On the other hand, for medicine, Germany is ceasing to attract foreign students as is revealed in Table 6

TABLE 6 FOREIGN STUDENTS OF MEDICAL SCIENCES

Winter Term	German Reich Students	Foreign Students
1932-33	32,437	1977
1933-34	33,482	1249
1934-35	30,123	1196
1935-36	28,383	1172
1936-37	22,797	1090
Percentage change (1932-33 = 100)	70 2	55 2

The Constitution of Starch

THE chemical structure of starch has not yet been fully elucidated In recent years evidence as to the size of its molecule has been derived from a study of the products obtained when trimethyl starch is broken down, and it is supposed that like cellulose, starch consists of chains of glucopyranose residues but united by α glucosidic instead of β glucosidic links Haworth has calculated that the molecule of starch consists of not more than 25 30 glucose units and that these units are associated into physical aggregates of much larger dimensions On the other hand, Prof Staudinger has long held the view that the physical properties of starch point to the existence of macro molecules as distinct from molecular aggregates and in the May issue of the *Berichte der deutschen chemischen Gesellschaft* he and Herr Husemann adduce fresh evidence in support of this view from a study of the effect of chemical reactions upon the degree of polymerization of various preparations of starch from wheat

The persistence of a particular degree of polymerization after the starch had been regenerated from an acetylated derivative has been clearly demonstrated and is held to be conclusive proof of the existence of macro molecules The reason why such evidence has not hitherto been available is because these macro molecules are far more sensitive than ordinary molecules to disruptive agencies and it has been shown that even traces of atmospheric oxygen in the solvent exert an enormous effect upon the degree of polymerization

The starch was first freed from phosphoric acid and purified by repeated precipitation by methanol from solution in formamide Osmotic pressure measurements of a solution of this in formamide indicated a molecular weight of 286 000 or a polymerization degree of 1770 Another preparation with a polymerization degree of only 600 was obtained from it by rapid hydrolysis with normal hydrochloric acid The two preparations were then acetylated the former giving an insoluble, the latter a soluble, derivative The acetylated compounds were then hydrolyzed by sodium methylate under very stringent conditions when it was found that the polymerization of the regenerated starches had only been reduced to 1640 and 530 respectively In view of the difficulty of eliminating the last traces of atmospheric oxygen during the alkaline hydrolysis it is claimed that the degree of polymerization of the starch was materially unaltered by the process of acetylation Viscosity measurements led to the same conclusion

Starch appears to be not one compound but a kind of polymeric series From the relation between degree of polymerization and specific viscosity the macro molecules of starch must be quite different in structure from the micelles of cellulose for the viscosity of the latter is 5–10 times as great as that of starch of the same degree of polymerization Since however the viscosity of the solution may be taken as a measure of the length of the dissolved molecules those of starch must be very much shorter and are therefore coiled It is also suggested that the coils are branched and the ends of the short glucose chains are linked in glucosidic fashion with hydroxyl groups of other chains This structure would not only account for a relatively high proportion of tetra methyl glucose among the fission products of tri methyl starch but also for the complete absence of aldehydic properties in starch itself

River Tees Survey

THE beauty and purity of our rivers is a national heritage, and the increasing attention that is being turned towards problems of pollution is therefore welcome But before the causes and effects of pollution can be truly understood it is necessary to have, as a foundation, a knowledge of the natural unpolluted state One of the most important British contributions in this respect is to be found in a recent publication of the Water Pollution Board of the Department of Scientific and Industrial Research* This report is concerned with the non tidal reaches of the River Tees and supplements the work on the tidal region previously published The survey was undertaken by the Ministry of Agriculture and Fisheries, the research staff being under the direction of Dr E S Russell The report is drafted by Dr R W Butcher, Dr J Longwell and Mr F T K Pentelow, who were botanist chemist and zoologist respectively, on the survey

A comprehensive chemical and biological survey was made and many experiments performed in the laboratory on the effects of sewage pollution It was found that the River Tees could conveniently be divided into two regions namely from the source at Cross Fell to the junction with the River Skerne at Croft Bridge a river mileage of 5[illegible] miles and from Croft Bridge to Yarm a distance of 24 miles Above the junction with the Skerne the Tees waters are fairly soft and slightly alkaline, except at periods of heavy flood The flora and fauna in this region are uniform, taking into consideration differences to be expected from type of bottom and rate of flow The only pollution comes from several small sewage works between Middleton in Teesdale and Croft but the dilution by the river is sufficiently great to prevent harmful effects

The River Skerne is however, quite different its water is very hard and it is heavily polluted with sewage effluent from Darlington The Skerne water on entering the River Tees produces a marked change in the chemical and biological characteristics of this lower reach The hardness of the water is increased, as is also the amount of organic matter in solution and in suspension with a resultant lowering of the oxygen content The composition of the flora and fauna is different from that above Croft Bridge, but owing to the presence of nutritive substances from the sewage effluent the numbers of plants and animals are greater By comparing the two regions of the Tees it was possible to discriminate certain organisms as useful indicators of pollution

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* Department of Scientific and Industrial Research Water Pollution Research Technical Paper No 6 Survey of the River Tees Part 3 The Non Tidal Reaches—Chemical and Biological By R W Butcher J Longwell and F T K Pentelow (London H M Stationery Office, 1937) 12s 6d net

The work opens up a number of questions, not only of economic importance but also of direct scientific interest One of the most noteworthy points disclosed is our complete lack of knowledge concerning the life histories of so many of those insects which form the major constituents in the food of trout and other fish It was found impossible to identify many of the larval stages as these have never been described The necessity for a comprehensive survey of this subject is stressed

The Study of Genetics

ON three occasions recently the Indian journal *Current Science* has appeared as a special issue devoted to a particular topic The third of these, dated March 1938 is devoted to genetics It includes eight short reviews by acknowledged authorities held together by an introduction by Dr Eileen W E Macfarlane

Dr H J Muller writes on The Present Status of the Mutation Theory , discussing the nature and the mode of action of the gene The following section headings indicate the scope of his contribution the gene as the material basis of mutation , the quantitative study of the normal mutation frequency , thermal and chemical influences on the mutation process , the production of mutations by irradiation , effects of mutations on the organism , changes in gene arrangement , and gene mutations as the primary steps of evolution

Prof O Winge gives a very concise and clear review of the facts concerning the cytology of sex He describes his own experiments on *Lebistes* in some detail in order to support his opinion that sex genes are present in all chromosomes and that there is always the possibility that the sex chromosome may become changed into an autosome and *vice versa*

Prof Kihara provides a short article on cytogenetics of species hybrids, whilst Dr H B Frost, in an article on the genetics and cytology of citrus, furnishes a valuable example of the application of these disciplines to the study of a special group of economic value

Special aspects of evolution are dealt with in the contributions by Prof E B Babcock on phylogeny in the light of genetics and cytology and by Prof A F Shull on adaptation in the light of genetics The former stresses the importance of genetics, and particularly of comparative cytology, in discussions concerning phylogenetic relationships between groups of animals and plants, and illustrates his views with references to data from his and his co workers' researches on the genus *Crepis* Prof Shull discusses the possible ways in which adaptation may have arisen through the interplay of mutation and selection, and suggests the lines which future work might profitably take when the problems of selection are being studied genetically

Dr C B Davenport in his Genetics of Human Inter racial Hybrids" stresses the importance of studies of this kind in regions where hybridization is just beginning, so that the first and second hybrid generations may be definitely known He suggests that the regions where such studies might be profitably made are the Amoor River region in Siberia where the Siberians are coming into contact with the Japanese, in certain regions in Africa where the whites are meeting the practically full blooded Negro stock, and in North America where the Eskimo and the white are now newly meeting

The final article is by Dr C B Bridges, who discusses in a most attractive way the future of genetics He is of opinion that the near future will see genetical studies extended to an ever increasing number of animal and plant forms the intensive study of such forms as have so far failed to conform to established genetic principles such studies leading to the consequent extension of those principles and to the invention of new hypotheses and the simplification of the old , the elaboration of new technical methods in genetic experimentation and in cytology the employment of further physical or chemical and environmental agencies in the induction of cytogenetic novelty , the hybridization of genetics and cytology with other sciences such as chemistry embryology, physiology and finally, the progressive clarification of man s philosophical outlook as to his origin, development and activities, with the rescue of still other departments of life from the deistic and vitalistic to the naturalistic and mechanistic realms

Dr Bridges recommends studies of bacteria and viruses and phages for an understanding of gene action and of the nature of sex and points out that the gene now occupies for us the place held by the cell for a previous generation of biologists The gene must be analysed in terms of its physical structure and chemical behaviour For the moment we think of it as a crystalline body, probably of the fibre type, the autocatalytic growth of which is by surface condensation of constituent simpler materials from the surrounding medium, and its reproduction is pictured as a simple split of this fibrous crystal when its growth has exceeded the size limits proper to its internal bonding *versus* the disruption due to temperature and other environmental factors The model of gene structure must allow not only of autocatalytic growth and self reproduction, but also of compositional change and the subsequent perpetuation of that new structure On the hypothesis that the fields of force on the surface of the gene control its crystalline growth, it is conceivable that rare acceptance of a misfit building block would alter the surface material The interpretation of position effects will probably follow the idea that the action of the gene is limited by materials which diffuse into it The induction of changes in the gene and in the chromosome by the use of radiations and of chemical agents is now only just begun By their extended use, problems of the size, number, structure, mutability and action of the gene have become soluble The cytologists may be expected to continue and elaborate their studies of the salivary gland chromosomes, and will proceed intensively to study the phenomena involved in the synapsis, crossing over and distribution of chromosomes to the gametes

Reading these articles, one cannot but be impressed by the extraordinary activity that is everywhere present in the field of genetics, by the luxuriance of its growth, and especially by its promise of great adventure

Science News a Century Ago

Jenner and John Hunter

IN 1838 Dr John Baron (1786 1851), the founder of the Medical Benevolent Society, published his book The Life of Edward Jenner, M D etc Jenner who was born in 1749 and died in 1823 was a pupil of John Hunter, and in the course of a review of Baron s biography of him contained in the *Athenæum* of July 28 1838 the reviewer said Between Hunter and his favourite pupil there was much in common Jenner was a full participator in his master s views and Hunter acknowledged in him a kindred genius Their correspondence in after life was active, and Jenner continued his assistance in the labours of the school by observations experiments and original speculations directed to the development of its favourite objects Trained under such a chief, and possessing an equally ardent love of nature, it is not to be doubted that in whatever circumstances of professional life Jenner had been thrown, he would have made for himself a great name in science, and had he accepted a proposal which was made to him, to join Hunter in the business of lecturing, he could not but have become more favourably known to the medical world than he was as the provincial practitioner and discoverer of vaccination '

Differences between Pears and Apples

'A LONG and interesting memoir has been presented by M Turpin to the French Academy of Sciences , said the *Athenæum* of July 28 1838 on the difference which exists between the cellular tissues of the apple and pear which observations are expected to extend to knots of wood to ligneous kernels, to the calcareous concretions found in the mantle of the Arions, and to the ossification of animals in general Those authors most tenacious concerning the establishment of these two vegetables as different genera have drawn their characters from the adherence of the lower part of the fine styles to their villosity, to the speroid form of the fruit and to the stalk being set in a cavity , characters which are frequently effaced M Turpin founds his on the absence or presence of those stony concretions which are met with in the cellular tissue of the pear

Medicine in Holland

THE issue of the *British and Foreign Medical Review* of July 1838 No 3 contains the following information Holland contains three universities those of Leyden, Utrecht and Groningen Harderwyke and Franecker were formerly the seats of universities but owing to the small number of students at each were disfranchised early in the present century Linnaeus for some time studied and ultimately graduated at Harderwyke , and here were published his *Amoenitates Anatomicae* There are also three subsidised colleges or Athenæums, one at Amsterdam, another at Franecken, and the third at Deventer Each of these has five faculties , and the medical faculties are subject to arrangements in accordance with the general system of instruction established in Holland Owing to its contracted territory and its intimate connexion with other centres, of which the languages are more generally studied and more extensively known, and from which, particularly Germany and France, books are continually imported, the medical literature of Holland is at present rather circumscribed"

University Events

BIRMINGHAM The following candidates have been awarded the degree of D Sc F W Norris for contributions to the *Biochemical Journal* on The Pectic Substances of Plants , Studies on Hemicelluloses Analysis of Carbohydrates of the Cell Wall of Plants , and other papers L I C Northcott for various papers on the structure of metals and alloys in the *Journal of the Institute of Metals Journal of the Iron and Steel Institute* publications of the British Cast Iron Research Association and elsewhere E Preston for papers on Viscosity of the Soda Silicate Glasses at High Temperatures and its Bearing on their Constitution in the *Journal of Glass Technology* Evaporation and Diffusion of Volatile Material into an Inert Gas Stream in the *Transactions of the Faraday Society* and other papers on the technology of glass

EDINBURGH Sir Arthur Olver has been appointed principal of the Royal (Dick) Veterinary College Edinburgh (now affiliated with the University) in succession to the late Principal O Charnock Bradley who died in November 1937 Sir Arthur graduated at the London Veterinary College in 1897 and obtained his fellowship in 1909 He served in the South African War in Egypt and in the Sudan, in 1907 In 1908 he was appointed assistant director general Army Veterinary Services and served throughout the Great War In 1928 30 he was deputy director of veterinary services for India and in 1930 was appointed to the Imperial Council of Agricultural Research of India, from which post he has but recently retired In his last positions he was largely responsible for the reorganization of the veterinary colleges and of veterinary research in India

LONDON University postgraduate travelling studentships of the value of £275 for one year have been awarded to Margaret Elizabeth Broughton (King s College) and Mr Edward Michael Evans (Imperial College—Royal College of Science) Miss Broughton proposes to visit Nigeria and make a study of the land use and native agriculture in the Lower Niger Basin Mr Evans proposes to investigate under Prof Bonhoeffer in the University of Leipzig the synthesis of the sugars under the action of light and in the presence of various catalysts

University postgraduate studentships of the value of £150 for one year have been awarded among others to R J Bray botany (Imperial College), V C E Burnop, chemistry (Imperial College) , M G Church, chemistry (University College) Elizabeth H McPherson, philosophy (University College) , W H Ward engineering (Imperial College—City and Guilds Engineering College)

ST ANDREWS —The Court has agreed to accept the legacy by the late Miss Scott Lang on the conditions attached to that legacy, and has approved a scheme for the erection at the United College of an astronomical observatory and for the appointment of a lecturer in astronomy in fulfilment of these conditions

Dr C A Coulson, fellow of Trinity College, Cambridge, has been appointed lecturer in mathematics in University College, Dundee

Societies and Academies

Dublin

Royal Irish Academy, June 13

J J **Nolan** and P J **Nolan** Diffusion and fall of atmospheric condensation nuclei (with an appendix by P G Gormley) Recalculation of results obtained previously by Nolan and Guerrini give for the diffusion coefficients of nuclei held during the experiment in a water sealed gasometer, the value D 12×10^{-4} cm ^{2}/sec New experiments with nuclei held in an oil sealed gasometer give D 20×10^{-4} cm ^{2}/sec The values of the radii of the nuclei deduced from these results are 3 55 and $2\ 68 \times 10^{-4}$ cm respectively

Dorothy Hill and L B **Smyth** The identity of *Monilopora* (Nicholson and Ethridge 1879) with *Cladochonus* (McCoy 1847) The genolectotype of *Cladochonus* McCoy, 1847, is *C tenuicollis* McCoy The type specimen of this, from the Carboniferous of New South Wales has been sectioned, and is here figured and described The types of *C bacillarius* McCoy and *C crassus* McCoy are from the Carboniferous of Co Donegal Ireland The latter species was made the type of *Monilopora* Nich and Eth 1879 the distinguishing features being the unique reticulate tissue and the attachment to a crinoid columnal Work on new material from Doorin Point halfway between the two type localities has revealed (*a*) that *C bacillarius* and *C* (*Monilopora*) *crassus* are parts of the same organism the upright zig zag *bacillarius* phase arising from the creeping ring like *crassus* phase (*b*) that the reticulate tissue occurs in the calice wall of both (*c*) that the *crassus* phase is not confined to a crinoid stem as a support a specimen having been found attached to a bryozoan and several with an empty ring The reconstructed organism is assigned to *Cladochonus* *Monilopora* is discarded and *crassus* is chosen as the specific name

Paris

Academy of Sciences, June 8 (*C R* 206 689 1768)

Elie Cartan Generalized spaces and the integration of certain classes of differential equations

Henri Devaux and **Louis Pallu** A macroscopic representation of monomolecular films and their behaviour in various states of compression Description of experiments on the distribution of rape seed on the surface of a sheet of mercury The results confirm the generally admitted interpretation of the arrangement of the molecules in monomolecular layers

Marc Krasner A generalization of the local theory of bodies of classes Value of the conductor Interpretation of a formula of Artin Law of limitation for Galoisian extensions

Paul Lévy Correction to a previous note

Th Motzkin Plane arcs the osculating curves of which do not cut

Nicolas Bourbaki Banach spaces

Heinrich Behnke and **Karl Stein** Convergent suites of domains of holomorphy

Henri Pailloux The equilibrium of certain deformable membranes

Léopold Escande New experimental researches on flow through a submerged valve gate

J **Géhéniau** Study of the interaction between a photon and an electron by wave mechanics

Mme Marie Antoinette Tonnelat Baudot The equation of propagation of the photon in a non Euclidian space

Maurice Bayen Measurement of the dispersion of the ultra violet refraction of heavy water

Maurice Parodi The vibrations of some fluorine compounds

Jean Rouvillois and **Henri Muraour** The study of the transformation of a band spectrum into a continuous spectrum under the influence of pressure

Pierre Auger **Raymond Maze** and **Mme Thérèse Grivet Meyer** Large atmospheric cosmic sprays containing ultra penetrating corpuscles

Henri Muraour and **Gabriel Aunis** Verification of the law of combustion by parallel layers for colloidal powders

Enrique Moles **Mlle T Toral** and A **Escribano** The limiting density of the gas SO_2 The atomic weight of sulphur The mean figure for the normal density was 2 92655 giving 2 85794 as the limiting density From this the atomic weight of sulphur is deduced as 32 062

Thadée Peczalski The sublimation and mutual diffusion of salts and of metals

Marcus Brutzcus The theory of heterogeneous catalysis

André Boulle Sodium tetrametaphosphate

Mlle France Bloch The constitution of the thioacids From a study of the absorption spectrum in the infra red it is concluded that if thioacetic acid is a mixture of the two tautomeric forms, $CH_3CO\ SH$ and $CH_3CS\ OH$ the amount of the latter form is very small

Z **Charles Glacet** and **Joseph Wiemann** Duplicative reductions

Alfred Silberstein The crystalline structure of ammonium cupridiamminotetrachloride

Gilbert Mathieu Discovery of an Ordovician fauna in the synclinal of Saint Pierre du Chemin (Vendée)

Pierre Comte The upper Famennian in the Cantabrian Cordillera

André Cailleux Pebbles shaped by the wind in the Quaternary in the south of Brittany

Louis Besse Experimental study of the velocity of fall of plane particles in a viscous medium It is impossible to apply Stokes's law even in a form embodying corrections to non spherical particles

Georges Déjardin and **René Bernard** The bands of the (OH) molecule in the spectrum of the night sky

André Renaud A halo at the surface of snow

Pierre Dangeard The enumeration of the chromocentres in the quiescent or interphase nucleus

J **Rabaté** and A **Gourevitch** The presence of *l* tartaric acid in the leaves and fruits of *Bauhinia reticulata* This is the first example of laevotartaric acid being extracted from a plant The leaves or fruits yield 4 6 per cent of the pure acid

Ottavio Munerati The possibility of forcing beetroots to give stems outside the normal time

Philippe Joyet Lavergne The mechanism of *the action of the X rays on the cytoplasm of the cell*

Mlle Paulette Berthier The action of electrolytes on the surface tension of saponin solutions

Georges Mouriquand, **Jacques Rollet** and **Mlle Adela Pape** Chronic A avitaminosis

Amsterdam

Royal Netherlands Academy (*Proc* 41 No 5 1938)

J G van der Corput Contribution to the additive theory of numbers (3)

R Weitzenbock On trivectors (7)

E Cohen and W A T Cohen de Meester Acute tin plague (2) The very great influence of small quantities of aluminium alloyed with tin on the rate of change of white tin into grey tin is closely connected with the effect of traces of water on such alloys as observed by Heyn and Wetzel

P P Bijlaard A theory of plastic buckling with its application to geophysics

A Erdélyi Some integral formulæ for Whittaker functions

C Visser The iteration of linear operators in a Hilbert space

J A Barrau Generalizations of Steiner s Roman surface

O Bottema Families of quadratic varieties

H J de Boer A period of 5 25 years in rainfall temperature and pressure

Anna M A van Santen Influence of hydrogen ion concentration on the growth rate of the *Avena* coleoptile The curve representing the growth rate of excised coleoptile sections of *Avena* in 0 01 molar phosphate buffer solutions as a function of *p*H coincides in part with the dissociation curve of auxin indicating that the growth substance is only active in its undissociated acid form

Ong Sian Gwan Exaltation and maintenance of the virulence, variation of the rate of agglutination *increase of the velocity of displacement and of* propagation of *B coli*

Capetown

Royal Society of South Africa, May 18

H B Fantham (the late) *Lecithostaphylus canthari*, n sp , a trematode parasite of the hottentot fish *Spondyliosoma blochii* of South African waters

E H Ashton A sociological sketch of Southern Sotho diet

Moscow

Academy of Sciences (*C R* 18 No 9, 1938)

M Krein The best approximation of the continuous functions

M A Rutmann A *special class of wholly con*tinuous linear operators

L S Gilman Application of the conformic representation to the solution of a problem in the theory of elasticity

P A Walther and W A Stefanowski Comparison between two axial pumps, one calculated according to the Joukowski theory, and the other according to that of the triangle of velocities

J A Alpert, V V Migulin and P A Riasin Dispersion of electro magnetic waves above the earth's surface

A Gorodezkaya *and* A Frumkin *Investigation* of thin layers of organic substances at the mercury/ solution boundary by the method of capacity measurements (1) High molecular alcohols and acids

Anna Gelman and M Bauman Compounds of platinum and carbon monoxide

E A Šilov *Transmitting mechanisms of organic* reactions

V S Bykova Quantitative separation of niobium and titanium

V S Butkewitch E Menzhinskaia and E I Trofimova Glucuronic acid as an intermediate phase in the formation of citric acid from sugar

V S Butkewitch The question of intermediate phases of biochemical transformation of sugar into citric acid

K V Radugin The Salair folding

B M Keller Eocene sediments of the Tuapse region

D S Beliankin Characteristics of the mineral monothermite

M A Rosanova Polymorphic type of the origin of species

H F Kushner Composition of blood of camels in relation to their working ability

B A Zenkovič The temperature of whales

N A Manuilova Lens building power of the eye cup in Amphibia as affected by repeated induction

N A Manuilova A I Machabeli and T A Sikharulidze Investigation of the morphogenetic properties of the eye cup in tail less Amphibia

Washington, D C

National Academy of Sciences (*Proc* 24 199 227, May 15 1938)

G A Miller (1) Relative numbers of operators and subgroups of a finite group (2) Minimum degree of substitutions of highest degree in a group

C F Buchwald D M Gallagher C P Haskins T M Thatcher and P A Zahl Measurements of resistance and capacity of monofilms of barium stearate For this purpose a standard A C. bridge (0 25 volt at 1000 cycles) was used with one arm modified to allow preliminary balancing of the unfilmed cell

D F Jones Translocation in relation to mosaic formation in maize

R D Gordon Estimating bacterial populations by the dilution method Halvorson and Ziegler's *tables* which give an estimate of the mean density of viable bacteria in the middle of three successive dilutions using a dilution of 10 1 and three sets of ten test tubes are apparently based on Fisher s criterion of maximum likelihood A better result is obtained by using the geometric mean, and appropriate formulæ are deduced

W J Crozier E Wolf and Gertrud Zerrahn Wolf (1) Temperature and the critical intensity for response to visual flicker Experiments on the turtle indicate that the shape of the curve of flash frequency (F) against logarithm of the critical intensity for 'recognition' of flicker (I) is unaffected by change of temperature, the whole curve being shifted to lower intensities with rise of temperature It is suggested that recognition of flicker is governed by the velocity of a terminal reaction affecting several nervous elements, and that this reaction involves at least two steps of a catalytic nature (2) Specific constants for visual excitation (ii) Experiments with albino teleosteans gave curves for F against log I which correspond exactly with those of normal fish of the same stock

E Guth and A E Haas Relation between Stefan s radiation law, Nernst's heat theorem and Maxwell's formula for the radiation pressure

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

SENIOR LECTURER IN MECHANICAL ENGINEERING at the South West Essex Technical College The Clerk to the Governors 268 High Street Walthamstow E 17 enclosing stamped addressed foolscap envelope (July 25)

LECTURER IN CIVIL ENGINEERING AND OR BUILDING at the Chesterfield Technical College—The Clerk to the Governors enclosing stamped addressed foolscap envelope (July 28)

AN ASSISTANT LECTURER IN APPLIED CHEMISTRY with special reference to bleaching dyeing and finishing at University College Nottingham—The Registrar (July 30)

INSPECTOR (*male*) in the *Ministry of Agriculture and Fisheries* for the purposes of the Diseases of Animals Acts 1894 1935—The Secretary of the Ministry 10 Whitehall Place S W 1 (August 2)

ASSISTANT LECTURER IN HORTICULTURE at the East Anglian Institute of Agriculture Chelmsford—The Clerk of the County Council County Hall Chelmsford (August 3)

TWO ENGINEERING INSPECTORS in the Ministry of Health one with *experience of sewage disposal works The Director of Establishments* Ministry of Health Whitehall S W 1 (August 8)

ASSISTANT LECTURER IN METALLURGY at the University College of Swansea—The Registrar (September 10)

PROFESSOR OF INORGANIC AND PHYSICAL CHEMISTRY in the Egyptian University—The Dean Faculty of Science Abbassia Cairo (September 15)

JUNIOR ASSISTANT in the Development Department British Non Ferrous Metals Research Association The Secretary B N F M R A Regnart Buildings Euston Street N W 1

EVENING TEACHERS FOR ELECTRICAL ENGINEERING INSTALLATION RADIO ACOUSTICS, LIGHT AND ELECTRICITY at the Borough Polytechnic London S E 1 The Principal

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Committee of the Privy Council for the Organisation and Development of Agricultural Research Report of the Agricultural Research Council for the Period October 1935 September 1937 (Cmd 5768) Pp vi+378 (London H M Stationery Office) 5*s* 6*d* net [117

Federal Council of Lancashire and Cheshire Teachers Associations Report on Entry into Employment Pp 12 (Manchester Federal Council of Lancashire and Cheshire Teachers Associations) [117

National Union of Teachers Junior Technical Schools Memoranda on Pamphlets 111 and 113 of the Board of Education Pp 32 (London National Union of Teachers) [117

King s College Newcastle upon Tyne Standing Committee for Research Report Session 1936 1937 Pp 45 (Newcastle upon Tyne King s College) [117

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1798 (3287) *Galerkin s Method in Mechanics* and Differential Equations By Prof W J Duncan Pp 33 4*s* 6*d* net No 1803 (3137) Visual and Photographic Methods of Studying Boundary Layer Flow By Dr H C H Townend Pp 22+11 plates 5*s* 6*d* net No 1808 (3257) The Determination of Drag by the Pitot Traverse Method By G I Taylor Pp 10 1*s* 6*d* net No 1814 (2827) Wind Tunnel Tests and Charts of Airscrews at Negative Thrust By C N H Lock, H Bateman and H L Nixon Pp 20 3*s* net No 1818 (3105) An Approximate Method of Stressing the Struts of a Stiff jointed Framework By J B B Owen and J Taylor Pp 30 4*s* net No 1819 (2951) Full Scale Tests of Slotted Flaps and Ailerons on a Courier By R H Francis Pp 20 3*s* net No 1821 (3163) A Review of some Full scale Tests on Landing Flaps By J E Serby Pp 17 2*s* 6*d* net No 1823 (3013) Gust Loads on Tails and Wings By D Williams and J Hanson Pp 39 5*s* 6*d* net No 1824 (3321) *Relaxation Methods applied to Grid Frameworks* By Derman Guy Christopherson Pp 12 2*s* net No 1828 Abstracts of Papers published externally Pp 20 3*s* net (London H M Stationery Office) [117

Brief Guide to Government Publications By F R Cowell Pp 44 (London H M Stationery Office) 3*d* [127

London Shellac Research Bureau Technical Paper No 13 A New Process *for* Hard Lac Resin By Dr R Bhattacharya and Dr B S Gidvani Pp 21 Technical Paper No 14 Modification of Lac with Higher Fatty Acids and their Mixed Glycerol Esters, Part 2 By Dr R Bhattacharya and Dr B S Gidvani Pp 17 (London London Shellac Research Bureau) [127

Technical College, Bradford Diploma and Special Day Courses, Session 1938 1939 Pp 262+23 plates (Bradford Bradford Education Committee) [127

Ministry of Health First Report of the Central Advisory Water Committee Underground Water, Planning of Water Resources and Supplies Pp 28 (London H.M Stationery Office) 6*d* net [137

County Borough of Southport Meteorological Department The Fernley Observatory, Southport Report and Results of Observations for the Year 1937 By George A Lidster Pp 32 (Southport Fernley Observatory) [137

British Trust for Ornithology Fourth Report, Summer 1938 Pp 33 (London British Trust for Ornithology) [147

Transactions of the Royal Society of Edinburgh Vol 59 Part 2 No 12 On Tetrastichia Bupatides, a Carboniferous Pteridosperm from East Lothian By Dr W T Gordon Pp 351 370+6 plates (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) 3*s* 9*d* [187

Torrington Square Saved! Supplement to New Buildings for the University of London a Symposium 1933 By Thomas Lloyd Humberstone Pp 24+4 plates (London William Rice) 1*s* [187

British Museum (Natural History) Economic Series No 12 The Cockroach its Life History and how to deal with it By Frederick Laing Third edition Pp ii+24 (London British Museum (Natural History)) 6*d* [187

Ministry of Health Costing Returns Year ending 31st March 1937 Part 1 Pp 25 (London H M Stationery Office) 1*s* 3*d* net [187

National Central Library 22nd Annual Report of the Executive Committee 1937 38 Pp 84 (London National Central Library) [187

British Non Ferrous Metals Research Association Miscellaneous Publication No 133 Swedenborg s Treatise on Copper (Opera Philosophica et Mineralia Vol 3) Translated into English by Arthur Hodson Searle Section 1 Being Chapters I XIX of Part 1 of Original Pp xviii+180 Section 2 Being Chapters XX XLIX of Part 1 of Original Pp iii+181 348 Section 3 Being Chapters L LIII of Part 1 Part 2 (Chapters I IV) and Part 3 (Chapters I XII) of Original with Index Pp iv+349 536 (London British Non Ferrous Metals Research Association) To members 15*s* General Public 25*s* [187

Other Countries

University of Sydney Publications in Geography No 1 The Meaning of Soil Erosion By Macdonald Holmes Pp 38+1 plate (Sydney N S W Gordon and Gotch (Australia) Ltd) 2*s* 6*d* [117

Gokhale Institute of Politics and Economics R R Kale Memorial Lecture 1938 The Social Process (in the Light of a Century of Sociology) By Prof G S Ghurye Pp 24 (Poona Gokhale Institute of Politics and Economics) 8 annas [117

U S Department of the Interior Geological Survey Bulletin 897 A Mineral Industry of Alaska in 1936 By Philip S Smith Pp ii+108+1 map 30 cents Bulletin 897 B The Valdez Creek Mining District Alaska in 1936 By Ralph Tuck Pp 109 131 5 cents Water Supply Paper 799 The Floods of March 1936 Part 2 Hudson River to Susquehanna River Region Pp x+380+12 plates 50 cents Water Supply Paper 800 The Floods of March 1936 Part 3 Potomac James and Upper Ohio Rivers With a Section on the Weather associated with the Floods of March 1936 by Stephen Lichtblau Pp ix+351+16 plates 45 cents Water Supply Paper 806 Surface Water Supply of the United States 1936 Part 6 Missouri River Basin Pp 370+1 plate 50 cents Water Supply Paper 836 A Stages and Flood Discharges of the Connecticut River at *Hartford Connecticut* By H B Kinnison L F Conover and B L Bigwood Pp 18+1 plate 10 cents (Washington D C Government Printing Office) [117

Proceedings of the U S National Museum Vol 85 No 3032 Descriptions of New Fishes obtained by the United States Bureau of Fisheries Steamer *Albatross* chiefly in Philippine Seas and Adjacent Waters By Henry W Fowler Pp 31 135 Vol 85 No 3036 Revision of the Nearctic Leafhoppers of the Tribe Errhomenellini (Homoptera Cicadellidæ) By P W Oman Pp 163 180+2 plates (Washington D C Government Printing Office) [117

Smithsonian Miscellaneous Collections Vol 91 Reports on the Collections obtained by the First Johnson Smithsonian *Deep Sea* Expedition to the Puerto Rican Deep No 29 A New Genus of Starfishes from Puerto Rico By Austin H Clark (Publication 3481) Pp ii+7+1 plate (Washington D C Smithsonian Institution) [117

U S Department of the Interior Hawaii National Park, Hawaii Pp ii+34 (Washington D C Government Printing Office) [117

Publications of the Observatory of the University of Michigan Vol 7 No 3 Effect of Projection Factor on Time Distance Plots of Motions in Loops of Class 3 Prominences By Harold E Sawyer and John Brodie Pp 79 92+2 plates (Pontiac Mich Observatory of the University of Michigan) [117

University of California Publications in Zoology Vol 42 No 4 Geographical Variation in Wood Rats of the Species *Neotoma fuscipes* By Emmet T Hooper Pp ii+213 246 (Berkeley, Cal University *of California Press*) *35 cents* [127

University of Washington Publications in Anthropology, Vol 7, No 2 Lower Chinook Ethnographic Notes By Verne F Ray Pp ii+29-165 (Seattle University of Washington) 1 35 dollars [127

U S Department of Agriculture Bureau of Biological Survey North American Fauna No 56 Revision of the North American Ground Squirrels, with a Classification of the North American Sciuridæ By Arthur H Howell Pp 256+32 plates (Washington D C Government Printing Office) 40 cents [127

12e Congrès International de Zoologie tenu à Lisbonne du 15 au 21 Septembre 1935 Comptes Rendus Vol 1 Pp xix+228+644+30 plates Vol 2 Pp 645-1514+41 plates Vol 3 Pp 1515-2424+28 plates (Lisboa Casa Portuguesa) [137

Catalogues, etc

Stokes High Vacuum Pumps (Catalog No 38-P) Pp 28 (London W Edwards and Co)

Das Werden einer grossen Encyclopædie Teil 2 Die Wahrheit u den C C Von Dr Wilhelm Junk Pp 23-72 ('s-Gravenhag Dr W Junk)

"Prontosil a Survey of the New Chemotherapy Pp 71 (London Bayer Products, Ltd)

Colour Plate Books a Catalogue of Books illustrated with Colour Aquatints and Lithographs, Hand Coloured Copper Plates, Books Views, Costumes, etc. (Catalogue No 629) Pp 36 (London Franc Edwards, Ltd)

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Protection of the Fauna and Flora of Africa

If a review is made of the steps which have been taken in the past to safeguard the fauna and flora of any particular country, it will generally be found that whatever has been done, or at any rate originated, in this direction has been almost entirely due to private enterprise or through the efforts of such scientific field societies as happened to be interested in some restricted portion, or individual members, of such faunas and floras. These societies, besides being very numerous, were necessarily of a very heterogeneous character, varying in that respect with the particular field of biological research in which they were more especially interested. They were generally handicapped by lack of funds, lack of public or private interest and consequently lack of means or opportunity for carrying out, *on the necessary scale required*, protective measures adequate for the schemes which they had in view. Each society, moreover, worked in its own limited field, usually without co-operation with other societies.

Thus, although we would not for a moment belittle the pioneering work which has been done in the past, this lack of co-ordination has contributed to a large extent towards rendering that devoted work either ineffective or of far less effect than it might otherwise have been. There has, in a word, been a tremendous output of individual energy, devotion and interest, with an inadequate and often disappointing result.

Fortunately, there has been a tendency in recent years to consider the protection of faunas and floras on a large and comprehensive scale, to realize more and more the essential interdependence of species, and, where protection is needed, to set aside larger and larger areas of country for that purpose. It has been realized, too, that protection on a large and efficient scale connotes international co-operation, that where in the past the efforts of individuals or individual national societies led the way, Governments must now step in and take up the work.

A good example of united action on a large scale has lately been manifest in the International Conference for the Protection of the Fauna and Flora of Africa, held in the House of Lords in May of this year. It was the second conference of its kind to be held, the first having taken place in 1933 in the same building. Both may be regarded as having inaugurated a new policy in dealing with the protection of animal and plant life; for although many international conferences have assembled to consider biological and economic problems relating to the welfare of individual species, none, so far as we are aware, has ever before been set the task of considering from the point of view of its protection the fauna and flora of an entire continent.

The second conference, like the first, was held under the chairmanship of the Earl of Onslow and was opened on behalf of His Majesty's Government by the Marquess of Dufferin and Ava, Parliamentary Under-Secretary of State for the Colonies. It was attended by Government delegates of the Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly. A report of the proceedings has already appeared in Nature of June 4. The main object of the second conference was to report progress since the holding of the first conference of 1933; to exchange information, and to engage in exploratory discussion preparatory to a further conference which it is hoped to hold in 1939 An outline of the various delegates' announcements will be found in the report to which reference is made above

In addition to these announcements, however, a report of the Committee of Experts relating to the principal species suitable for inclusion in the Annex to the Convention was handed in, and although for obvious reasons we cannot here consider this report in detail, there are two questions of a general nature to which this Committee has directed special attention, questions which are not easy of solution, and to the discussion of which we propose to devote a good deal of the space available

The first of these questions relates to the method to be adopted to secure protection for species which, owing to their scarcity, require protection over wide areas in Africa, but are so relatively plentiful in certain other areas as not to require protection The second relates to species which in the greater part of Africa do not require special protection, but, owing to special factors, are exceptionally scarce in certain areas, where, therefore, such protection is called for

It was felt by those drawing up the report of the Committee of Experts that species falling into either of these categories could not, and indeed should not, be treated in the same way as species which are extremely rare throughout the whole range of their distribution There will be general agreement among biologists with the Committee's view that some suitable method should be thought out for securing protection on an international plane for species in those parts of Africa where they are extremely scarce although they may be so plentiful elsewhere in Africa as not to call for such protection

It may be added that in this connexion, the Committee of Experts, very properly we think, directed attention to the danger which exists when the population of any given species, or group of species, is reduced to a low ebb ; and that any unnecessary disturbance of the balance of Nature may have far-reaching consequences the ultimate effect of which it is impossible in any given case to foretell

To return, however, to the first question, which concerns species requiring protection over wide areas in Africa but plentiful in certain territories It was brought to the notice of the Committee that there are a number of species found over wide areas in Africa of which all but possibly one or two subspecies are so scarce as to justify being placed in one or other of the categories of the Annex to the Convention This, however, in certain cases has not so far been done, owing to the relative abundance of some subspecies in certain other areas In dealing with this and another very similar type of case, the Committee suggested (1) that there might be included in the Annex itself a direct exception in respect of whatever might be the territory where special protection is not required , and (2) that the Government of the territories in which special protection is not required should follow the precedent set by the Union of South Africa in the case of the aard wolf and the mountain zebra, in respect of which reservations were made by that Government at the time of the ratification of the Convention

Coming to the consideration of species which we may refer to as those of Category 2, namely, those which require protection in certain parts of Africa only, the Committee was struck by the fact that there are a number of species which over the greater part of Africa do not require protection on the international plane, owing to their relative abundance in the majority of the territories concerned On the other hand, in one or more parts of Africa their population is so reduced that vigorous action is necessary Examples are quoted in the Committee's report in respect of the Cape hartebeest, *Bubalis caama*, and the oribi, *Ourebia ourebi*, which, it is understood, the national provincial administration proposes to protect on a scale equivalent to that given to species in Class A of the Annex

It is suggested that these problems, which are mainly concerned with the welfare of mammals, may well be given careful consideration until such time as they may be brought up for final decision at the next conference, which it is proposed to hold in 1939, for they are problems urgently calling for solution

There were other problems of protection, more especially concerned with birds, which the Committee of Experts was called upon to consider One of these was concerned with the recent discovery of species like the African peacock, *Afropavo congensis* Chapin, and the African broadbill, *Pseudocalyptomena graueri* Rothschild Both species are of very great zoological interest , for prior to their discovery the presence of neither peacocks nor broadbills had been suspected in

Africa; both have very restricted distributions indeed, and we may take it for granted that no museum of importance will rest content until it has secured specimens To satisfy such a demand, local 'agencies' will be established, and unless great care is taken there will be over-exploitation with the inevitable and usual result It is to be feared that this commercialization has taken place in the case of the very interesting flightless rail of Inaccessible Island

We are far from advocating any pernickety interference with the privileges of the *bona fide* scientific collector, but we think there should be real and rational control on the part of the Governments concerned in cases of this kind If there were, we should not be faced with the possibility of the extinction of such a biological treasure as the diminutive flightless rail just referred to Until it was discovered by scientific investigators living an almost underground life among the rocks of Inaccessible Island, the inhabitants of Tristan da Cunha had been indifferent to its existence As soon, however, as it was realized that 'there was money in it', its exploitation went on uncontrolled, in a similar way, other relatively rare or unusual animals, such as the African peacock and the broadbill, to mention just two other examples, will quickly be brought to the verge of extinction, unless adequate measures for their preservation are quickly devised

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Nature and Uses of Rubber Latex

The Chemistry and Technology of Rubber Latex

The Chemistry and Technology of Rubber Latex. By Dr C Falconer Flint Based on Georges Génin's "Chimie et technologie du latex de caoutchouc". Pp xx + 715 + 40 plates (London: Chapman and Hall, Ltd, 1938) 42*s* net

THE fund of information concerning rubber latex has attained its present proportions by contributions from two widely separated sources For many years, excellent work has been in progress in the rubber-producing countries of the East on the physiology and general properties of latex, chiefly with a view to its use as a source of first-grade dry rubber of uniform quality More recently, latex has become available in quantity in the industrial countries of the world, and this has led to intense and detailed study, particularly in Great Britain and the United States, of the problems associated with its use as latex in industrial processes It follows that few men of unquestioned scientific attainments have had working experience in both fields of investigation

Dr Falconer Flint is one of these few After service in the East as a scientific officer on the staff of the Rubber Research Institute of Malaya, he is now working in Great Britain for Imperial Chemical Industries, Ltd, on problems associated with the applications of latex as such It will be with keen anticipation, therefore, that the reader will take up this book He will be hard to please who is disappointed Although the author's original intention was to translate the treatise prepared in 1934 by Georges Génin, he has in reality so amplified and extended it as to constitute the volume under review practically a new work He presents an orderly, thoughtful, and balanced analysis of the literature, including patent specifications.

Proceeding from a historical introduction, the author treats rubber latex first as to its sources, composition, properties, employment as a source of raw rubber (including special varieties such as rubber crumb and powder) preservation, concentration, and transport A later chapter is concerned with the physical testing of latex The large volume of literature to be digested compels a selective treatment in many places, and by the courtesy of the Research Association of British Rubber Manufacturers the reviewer has been able to compare Dr Flint's selected references with those on file in the comprehensive records of the Association's Intelligence Division From this it would appear that the policy adopted has been to quote freely the literature of a subject when that literature is scanty, but to discriminate as the literature accumulates In this way the more familiar tracts of knowledge are adequately treated and space is found fo less familiar matter. For example, attention is directed to the fact that copper is a normal constituent of natural latex as it exists in the tree, moreover, that this copper is associated with the rubber particles rather than with the serum The significance of this as regards the ageing of vulcanized rubber will be appreciated by every rubber technologist, and suggests an investigation into the ageing properties of vulcanized rubber freed from these traces of copper.

Again in the sharply defined subject of surface tension of latex significant in regard to foaming every important reference seems to have been noted When a selection has been imperative what to include and what to omit is a matter of judgment and the selection seems on the whole to have been wisely done In the chapter on the physical testing of rubber latex however in sufficient notice seems to have been taken of recent American research particularly that by Wohler stressing the need for humidity control in tensile testing In this connexion more use might have been made of the opportunity afforded by the chapter bibliographies of including references not discussed in the text as by so doing the work of the reader desirous of following up his study would have been facilitated with no great increase to the cost of production of the book

The latter portion of the book takes up the discussion of the industrial applications of latex—a wide subject indeed with ramifications extending far beyond the confines of the rubber industry This section includes reviews of latex compounding and vulcanization manufacture of dipped goods from latex electro deposition of rubber from latex latex and textiles various other important applications of latex and synthetic latices Here selection has been more severe Thus in the sixteen pages devoted to the vulcanization of latex one is disappointed not to find a mention of the interesting work of Spence and Ferry The insulation of wire and cables by latex processes is dismissed in two and a half pages occupied mainly with a discussion of a single paper The developments introduced by the Simplex Wire and Cable Co (Latox cord) are ignored as are some half dozen general articles and still more patent specifications A book of 88 pages published in the United States last year was devoted entirely to the use of latex in chiropody but this subject is not even mentioned in the volume under review

It is perhaps ungenerous to mention such imperfections since omissions of this kind are almost inevitable in a review of so complex a subject and one in which knowledge is advancing so rapidly We therefore hasten to add that in our opinion it would not be easy within the limits set to improve upon Dr Flint s text Indeed the detail he is able to include is sometimes surprising and indicates first hand familiarity with the subject For example the reviewer was seeking information concerning an obscure detail in the manufacture of latex paper and the desired facts were located immediately on referring to the appropriate section in Flint Moreover he writes concisely clearly accurately and in polished style while his authority is such that his guidance may be followed with confidence

Each chapter concludes with a numbered bibliography There are also author and subject indexes These features will cause irritation to the experienced indexer Strange liberties are taken with proper names both of persons and of companies Small letters and capitals are used with little regard to system Such details though a blemish on the book are not misleading and definite errors are relatively few (the reviewer has noted three) But the author index does mislead It is incomplete in respect of both names occurring in the book and of page references to names entered in the index The subject index is too short to be comprehensive The title of the book also is unfortunate in that it lends itself to confusion with Chemistry and Technology of Rubber recently issued by the publishers of the present work and with the journal *Rubber Chemistry and Technology* Confusion of this kind has already occurred in two cases known to the reviewer

The fact remains that Dr Flint has written the most comprehensive treatise on his subject that has yet appeared and all interested in either the scientific or industrial aspects of latex will be well advised to obtain and use this work Printing and binding are good T H MESSENGER

Patent Medicines in Great Britain

Patent Medicines
By Prof A J Clark (Fact No 14) Pp 98
(London Fact' 1938) 6d

SOME of the facts revealed in this book will come as a surprise to many people Patent medicines is a convenient misnomer for remedies the reputation and sale of which depends more upon advertisement than upon proved efficacy The name of the remedy is protected as a trade mark and vast sums are spent on making the name a household word These advertisements enjoy remarkable legal privileges including specific exemption from the Foods and Drugs Act The publication of fictitious testimonials from bogus physicians is common practice and quite legal The use of fictitious testimonials from real physicians is less common but a physician who sued a firm for this offence lost his case

The proprietors of secret remedies pay a tax and must affix a stamp to each packet This stamp looks like an official guarantee, but since it is only applied to remedies the composition of which is not only secret, but also potentially variable, it cannot possibly be anything of the kind. The tax can be evaded, and secrecy, to some extent, maintained by publishing the composition in a form which the public cannot understand, and considerable ingenuity is shown in the invention of words like 'hydroxyethane' and 'trihydroxypropane' The actual composition is not considered important, and is often decided upon quite casually

Patent medicines do harm by making the nation hypochondriacal, by delaying the rational treatment of cancer and other diseases until it is too late, by wasting the money of poor families when there is incurable disease in the house, and by poisoning Prof Clark omits the tale of the cure for obesity which consisted of living tapeworms, but quotes several authentic cases of widespread poisoning from secret remedies There is no law against the distribution of medicines with unknown properties New synthetic products sometimes have remarkable therapeutic properties, but they should be tested under careful observation before being sold indiscriminately

Various legal reforms were advocated in the strongly worded report of the Select Committee on Patent Medicines which was unfortunately published on August 4, 1914 Prof Clark supports the recommendations of this Committee, and believes that action has been delayed by the fact that the Press derives large revenues from the advertisers of patent medicines and is reluctant to lose this source of income The law is particularly lax in Great Britain

The book is probably an overstatement of the case, and is likely to irritate anyone who actively distrusts the medical profession, but it is much more readable than any dispassionate statement of the facts could have been It is not intended as an attack on all the advertisements of medicines, since the author clearly realizes that important advances in therapeutics have been made in the laboratories of reputable firms, whose incomes depend largely upon advertisement, but whose ethical standard is high. J H G

Trade Cycles

The Mechanics of Prosperity
By Hobart C Dickinson Pp xvi+136 (Baltimore, Md.: Williams and Wilkins Co , London . Baillière, Tindall and Cox, 1937) 9s

WHEN the admitted imperfections of the present monetary system come to be impartially and scientifically investigated, the system advocated by Mr Dickinson in this book will surely deserve consideration The book is directed to American conditions, and does not attempt to give a complete survey , in particular, it scarcely touches at all on the unstabilizing effects of gold—to which Prof Gustav Cassel gave such prominence in his recent book, "The Downfall of the Gold Standard", confirming the views of the late Sir Basil Blackett, in his "Planned Money"

Mr. Dickinson, in contrast to the two authors just mentioned, takes the view that the trade cycle arises primarily from the operation of interest —which in his view is neither completely elastic in rate, and returned to circulation (as assumed in classical economics) nor reinvested and compounded at a fixed rate (as assumed by Marx) It follows that, owing to this 'stickiness' of interest rates, accumulations of unused spending power occur periodically, and cause a temporary inflation which is followed by deflation. During deflation the debts, due to the issue of new money and credits during the inflation period, are wiped out by bankruptcy and defaults, and the cycle begins again

The author's remedy is that the State shall operate as a form of savings bank, accepting money on deposit at an attractive rate of interest when occasion demands, and utilizing the proceeds in the execution of desirable public works by private contract, so that the unused spending power is restored to circulation The State may also 'retire' money In this way the 'work-flow' is kept constant When normal conditions return, the rate of interest on deposits is lowered All deposits may be withdrawn at any time—the Government issuing new money (*not* bonds), without interest, for the purpose , or the Treasury may sell securities

Inflation is prevented by the imposition of taxes on unearned profits (due to rise of price-level) : for example, a national retail sales tax, and a capital gains tax, which are applied automatically, and at appropriate rates, on the rise of price-level of goods or securities, and discontinued when the price-level falls again The author claims that this system of stabilization, which substitutes public works at home for enterprise abroad, avoids the necessity for securing a favourable trade balance, and thus makes for international peace.

The author does not discuss the alternative methods of encouraging spending and preventing the accumulation of unused purchasing power, such as the depreciating money advocated by Silvio Gesel in his book, "The New Economic Order", or the interesting proposals of Dahlberg, in "When Capital goes on Strike"

Some of the present author's conclusions—for example, his objections to taxation for the purpose of providing "social security", such as old age pension, etc —are not in accordance with British experience, and his disregard of the effects of the varying value and supplies of gold (or silver) on price-levels and purchasing power is open to criticism The scheme is clearly described, and constitutes a useful contribution to the growing literature of monetary reform

R A S P

Elementary Science

(1) Chemistry (with some Geology)
By J. A Lauwerys and J Ellison (New General Science Series) Pp xii + 356 (London University of London Press, Ltd , 1938) 4*s* 6*d*

(2) Introductory General Science
By Dr L M Parsons. Pp viii + 308. (London Macmillan and Co , Ltd , 1938) 3*s* 6*d*.

(3) General Science
By Miss I C. Joslin Pp viii + 360 (London · Macmillan and Co , Ltd , 1937) 4*s* 6*d*.

(4) Elementary General Science
By T. H J Field. Book 1 Pp viii + 200 (London : Edward Arnold and Co , 1937) 2*s* 6*d*.

FOR the past twenty years or so, a movement has been afoot for a more liberal approach to science in the schools, and, although this movement has latterly shown signs of becoming widespread, there are still many masters and mistresses who hesitate to put their belief in it into practice One serious drawback to the wider adoption of courses in general science has been the lack of text-books from which the ordinary work of the laboratory or the classroom might be supplemented or even directed

(1) The chief interest of the first volume named above lies in the insight it affords into the kind of technique which may be employed in the teaching of general science. The title, "Chemistry (with some Geology)", indicates that this is no ordinary book according to standard pattern It is one of a series for which two smaller volumes afford an introduction through the medium of topics The companion volumes in the series proper are concerned with biology and physics. The authors have solved the difficulty of indicating important related matters in the biological and physical fields by a series of cross references, thereby avoiding unnecessary repetition, whilst emphasizing the inter-relationship.

In the selection of subject-matter the book is outstanding, for in this the break with tradition is most marked, and the authors are to be congratulated on a work which must be regarded as a pioneer achievement A consideration of water and solutions introduces ideas of solubility and crystallization, and, following the next chapter on the composition of water, comes a simple treatment of fundamental geology. Here the new emphasis is clearly apparent · chalk, carbon dioxide, carbonates, lime, cement, hardness of water, furring, water softeners, sand, glass, coal, coal gas, coal tar, pass under review, and each arises for discussion perfectly naturally, though in an order which is unorthodox. Then the general process of winning metals from their ores provides a fresh approach to the further resources of the earth Copper, iron and lead are examined with emphasis on their service to man, and a consideration of the protection of metallic surfaces by painting leads to the whole question of the chemical activity of the metals and the subject of equivalence At this juncture, some chemical theory is necessary and the laws of constant composition and multiple proportions, and a simple treatment of atomic weights and valency are introduced

After this pause for consolidation, the sea is considered as a source of raw materials · salt, hydrochloric acid, chlorine, bromine, iodine and fluorine being treated with a refreshing vitality So to the air as a further source of raw materials and to the story of nitrates and ammonia The consideration of sulphur and its uses in industry and a further section of chemical theory mark the end of such chemistry in the book as has normally been regarded as proper in a school certificate course

Much that is found in such courses has been omitted, and the reason is not far to seek the authors have regarded it as of less importance than those matters to which the remaining third of the book is devoted. It is indeed refreshing to find attention being paid here to sugars and starch, cellulose and paper, rayon and celluloid, alcohol and wines, beer and vinegar, esters, fats and oils. Foods, fuels and explosives occupy a further sixty pages before the final chapters on electricity in the service of chemistry, and on light with reference to chemical action. One is left with the impression of a good story well told.

An important question remains to be answered: granting that it is all very interesting, is it not very superficial? Will a pupil be benefited by such a course as it is claimed that he is by one which is narrower but more intensive? A key to the answer to this can perhaps be found in the many questions which follow each chapter. These are a striking feature of a striking book. Those who can answer them will need a sound knowledge of the facts and principles of chemistry and a considerable facility in applying this knowledge to new situations. Stimulating in their originality, these questions represent a noteworthy attempt to produce a conscious transfer of training whereby the pupil will be made to realize that there is chemistry outside the test-tube and outside the laboratory.

While Messrs Lauwerys' and Ellison's book is intended to be used in conjunction with other texts, the remaining three here reviewed cover the whole range of general science. They thus give a clearer indication of the scope which supporters of that subject—if it can be called a 'subject'—consider desirable. Clearly, there is a much wider measure of common agreement than is often supposed. All three books maintain some form of subject division, though sometimes chapters on different subjects follow each other. In all cases, physics, chemistry and biology are the staple ingredients of the diet. In all cases, too, the application of scientific knowledge to everyday activities is made clear and the social importance of science is stressed. Lastly, while generalities are by no means ignored, formal theoretical work plays a much smaller part than has hitherto been thought necessary.

(2) Dr Parsons divides his work into three parts: physics, chemistry and biology. To some extent, his book is an abridged version of his well-known "Everyday Science". The biological sections, however, are almost entirely new and they contain an excellent chapter on the human body in health and disease. The material is up to date, and a great number of applications are described and explained. Some attention is paid to meteorology and to simple mineralogy—these are welcome features. The biological sections, as is now usual, are arranged functionally.

(3) Miss Joslin in her book starts with the earth and the solar system. Though the astronomical section is not extensive, it will be welcomed by children, who almost always find this subject fascinating and exciting. She goes on to consider simple mechanics, physics and chemistry. The last third of her book is devoted to biology, including a chapter on hygiene and the human body. An interesting aspect of Miss Joslin's book is the attention she pays to domestic appliances. Possibly this may prove to be the best avenue through which girls may profitably approach the principles and generalizations of science.

Both of the two foregoing books are attractively written and are obviously the work of experienced teachers. Miss Joslin has included nearly a hundred experiments to be performed by the pupils, and teachers will be helped by the clear directions which she gives. Nevertheless, two important difficulties remain: the material in both books is all of about the same order of difficulty, and the various subjects are rather separated. Teachers will have to use these books rather freely, but this is probably what the authors intended.

(4) Mr Field's book covers the first year only of a general science course, clearly planned on concentric lines. His arrangement is interesting and many of his ideas are novel. He pays much attention to the soil and uses these studies in a very profitable manner. The most interesting part of his book is that in which he deals with biology—the animals of the soil, for example. Here he treats of garden slugs, wireworms, centipedes, tiger-moths, aphis, greenfly, and he adds an excellent chapter on the cultivation of the runner-bean. In fact, most of the biological work he suggests could be done in a suburban back-garden. This is a feature which will be found very useful by many teachers. Furthermore, Mr Field has graded his work well, he gives considerable help to the teacher, and his style is simple and direct.

All these four books illustrate the great advance which has taken place in the production of text-books for schools during the last ten years: they are illustrated by numerous photographs; explanations of simple applications and of familiar things abound; the style of presentation is lively, vigorous and direct. Above all, science is made to appear attractive, and the interests and needs of the pupils receive full consideration. It is clear that teachers of science are beginning to find their inspiration in the everyday world rather than in the somewhat rarefied atmosphere of specialist courses. Further progress, however, is still desirable. Much more, for example, might be done to assist children to transfer scientific modes of thought to ordinary life and to relate the school work more closely to the social background.

The Birds of Kenya Colony and the Uganda Protectorate

By Sir Frederick John Jackson, K C M G, C B Completed and Edited by W L Sclater Vol 1 Struthionidae to Psittacidae Pp. lii+542+10 plates. Vol. 2 Coraciidae to Sylviidae. Pp viii+545–1134 Vol 3 Hirundinidae to Emberizidae Pp viii+1137–1592+6 plates. (London Gurney and Jackson, 1938.) 90*s* net

TO the making of bird books there is no end, and out of the vast bird fauna of Africa there comes continually something new For more than thirty years, Sir Frederick Jackson served his country in East Africa, ending as Governor of Uganda, and all his leisure was spent on safari, mostly in the happy study of the birds He planned a great book, but left it unfinished. It has now been completed with the utmost care and skill by Mr W L Sclater, and, beautifully illustrated by Mr Lodge and Mr. Grunwald, it takes its place beside the works of Reichenow, Shelley, Sclater and Bannerman

In a graceful preface, Lady Jackson tells how her husband on his first arrival in East Africa was cheered by the call of a curlew and gladdened by the familiar sight of sandpipers, oyster-catchers and ringed plovers. It is indeed wonderful to find true swallows, kestrels, nightjars and many another homely bird, not to speak of the all but world-wide osprey and barn owl, all at home in the same land with trogons, barbets, plantain-eaters, guinea-fowl and the endless host of foreign fowl besides. The book is packed full of field notes, straight from the diary of a true field-naturalist. An admirable example is Sir Frederick's account of the great fish eagle (*C. vocifer*), the home of which is on Lake Victoria, and which ranges from the ocean to the Belgian Congo. How its mode of fishing differs from the osprey's is beautifully explained; and the zoologist will be interested to know how it catches perch, catfish and an occasional lungfish (or *Protopterus*), but leaves the last uneaten ! The hammerhead (*Scopus*), the ground hornbill and several of the sunbirds are a few more among the countless examples of Sir Frederick's powers of observation and description The book is a fine memorial to a modest and a useful life.

Outline of Historical Geology

By Dr. A K Wells. Pp. xiv+266 (London George Allen and Unwin, Ltd, 1938.) 12*s* 6*d* net

DR. WELLS'S new book, although essentially a text-book of stratigraphy, is something more than a formal descriptive catalogue of the various divisions and subdivisions of the geological column. It is an excellent general account of British stratigraphy, pleasantly written in the form of a continuous narrative, and very fully illustrated by line drawings, many of which have been specially prepared.

The book is expressly intended for beginners in geology, either undergraduates about to commence a course in this subject, or general readers who wish to acquire a knowledge of geology for cultural reasons. The author's experience as a lecturer is sufficient guarantee that the text is suitable for the first class of reader, but it is rather doubtful whether the needs of general readers with absolutely no previous knowledge of the subject are adequately met

Such readers would surely be curious about the various geological processes that have operated in past ages to produce the rocks that now form the earth's crust This branch of historical geology is, however, rather summarily dismissed in the short introductory chapter (further references to geological processes are, it is true, made in the text, *en passant*) A more complete account of these processes seems desirable in order that uninformed readers may fully appreciate the details of stratigraphy, with which 'historical geology' is largely concerned Again, although technical terms have been avoided wherever possible, a general reader would probably appreciate a glossary in explanation of some that are used

Apart from beginners, specialists in other branches of geology will find this work provides an excellent refresher course in stratigraphy, and it should be appreciated by a wide circle of readers.

Comprehensive Index of the Publications of the American Association of Petroleum Geologists, 1917–1936

By Daisy Winifred Heath Pp vi+382 (Tulsa, Okla American Association of Petroleum Geologists, London Thomas Murby and Co, 1937) 13*s* 6*d* net

THE comprehensive index to the first twenty volumes of the *Bulletin of the American Association of Petroleum Geologists* is a fitting tribute to the work achieved by the Association during the first two decades of its existence In 1917, the production of petroleum in the United States amounted to approximately 355 million barrels, whereas in 1936 it exceeded one billion barrels The first volume of the *Bulletin*, issued in 1917, contained 176 pages, whereas the twentieth volume contains 1868 pages This in itself is proof of the efforts made by the Association to further the search for oil and aid its scientific development during these years. The value of the work has been immeasurably enhanced by the compilation of an index, which facilitates reference to all publications of the Association during the period 1917–36

Numerical Problems in Advanced Physical Chemistry

By J. H. Wolfenden Pp. xx+227. (Oxford: Clarendon Press, 1938) 7*s*. 6*d* net.

MOST teachers of advanced physical chemistry will have felt a need of a collection of examples taken from modern publications on such subjects as photochemistry, dipole moments, activity coefficients, kinetics and molecular spectra. Mr. Wolfenden's book contains an adequate number of such exercises with answers and explanatory notes, although for the theory the reader is referred to textbooks. The book is attractively produced and its price is very moderate. It may be recommended as likely to prove very helpful both to teachers and to students.

Les Instruments de Musique de Madagascar

Par Prof Curt Sachs (Université de Paris Travaux et Mémoires de l Institut d Ethnologie, 28) Pp ix + 96 + 15 plates (Paris Institut d Ethnologie 1938) 37 50 francs

THIS study of the musical instruments of Madagascar by Prof Sachs, the well known authority, fills a gap in the study of primitive music, which in itself is not a little remarkable As the author points out, ethnographical museums and collections of musical instruments are singularly ill supplied with specimens from this source The Musée du Trocadero, however, or the Musée de l Homme as it is now called, possesses a collection of nearly two hundred examples Prof Sachs, accordingly has prepared a *catalogue raisonné* of the collection and in order to make his study as complete as possible, has supplemented it with a description of types to be found in other collections, or if not otherwise available, recorded in the literature

In view of the ethnic composition of the people of Madagascar in part African, in part of Malayan origin, and keeping in mind its geographical position which has made it from early times accessible to all the seafaring peoples who traversed the Indian Ocean, it is not surprising to find that the musical instruments are of a varied character and mixed origin African, Malayan, Indonesian, Arab and European Nor is it safe to infer that when an instrument has been traced to its place of origin, it has reached Madagascar direct It may have come for example by way of India Hence it will be seen that the task which Prof Sachs has set himself of constructing a chronology is by no means simple One very interesting point which emerges in connexion with the instruments from Malaya The absence of the Javanese gong and other bell like Indonesian types leads to the conclusion that the Malayan instruments cannot have been introduced in the island later than the beginning of the Christian era

Elementary Mathematics for Electrical Engineers

By Sir Ambrose Fleming Pp 110 (London George Newnes, Ltd , 1938) 5*s* net

THIS handbook of mathematics is designed to provide the engineering student with just those practical parts of the subject which are of the greatest importance to him The subject matter, arranged in ten sections, ranges from simple to differential equations , from the elements of trigonometry to hyperbolic functions and from plane co ordinate geometry to vector algebra and harmonic analysis There is a commendable continuity in the treatment of such a variety of topics, the connecting link being naturally the calculus, which is the foundation of engineering calculations

The section on quadratic equations may prove somewhat confusing as an x is missing in several places on p 16, and in the following paragraph, the condition for *one* real root is explained after the existence of *two* roots has been well illustrated

There are few exercises for the student, but many of the basic principles are well applied to some interesting and really practical problems Some useful tables are given at the end by the use of which numerical calculations may be facilitated The engineering student should find this a very useful book, in spite of its brevity, and if he makes himself thoroughly acquainted with its contents, he will be able as the author hopes, to continue his mathematical studies from more advanced works on mathematics

The League from Year to Year (1937)

Pp 246 (Geneva Information Section, League of Nations , London George Allen and Unwin, Ltd , 1938) 1*s*

UNDER the title The League from Year to Year (1937) the Information Section of the League of Nations Secretariat has issued its annual survey of the League s activities in 1937 This volume of 246 pages gives a clear and concise review of all the main activities of the year in sufficient detail to emphasize the value and significance of the technical co operation which is being maintained in spite of the deterioration in the international political situation

Scientific workers should find in the volume much material to facilitate the study of technical questions in which they are specially interested The chapter on communications and transit, for example, refers to action taken in relation to oil pollution at sea and in regard to road transport A separate chapter is devoted to nutrition, while the chapters on the Health Organization and on intellectual co operation indicate very clearly the significant contribution to human welfare that is being made in those fields

Other chapters deal with mandates, the Permanent Court of International Justice economic and financial work, the protection of minorities, opium, social questions etc a detailed chronological table of the chief events of the year so far as the League is concerned is also included

Commonwealth Bureau of Census and Statistics, Canberra

Official Year Book of the Commonwealth of Australia No 30, 1937 Prepared by Dr Roland Wilson Pp xxvii + 1021 (Canberra Government Printer, 1938) 5*s*

THE Commonwealth Year Book is always most informative It contrives, mainly through the medium of statistics, to give a view of Australian life as a whole It would be difficult to find any important aspect of Australian activity that is omitted from its pages, and where considerations of space demand curtailment of treatment, full reference is given to relevant publications In many aspects also the statistics are all the more useful since comparable statistics are given for other States

The book contains a number of maps, including an average annual rainfall map, an air route map, a railway map and a map of artesian basins The number of artesian and subartesian bores increases only slowly, but on the other hand the area irrigated by surface water has grown in several States As usual, a long list of books on Australia appears

Ice

By the late Dr A E H Tutton, FRS

THE subject of Sir William Bragg's Friday evening discourse at the Royal Institution on March 18 last is one which is of deep interest from a remarkable variety of points of view among them that of the crystallographer the physicist the geologist the climber the ski runner the plumber the food purveyor and distributor and even the very housewife herself Moreover it is one which has proved of unusual difficulty although it concerns natural phenomena of the most familiar kind and one of the most abundant substances in Nature Indeed we never seem to get a thorough and complete understanding concerning the extraordinary nature and unusual properties of ice although they have been investigated and discussed for ages Only quite recently an Association for the Study of Snow and Ice has been formed in Great Britain now numbering about eighty members the nucleus being the British members of the International Commission of Ice and Snow which deals with the survey of glaciers and the prevention of catastrophes due to them One of the latest discussions at the London meeting of the Association concerned The Structure of Flow of Glacier Ice

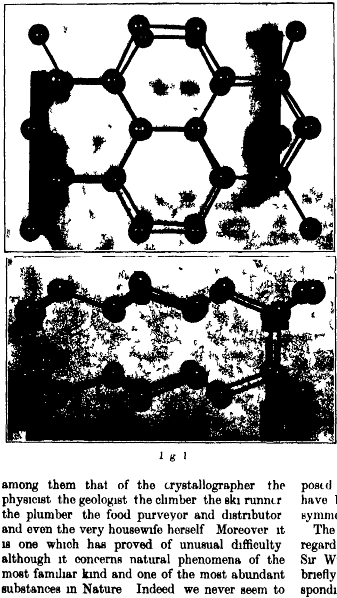

Fig 1

One property of ice its crystal form and structure and especially the system of symmetry to which it belongs has however now after long discussion been settled a satisfactory conclusion mainly derived from the X ray analysis of ice crystals which we owe largely to Sir William Bragg himself For ice is now definitely known to crystallize in the hexagonal system and in the holohedral class exhibiting the full symmetry of that system the dihexagonal bipyramidal A whimsical yet very beautiful illustration of this fact is afforded by one of the exquisite photographs of snow flakes taken in a severe winter on the other side of the Atlantic by Mr Wilson Bentley one of the four thousand which we owe to his genius no two of which are alike while all exhibit the same symmetry For this particular snow flake of the plate like rather than the feathery star like kind resembles almost ridiculously closely a grandfather clock face in its case with twelve markings very like Roman numerals in exactly the positions of the twelve hours These twelve markings correspond to the dihexagonal character of the crystal for if the symmetry had been merely trigonal as so long supposed one would have expected the markings to have been only six corresponding to ditrigonal symmetry

The crystallographic facts now definitely known regarding ice crystals due to the work of Dennison Sir William Bragg and Prof Barnes may very briefly be stated The space group is D_6^4 corresponding to the class already mentioned There are four molecules of water in the unit cell of the structure the dimensions of which are $a = 4\ 53$ A $c = 7\ 41$ A The ratio of the axes is $c\ \ a = 1\ 634$ This structure remains unchanged for all temperatures between 0° C and − 183° C The density of the crystals is 0 9168 and their cubical expansion coefficient is 0 00016

Sir William now regards the ice crystal as a set of parallel sheets of puckered hexagons as shown in the photograph of a model reproduced in the upper part of Fig 1 the observer being supposed to be looking along the optic (hexagonal) axis perpendicularly to the basal plane The sheets are connected by links perpendicular to them The balls in the photograph (and model) are supposed to be oxygen atoms for as hydrogen has so little effect on X rays owing to its extreme lightness the position of the hydrogen atoms is even yet not quite certain although there is great probability that they lie between the oxygen atoms alternately with them in such a manner as causes the hydrogen atoms to be double in number to the oxygens The second photograph in the lower half of Fig 1 was taken at right angles to the upper one showing two sheets the observer looking along the basal plane Each oxygen atom lies at the centre of a tetrahedron of which the four corners are occupied by other oxygen atoms The distance between adjacent oxygen atoms is 2 74 angstrom units whether in the same sheet or two neighbouring sheets

Sir William directs attention to some singular experiments in 1936 by McFarlan as to the effect of pressure on the structure from which it would appear that under high pressures ice changes its structure somewhat forming in succession two different forms II and III and two other photographs were shown in the lecture reproduced in Fig 2 of form II While the sheets remain much the same they are brought nearer together by the pressure as shown in the lower half of Fig 2 In form III the sheets also give way

Tamman in 1910 first observed this remarkable fact and showed that the forms II and III are solids at the low temperature of liquid air by actually removing them from the steel high pressure cylinder after releasing the pressure The new solids rapidly changed into ice with a large increase of volume at the ordinary atmospheric pressure Bridgman in 1912 confirmed Tamman s facts using pressures up to ten thousand kilograms per square centimetre McFarlan has taken the matter further by obtaining X ray analyses of these two forms II and III at the low temperature of – 155° C and concludes that they are polymers of ice, having eight molecules of water to a side centred orthorhombic cell in the case of II and sixteen molecules to a body centred orthorhombic cell in the case of III McFarlan appears to have found pressures up to 2100 atmospheres adequate for the production of these two new forms of solid water He gives the space group of II as $V^5-C\,222$ and the cell dimensions a 7 80 A b – 4 50 A and c 5 56 A and for III the space group V_h Ibmm and the dimensions a 10 20 A b 87 A and c 7 17 A

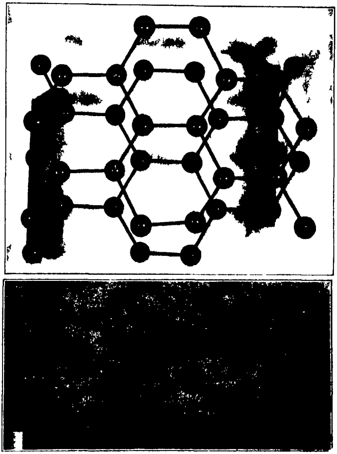

Fig 1

The slip or glide plane of ice made known in 1891 by the work of McConnell of Cambridge a frequent visitor to Davos for health reasons and fully confirmed by all recent work to be parallel to the basal plane is due to the readiness with which the sheets of hexagons although puckered can glide over one another Moreover water freezing in an open pond or vessel crystallizes as a plate parallel to the basal plane Hence McConnell in order to test the plasticity of single ice crystals cut some bars of ice from single crystals from a frozen lake surface the bars being several inches long and an inch or so wide and deep Each was supported in turn near its two ends and a weight was suspended by a loop from its middle When the bar had been cut with its length parallel to the basal plane and the water surface, and was arranged on the supports with its upper surface also horizontal, parallel to that same plane, a little bending occurred when the weight was placed in position, but it was only elastic bending, and the original position was restored on removal of the weight. If the bar were turned over on its other side, with the basal plane now vertical, practically no bending at all occurred on adding the weight. But if the bar had been cut from a very thick plate of pond ice, so that its length could be made to be perpendicular to the basal plane, then on adding the weight the bar sagged continuously in the middle, taking a V-shape with a more and more acute angle, owing to the glide plane having full freedom of action, the sheets of hexagons readily gliding past each other. The deformation was, moreover, permanent to almost the complete extent. Indeed it seemed at first as if this newly discovered property of the glide plane might afford a better explanation of the movement of glaciers than regelation. For a glacier is a conglomerate of single crystal grains, closely fitting together, with irregular bounding surfaces instead of crystal facets.

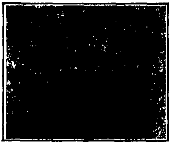

Fig. 3

Even this was not the only additional factor required to supplement the inadequate regelation principle of Faraday (the freezing together of freely floating pieces of ice on contact) and Thomson and Tyndall (the liquefaction under pressure and re-freezing on removal of the pressure). For the crystal grains are usually promiscuously orientated, neutralizing each other's glide-plane movements. But subsequent researches showed that the irregular bounding surfaces are in reality liquid films, the pressure occurring from time to time during the glacier's movement down its unevenly inclined bed being most effective at these boundaries. Hence, molecular transpiration across them occurs, the crystal grains growing in size as the glacier descends, so materially indeed that while it is microscopic in the upper reaches, the 'firn', it may be as great as a yard or more at the snout of the glacier.

Of course Sir William emphasized the fact that the liquefaction of ice by pressure is rendered possible by the very open structure of ice, as revealed by X-rays, which also accounts for the abnormal expansion (instead of contraction) of water on freezing. I would like to add that it is even yet rarely appreciated how immense is this volume change which occurs on the freezing of water, compared with the thermal expansion of either ice or water. That of ice has already been mentioned (0·00016), and that of water is not far different; between 7° and 8° C. it is 0·000053, between 10° and 11° it is 0·000091, and between 19° and 20° it is 0·00021, the average coefficient between 10° and 20° and also the actual coefficient at 15° being exactly 0·00016. For the interesting interval between the maximum density at 4° (or more accurately 3·945° C.) and 0° (without freezing) the total expansion of the water is only one ten-thousandth of its bulk. But when freezing occurs there is a sudden expansive leap of nearly one-tenth of the whole volume of water frozen. The 'water-flowers' (Tyndall's 'ice flowers') or negative ice-crystals, produced in a slab of lake-ice by passing through it the hot rays from an electric lantern, are particularly interesting as illustrating the foregoing fact most elegantly, for they always exhibit a vacuole about their centre, of about one-ninth of the water content in the whole star-like cavity. Sir William exhibited a film which had been taken at the Royal Institution of this phenomenon, and Fig. 3 reproduces one of the best of these six-rayed 'flowers' shown by the film.

At the recent meeting of the Snow and Ice Association already mentioned, Dr. C. H. Desch emphasized the necessity of distinguishing between plastic and viscous flow. He pointed out that the former means an immediate yield under constant stress, and quoted Ruskin's example of butter (plastic) and honey (viscous), as an excellent illustration of the difference. He also showed that no formula can be found for the flow of glacier ice because flow is here complicated by recrystallization. He also propounded the question as to whether, in the production of a crack in ice leading to the formation of a crevasse, the fracture occurred between the crystals or along the basal planes (glide planes) within the crystals. In this connexion, I well remember being present at the startling event of the birth of a crevasse. It occurred during a crossing of the Alphubeljoch from Saas-Fee to Zermatt, in company with Alessandro Corsi of Macugnaga. Suddenly there was an explosion like a rifle shot fired at one's feet, at which both of us leapt forwards (the rope being taut between us). On recovering our equanimity and looking down at the glacier surface, which at that spot had been unusually free from crevasses, we perceived a thin sinuous line of crack extending as far as we could see on each side of us, which obviously, before our eyes, opened more and more, until as we left to resume our climb this new crevasse had widened to more than a couple of inches

The chairman of the Association, Mr Gerald Seligman, quoted recent work indicating that the individual crystal was the unit of glacier movement, and that the slightest differential movement of the crystal grains might well be one of the principal causes of glacier movement It is to be hoped, and indeed expected, that confirmation or otherwise of this view, and the answer to Dr Desch's question, may be forthcoming from the investigations now proceeding at the Jungfraujoch by Mr Seligman and his collaborators

In conclusion, it appears to me that practically every seriously suggested cause for the movement of glaciers that has ever been put forward does operate, each playing its part when the conditions are favourable to its operation, and several of them usually acting simultaneously This opinion is not merely the result of an attempt to digest all the voluminous records of practical scientific work on glaciers, but of personal study commenced so long ago as the year 1891, materially assisted by careful examination of nearly two thousand photographs of ice and snow formations on glaciers and mountains, taken by me personally during more than thirty seasons spent in the Alps, besides visits to the Rocky Mountains and the Himalayas

Cambridge Meeting of the British Association

General Arrangements

THE Sectional programmes for the Cambridge meeting of the British Association were outlined in NATURE of July 16, it remains to add some general remarks to the notice which appeared in these columns when the preliminary programme was issued last April

The attendance promises to be large it should well exceed the average figure (which, since, but excluding, the centenary meeting in 1931, is 2,274), and this despite the unusually early, and to some members rather disconcerting, date of the meeting, August 17–24 This was inevitable, in order to meet the convenience of the colleges which are so generously offering their accommodation to visitors Those who remember the last Cambridge meeting, in 1904, may recall that it fell on exactly the same dates, for the same reason Nevertheless, the attendance then was 2,789, a very high figure for those days, but one which the present officers (and especially the General Treasurer) would very gladly see surpassed this year It may well be, however, that the indulgence of late-comers will have to be sought if there be not room for them all to hear Lord Rayleigh's presidential address on August 17 The same drawback supervened in 1904, when many were unavoidably excluded from the Corn Exchange in which Mr Arthur (afterwards Lord) Balfour as president inaugurated the meeting. On the present occasion the address will be given in the Regal Cinema There is more room there than in the Corn Exchange (and certainly those present will listen in conditions of greater comfort); but there may not be enough for all members. It has therefore been decided to number and reserve all seats and to issue tickets early next month to members according to priority of their intimation to be present, any who receive tickets but who do not intend to use them will be besought to return them at once in order that they may be made available for other members Consideration is being given to the desirability of relaying the address to another hall, a facility not available to the harassed officers in 1904

The general arrangements are nearing completion, and an ample list of excursions and visits has already been issued to those who have intimated intention to attend The full programme and timetable, together with the specially compiled scientific survey of the Cambridge district, will be sent out as usual some ten days in advance of the meeting

In recent years, the Association has attempted to meet a widespread demand for more specific attention to the direct relations between science and its bearing upon the life of the community, by the simple method of indicating in the programme all communications which bear specifically on this question There will, however, be presented to the Council and the General Committee important proposals to place the study and presentation of this aspect of the advancement of science in a more clearly defined position within the Association It will be recommended that a Division for the social and international relations of science be established—the Council having already approved this step in principle, and has appointed a committee to consider and report upon the method of working the new Division The inclusion of international relations is made with the more confidence because the interest of the American

Association for the Advancement of Science in these questions is well known and a representative delegation from that body is expected at Cambridge to confer with the officers of the British Association upon the ways and means of closer co operation The report of the committee will be circulated early in August to all members of the General Committee known to intend to be present at the meeting The same committee of the Council was charged with a review of the methods of publication at present practised by the Association the principal medium being the annual report which many people have long regarded as a graveyard of scientific communications the relegation of which thereto not infrequently appears to be something less than they deserve A far reaching proposal will be put forward in this connexion

It will be apparent from previous announcements that the scientific programme will be full of worthy subjects and one not previously mentioned calls for notice here The visit of the scientific delegation to India last winter was so notable an episode that it has been felt to call for due recognition at Cambridge and it is hoped to hold a special meeting with Sir James Jeans the jubilee president of the Indian Science Congress Association in the chair at which some of the delegates will give their impressions of the tour Also an exhibition of photographs taken by delegates will be displayed in the reception room the party was fortunate in including a number of very skilful amateur photographers Another unaccustomed exhibition will be that of paintings and drawings by members of the Association some of whom are already well known as artists in their hours of relaxation though hitherto there has been too little opportunity to appreciate their work

In certain directions therefore the Cambridge meeting may be expected to add materially to the history of the Association In one other it will assuredly do so For the first time a sherry party finds place in the official programme It will be given in Emmanuel College by the Mayor and Mayoress of Cambridge a very welcome innovation

Among other social functions will be a reception by the University in the Senate House and Old Schools on Thursday evening August 18 There will be informal conversaziones in Trinity College on Friday evening August 19 and in St John s College on Monday evening August 22 Garden parties will be held in Downing College and Sidney Sussex College on Friday afternoon August 19 and in Christ s College and Queens College on Monday afternoon August 22

Full details of the social functions will be published in the programme and time table

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The Piltdown Man Discovery

Unveiling of a Monolith Memorial

ON July 23 Sir Arthur Keith unveiled a monolith memorial which has been placed in the grounds of Barkham Manor Piltdown Sussex to mark the spot where the late Mr Charles Dawson found the fossil skull of Piltdown Man (*Eoanthropus dawsoni*) He paid a tribute to Mr Dawson whose important work as an amateur deserved our gratitude and remembrance He remarked that the Piltdown skull is so different from any other human skull previously discovered that the divergent opinions expressed by those who have attempted to interpret it are not surprising In 1912 1913 when the fossil was found much less was known of early man than is known at present If a similarly novel discovery were made now there would be closer agreement among those who studied it Sir Arthur is more impressed at present with the simian characters of the skull and brain cast as well as those of the lower jaw than he was when he originally examined the fossil

After the unveiling Sir Arthur Smith Woodward gave some reminiscences of his collaboration with Mr Dawson at Piltdown and he added that the first subscription towards the memorial was received from the late Prof Henry Fairfield Osborn of New York Brigadier General E G Godfrey Faussett chairman of Council of the Sussex Archæological Society spoke of the generosity of landowners to archæologists and expressed thanks to Mr D Kerr of Barkham Manor The memorial was designed by Mr Percival Bridgman of Lewes and is made of durable Carboniferous sandstone from Yorkshire

The following is the substance of Sir Arthur Keith s speech

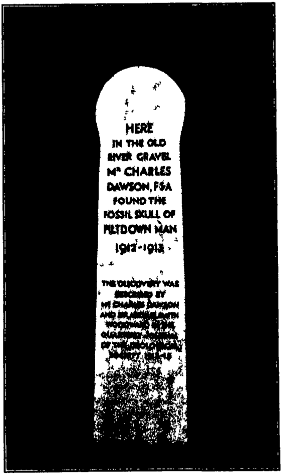
Mr Charles Dawson—solicitor and antiquarian—has been in his grave these twenty two years , he died in 1916 at the age of fifty-two but the discovery he made on the spot where we are now assembled, the fossil remains of the earliest Englishman known to us, goes on growing in magnitude and in importance. The fossil bones he gathered here from a heap of road metal by the wayside the private way leading to Barkham Manor—gave us the entrance to a long past world of humanity such a world as had never been dreamt of by anyone in England or in any other land.

I have in my hand a guide book to Sussex published in 1911. It was written by my learned friend the late Mr. A. R. Hope Moncrieff. He assured his readers that the earliest inhabitants of Sussex were the celtic tribes whose camps can still be traced on the Downs. When these words were being written by Mr. Moncrieff, Mr. Dawson was assembling evidence that carried the history of man in Sussex back to a remote period—one to which geologists assign a duration of half a million years—or perhaps twice that amount. This discovery was not sent to Mr. Dawson by the fickle goddess chance; it came to him because knowledge knew how to use its opportunities. The Weald was then alive with antiquaries searching for the handiwork of ancient man. Mr. Dawson had his own beat, and searching for implements in that beat he met with the fossil remains of a maker of the older stone implements.

The greater the novelty of a discovery the more it departs from ascertained knowledge the greater is the difficulty of getting it into its right perspective and the longer is the time needed to reach that end. More than ninety years ago an exciseman named Boucher de Perthes found worked stone implements in ancient deposits in the Somme Valley; it took seventy years to prove that what was true of the ancient deposits of the Somme Valley is repeated in every great river valley of the Old World. In 1857 when Neanderthal man was discovered, diverse explanations were given to account for the brutality of his structure; it took half a century of exploration to place him in his proper place in history. He proved to be a representative of the Europeans of a remote period the period which saw the onset of the last glaciation of Europe.

The fossil remains found at Piltdown by Mr. Dawson set students of man's evolution the most difficult task that has confronted them hitherto. In his characterization, Piltdown man was quite unlike any fossil type known to us. Sir Arthur Smith Woodward was impressed by his simian similarities; I, on the other hand, was impressed by those features which, as I thought then, were eminently human and modern. Hence arose those discrepancies between us—discrepancies of a quarter of a century ago.

Since then, much has happened. Discoveries are being made which help to throw Piltdown man into his proper place in the crowded throng of evolving human forms. We now know that when the Piltdown type was being evolved in England—or at the western end of the Old World—a totally different type had come into being in the Eastern lands of the Old World. The Eastern types had low receding foreheads, modelled as in the gorilla and chimpanzee. The Western or Piltdown type differed; it had a relatively upright and high forehead, modelled not on gorilla lines but rather on those of the orang. While the Eastern forms retained in their shape of head the low squat type of the chimpanzee and gorilla, the Western or Piltdown type tended to assume the higher vaulted skull seen in modern races. There is no denying that in many of his features Piltdown man foreshadowed some of the structural modifications we find in modern races of mankind. Sir Arthur Smith Woodward, I know, will agree with me as to how Piltdown man came by such features: he came by them independently, for discoveries of recent years have proved that diverse races of mankind have undergone the same structural change quite independently of each other. And there is also no denying that through all his known parts there runs a simian vein in Piltdown man, in his skull and brain as well as in his mandible.



Reeves photo Lewes

So long as man is interested in his long past history, in the vicissitudes which our early forerunners passed through, and the varying fate which overtook them, the name of Charles Dawson is certain of remembrance. We do well to link his name to this picturesque corner of Sussex—the scene of his discovery. I have now the honour of unveiling this monolith dedicated to his memory.

Obituary Notices

Mr C F M Swynnerton, C M G

THE recent death of Charles Francis Massy Swynnerton, as a result of an aeroplane accident in Tanganyika Territory on June 8, has been a heavy loss to science and especially to all who are interested in the development of tropical Africa, and it is particularly deplorable in that it occurred at a time when he had just been placed in a position to apply on a much larger scale the scientific ecological methods that he had devised for the control of tsetse flies

Swynnerton was born on December 3, 1877, in Lowestoft going to India later where his father was senior chaplin to the Indian Army, his mother being the daughter of Major W H Massy, of Grantstown Hall, Tipperary He was educated at Lancing College and went out from there to Southern Rhodesia at the age of nineteen years, where for many years he was engaged in farming in the Melsetter District, then generally known as Gazaland

Being a very keen all round naturalist, Swynnerton soon turned his attention to the birds of that area, and during 1907 and 1908 he published a series of papers (250 pp) in the *Ibis* recording his observations Owing largely to the fact that his farm comprised a portion of Chirinda Forest, a most interesting patch of residual tropical rain forest which was then quite unknown botanically, he soon took an interest in the plants of the district and sent home a large collection to the British Museum (Natural History) This was eventually worked out by various specialists, and an account of it was published in the *Journal of the Linnean Society* in 1911 The collection contained nearly 1,100 species, of which 190 were new to science, several of these were described by Swynnerton himself, including two fine new mahogany trees

Swynnerton then became interested in the problem of the significance of form and colour in Nature, and as he possessed to an unusual degree a capacity for precise and impartial observation, without any trace of that unfortunate urge to bolster up one's own theories or to smash those of other people, I suggested to him that he should undertake a really large scale experiment to test unpalatability in insects and the deductions based on it in the theory of mimicry He then began a long series of experiments lasting over five years in which very large numbers of insects of all kinds were used, the butterflies alone totalling more than 17,000 These experiments were made not only with captive animals, but also with wild birds, and were the first scientifically precise investigations in this field, and served to show the unreliability of much of the earlier work and also of criticisms based only on a few casual observations, or on the examination of the contents of birds' stomachs The mass of evidence obtained was so great that less than half of it has been published (principally in *J Linn Soc*, Zool, **33**, 203–385, 1919), though he rejected his first five hundred experiments for fear that they had not been done critically enough He demonstrated that his birds when really hungry would eat almost anything, becoming increasingly discriminative as the stomach filled, so that a graded series of preferences could be compiled with considerable accuracy

In 1918 a breakdown in health necessitated Swynnerton getting away from the worries of farming, but with his characteristic untiring energy he considered that a change of work was the best type of holiday At my suggestion he turned his critical mind to a study of the tsetse problem, for which his intimate knowledge of the fauna, flora and geology of the country specially fitted him With the assistance of the Mozambique Government he spent three months in analysing the tsetse situation in the Mossurise District of Portuguese East Africa His comprehensive report (*Bull Ent Research*, **2**, 315, 1921) contained a number of original ideas, and threw an entirely new light on the ecological aspects of the complex tsetse problem It was here that he first recommended the use of controlled grass fires as an economical method for eliminating these flies, a suggestion the value of which has been amply demonstrated in parts of Tanganyika and southern Uganda, where the vegetation was suitable for it In 1919, he became the first game warden of Tanganyika, with instructions to study the relations between game and tsetses, and in 1921 he made a preliminary survey which showed that two thirds of the Territory was infested by these flies An outbreak of human trypanosomiasis, carried by *Glossina swynnertoni*, in Mwanza district started him on the practical work of controlling the fly, and he inspired and organized the first voluntary communal effort on a large scale by the natives themselves to stop the advance of the fly by well planned clearing of bush The successful results led to a great increase in this work, and a timely visit to the country by the then Under Secretary of State for the Colonies, the Hon W Ormsby Gore (now Lord Harlech), led to official recognition of the importance of his work, so that funds were made available for its extension Nevertheless, incessant and unjustifiable difficulties were placed in his way by critics of his methods, which nearly disheartened him, but thanks to his unflagging persistence a special Department of Tsetse Research was established in 1929, and Swynnerton left the Game Department to become its first director

Here Swynnerton soon collected around him a small band of first rate scientific workers and field officers, whom he trained and inspired by his own untiring energy and enthusiasm These men have carried on a precise and intensive investigation of the ecology and habits of *Glossina* in all their complex aspects, and the work accomplished has been summarized by Swynnerton in his outstanding publication "The Tsetse Flies of East Africa", which will long be the standard work on the subject

The results obtained are such that it can now be said with some assurance that the recovery of large areas of valuable land from the tsetse fly has become economically feasible under the control of specially trained men , and it is to be hoped that the Department that Swynnerton built up will be allowed to continue its separate existence and carry on the great work for Africa which he initiated

GUY A K MARSHALL

Mr B D Burtt

THE tragic loss, through an aeroplane disaster of Mr C F M Swynnerton, Director of the Tsetse Research Department and of Mr B D Burtt botanist to the Department robs East Africa at one blow, both of a distinguished zoologist and administrator and of a field worker who had a more intimate knowledge of the vegetation of Tanganyika and probably of East Tropical Africa as a whole than any other living botanist The loss is the greater since news had just been received that the work of the Department was to be extended

Bernard Burtt was the son of Dr A H Burtt of York, who was himself a botanist Young Burtt who was born in 1902, was educated at the Friends School Ackworth, and at University College Aberystwyth, and came to Kew in 1923 He did not shine in examinations but as an all round naturalist he was outstanding Although he held a temporary post in the Kew Herbarium his real interest was in the open the living collections the local insect fauna, and the bird life in Richmond Park Later he assisted his cousin, Dr J Burtt Davy, who was preparing the first volume of his Flora of the Transvaal" Burtt's opportunity came when the tsetse fly campaign was organized The writer well remembers Swynnerton visiting the Herbarium in search of a botanist for field work in Tanganyika Burtt's services were pressed with every confidence He went out to East Africa in 1925 as District Reclamation Officer, an appointment in the Tsetse Reclamation branch of the Game Preservation Department When that branch later became the independent Department of Tsetse Research, he became the survey botanist for that Department He threw himself with all his enthusiasm into the work, the interrelationships of the fly, the game and the vegetation, and it is doubtful which of the three held the greatest attraction, for one possessed, as he was, of such intense biological interests and sporting instincts Though not the official ecologist to the Survey he became an ecologist in the widest sense At the same time he always appreciated and fostered taxonomic studies, both botanical and entomological

Burtt was an excellent collector His herbarium material was usually sufficient for a five fold distribution , a set each for Kew, the British Museum and the Imperial Forestry Institute, Oxford, a fourth and fifth set being retained in Africa for Amani and for his own Department The collections as a whole were dealt with at Kew, though specialists at South Kensington and Oxford helped in the identification of their respective groups Burtt s energies taxed the Kew staff to its utmost, one of his last sendings consisting of thirty one cases His material was always good and often represented little known or new species But though he collected many novelties they were not his first interest He was concerned with the vegetation as a whole the component species and the fly though he was quick to spot a beautiful new species as he fondly termed them He did not care for writing and published little When on leave, mountain exploration always had a strong appeal , he collected on Hanang and the Ngoro Ngoro crater and surrounding mountains besides the better known summits and he was probably the only British botanist to climb and collect on the difficult ground of the old crater of Mount Meru

Latterly Burtt travelled much by air, surveying the vegetation and the haunts of various species of tsetse fly In order to see more of Central Africa he curtailed his last leave and travelled back to Tanganyika by car with a friend by way of Nigeria, French Cameroons Belgian Congo Ituri Forest, Kivu and Uganda and of this he has left a graphic account His love of fun kindheartedness and fondness of children were evidences of a most attractive personality Always abounding in energy and good spirits, he was exactly the man for the post, and his loss will be severely felt not only by botanical institutions in Britain but very specially by the Department of Tsetse Research As a correspondent in the Territory writes I do not know how the Department will fill his place, for not only had he a unique knowledge of our country s flora but he had to an unusual extent the gift of enthusing others

A D C

THE above accounts of the loss which science in general, and East African science in particular, has sustained in the untimely deaths of Mr Swynnerton and Mr Burtt, have come from two writers who are in a far better position than I to appraise the magnitude of that loss As one who has worked for the last thirteen years under the direction of the one and in constant close association with the other, I am glad of this opportunity to add a few words about them in their capacities as leader and colleague Mr Swynnerton in addition to displaying the qualities which have been described above, so treated his staff that they one and all looked to him more as guide, philosopher and friend than as to an official superior , he was an inspiration to greater and ever greater efforts to achieve the objects for which his Department was created, and by his kindly appreciation of all efforts, even the smallest, made each feel that his contribution formed a vital part of the general scheme He never asked from anyone more than he was prepared to perform himself, and his visits to lonely workers were like an invigorating tonic, difficulties which had previously seemed insuperable disappearing, for the time at least, under his magic touch His work was inspired by a genuine love for the Africans in whose country he spent so much of his life and his treatment of them was characterized by a patriarchal attitude in the best sense of that word

Mr Swynnerton's qualities as a naturalist have been described no less than he was Mr Burtt a lover of Nature and a born observer, the great qualities of the latter in this respect, his delight in all such observations and the enthusiasm which he gave to them, all combined to make him a companion whose presence not only lightened many an arduous day under the trying conditions of the tropics, but also increased beyond measure the profits gained from such toils, to travel with him through the African forests was an education especially in the latter days as his own experience and knowledge grew His eagerness to co operate, his entire lack of selfishness, and the kindly enthusiasm with which he shared the fruits of his observations and experiences, often won at the expense of such arduous endeavour as one of lesser physical strength would have been incapable of exerting made him the most valuable of colleagues and one who inspired all with whom he came in contact with some measure of his own love of Nature This led frequently to their stimulation to attempt similar observations on their own so that his work was often extended and enriched beyond what he could have achieved alone One who was ever impatient of red tape, he found in his chief, Mr Swynnerton, a sympathetic leader under whom his natural abilities could develop and flourish in a way which would have been difficult under the more rigid and stereotyped conditions so often associated with Government service

The deaths of these two leave gaps in their Department which it will be impossible to fill entirely, their colleagues and friends suffer the bitter loss of two sources of inspiration and infectious enthusiasm which were a constant and quickening stimulus to them, the campaign against that plague of Africa—the tsetse fly—and the study of East African ecology in general both so essential to the proper development of the latent resources of that country are the poorer by the disappearance at one and the same time of an able and inspiring leader, and of a gifted and indefatigable worker who both possessed in no small degree the power to stimulate others to contribute to the subjects in which they were themselves interested and which it was their main object in life to foster

W H POTTS

WE regret to announce the following deaths

Lieut Colonel C H H Harold, O B E director of Water Examination, Metropolitan Water Board, on July 18 aged fifty three years

Miss A F Neilson lecturer in geology in the University of Glasgow on July 8

Mr F M Nelson, formerly president of the Quekett Microscopical Club and of the Royal Microscopical Society, an authority on microscopy and microscope construction, on July 20, aged eighty seven years

News and Views

Sir Gilbert Morgan, O B E, F R S

SIR GILBERT MORGAN is retiring from the directorship of the Chemical Laboratory Teddington under the Department of Scientific and Industrial Research and is taking over a directorship in another important field of work He was appointed director at Teddington in 1925 but had held previously the professorship of applied chemistry at Finsbury Technical College the professorship of applied chemistry at the Royal College of Science, Ireland, the professorship of chemistry at the University of Birmingham, as well as the post of assistant professor of chemistry in the Royal College of Science, London At Teddington, he was entrusted with the task of creating something out of nothing and was successful in establishing an institution which has become a valued national possession For this he received the honour of knighthood in 1936 Before his administrative duties limited the time which even he could find for research, Sir Gilbert published many papers in the *Journal of the Chemical Society* and other journals In fact, his invention of the word "chelate" in connexion with co ordination led his friends to name this branch of organic chemistry "Morganic Chemistry" To the Chemical Society he gave his services as editor, secretary and president, and he has been president also of the Society of Chemical Industry Sir Gilbert is one of those men who discreetly avoid giving the year of their birth in "Who's Who", but his age may be judged from the fact that he is now retiring under the usual Civil Service rules He has the good wishes of all his friends in his new appointment and they are confident that the success which has crowned all his other activities will attend his new effort Let us hope that like Chevreul, he will have a medal struck in his honour on his hundredth birthday Meanwhile, his 'chelate" personal character will continue to attract the affection and admiration of all who come into contact with him

Major F A. Freeth, O.B.E, F.R S

MAJOR F A FREETH, who has been research manager of Imperial Chemical Industries, Ltd, since the formation of the company in 1926, is retiring from that position but has consented to continue his connexion with the company in the capacity of consultant Major Freeth was educated at the University of Liverpool and at an early age gained considerable reputation as a physical chemist, becoming chief chemist to Messrs Brunner Mond and Co Ltd in 1910 On the outbreak of the Great War, he went to France with the Cheshire Regiment, but was recalled to England to undertake scientific work in connexion with the supply of munitions He rejoined Messrs Brunner Mond and for the remainder of the War he did very valuable work in developing new processes for the manufacture of explosives For his services to the country he was honoured with the O B E In 1924, Major Freeth was awarded the doctorate in the Faculty of Mathematics and Physics in the University of Leyden He was elected a fellow of the Royal Society in 1925

Mr A. G Lowndes

MR A G LOWNDES who for the past seventeen years has been a science master at Marlborough College, is retiring at the end of the present term Few science masters in public or other secondary schools devote themselves to original research, or have their contributions to knowledge published by scientific societies, but Mr Lowndes like the late Mr Edward Meyrick, who was for many years also a master at Marlborough, but on the classical side, has had a number of original contributions published in the proceedings of scientific societies and also in the columns of NATURE In 1934 he was awarded a Leverhulme research fellowship for his cinema photomicrography Immediately after the British Association meeting at Cambridge next month, Mr Lowndes is going to the Leper Settlement at Oji River, Onitsha, Southern Nigeria, as a guest of the Church Missionary Society to stay with an old pupil Dr David Money who is the medical officer in charge, and to see if useful work can be done there by a trained biologist He proposes to return to England in the spring and to work at least eighteen months at the Marine Biological Laboratory at Plymouth, where he will apply his method of finding the density of living aquatic organisms to the study of plankton

Society for the Protection of Science and Learning

MR DAVID CLEGHORN THOMSON, formerly secretary to the Oxford University Appeal Committee has been appointed general secretary, in succession to Mr Walter Adams, of the Society for the Protection of Science and Learning (formerly known as the Academic Assistance Council) which for five years has been handling the academic side of the international refugee problem Mr Cleghorn Thomson is a graduate of the Universities of Edinburgh and Oxford, a senior history exhibitioner of Balliol, he was for seven years the B B C's chief official in Scotland The Society for the Protection of Science and Learning, of which the Archbishop of York recently became president in succession to the late Lord Rutherford, acts as a central bureau of information regarding professors, lecturers and research workers displaced in their own country on account of 'race', religious or political opinions, and aids in securing the continuation of their valuable work in other countries So far, of the 1350 displaced scholars registered with this Society, 520 have been permanently placed in 38 countries, apart from more than 300 who have temporarily found work Within the last three months, the Society has received 340 applications from scholars who have had to discontinue academic activity in Austria The offices of the Society are at 6 Gordon Square, London, W C 1

Atlantic Flight with 'Pick-a-Back' Start

Mercury, the seaplane upper component of the Short Mayo composite aircraft, arrived at the airport of Boucherville near Montreal on July 21 at 12 20 p m Eastern Daylight Time, having flown from Foyne, County Limerick, in a little more than twenty hours The actual time from shore to shore, Foyne to Cape Baulewn, Newfoundland, was 13 hours 29 minutes Considerable rain and head winds were experienced during the flight, the machine arriving at Montreal with only about eighty gallons of fuel left After refuelling she took off for New York, reaching there about two hours later Captain Bennett, the pilot, and Mr Coster, the wireless operator, stated that they had experienced no unexpected difficulties during the journey, and had used their automatic pilot quite successfully as necessary The machine carried a cargo of newspapers, newsreels, and photographs principally of the royal visit to Paris The newspapers were on sale in New York on the day following their publication The successful finishing of this flight represents the completion of one of the experiments upon the problem of launching aircraft with excessive loading, due to the necessity for carrying considerable fuel and oil for long distance flights Other methods such as catapulting, topping up with fuel while in the air etc are being developed, and have been mentioned in NATURE as they have occurred

Depredations of Property by Rabbits

A BILL to protect agriculture from the ravages of rabbits was introduced in the House of Lords by Lord Sempill on July 25 It follows the lines of the report issued by the Mersey Committee on this subject, and provides powers for enabling the county councils to take action against the owner or occupier of rabbit infested land who fails to take precautions to prevent damage to neighbouring land It also provides for action for damages on the part of the aggrieved party To meet the difficulties of those who are unable to find the labour and equipment necessary for keeping down rabbits, the Bill enables county councils to provide staff and equipment for this purpose Gin traps, however, are not to be used by the staff so provided Some doubt has been expressed as to whether the destruction of rabbits by cyanide fumigation, which may now be regarded as the standard method of rabbit control, is strictly legal, and a clause of the Bill puts the use of this method for rodents beyond doubt The Bill also gives effect to the Mersey Committee's recommendation that "gin traps should in no circumstances be set in the open '

SPECIAL provision is made in the Bill for instances in which Scottish legal practice and administration differ from the English The introduction of the Bill is in the nature of a reconnaissance and has been undertaken in the hope that it may facilitate the passage next session of legislation on similar lines The promoters have a two fold objective, first to bring some relief to farmers who are suffering from the depredations of rabbits coming from neighbouring property and secondly by reducing the stock of wild rabbits in the country to reduce the amount of suffering inflicted annually by the rabbit trapping industry A leaflet written by a Bedfordshire farmer with illustrations by a Bedfordshire farm labourer has been issued in support of the Bill and copies of this together with a memorandum summarizing the details of the Bill may be obtained from ULAWS (The University of London Animal Welfare Society) 42 Torrington Square London W C 1

Prehistory and Quaternary Geology of the Sahara

THE first international meeting for the Study of the Prehistory and Quaternary Geology of the Sahara was held under the auspices of the Musée de l Homme Paris on June 27 30 Sir Robert Mond who has arranged for the publication of the results was *président d honneur* and Prof P Rivet who kindly allowed the magnificent organization of his new Museum to be used was president Archæological papers predominated at the meeting and of these the larger number dealt with the numerous and important rock drawings and rock paintings of the Desert This being the first general meeting of men of science working in different areas of almost half a continent it was more exploratory than definitive the primary purpose being to familiarize workers with progress in other parts Perhaps not least important was the opportunity for personal contact A second meeting will be held four years hence However, certain more concrete results were obtained Machinery was set up for forming a bibliography of rock paintings and drawings It was agreed that in the *pré cameline* era two clear periods of rock pictures were to be found throughout the entire area, an early level of hunters and a later one of cattle breeders Further subdivisions appear at present to be local and it also seems as if the hunters differed in different localities, whereas the cattle breeders were probably the same people throughout the Sahara Furthermore there was common accord that one *genre* of pottery is found throughout though it varies slightly locally The biggest uniform group stretches across the entire southern half and is the same as the Early *C* Group culture of Nubia and a similar culture found by the Robert Mond Expedition at Armant Its date of entry into Egypt is fixed at about 2500 B C The papers read at the meeting will be published later in full

Iron Age Site in Wiltshire

THE experiment of the Prehistoric Society in undertaking excavation on an archæological site in Wiltshire, hitherto known only from air survey, with the view of providing at the same time a training ground for young archæologists (see NATURE, July 9, p 65) has fully justified itself so far as concerns the archæological results, which, after a month's excavation, have proved of considerable interest The site selected was the lesser of two enclosures at Woodbury on the hill south of Salisbury A test excavation had shown that it had been thickly inhabited at a period definitely belonging to the Early Iron Age According to a preliminary report (*The Times*, July 20) not only did excavation confirm the existence of the pits inferred from the evidence of the air survey but it also revealed others not so indicated Further study of conditions affecting the two groups will no doubt prove of value in the future development of the technique of air photography In addition to isolated pits and post holes there is a large group of intercommunicating shallow pits appearing on the photographs as what has come to be known as the Great Dark Mark Finds included a blue bead of the Early Iron Age and quantities of Early Iron Age pottery No Romano British remains were found The pits were evidently for storage and the excavators conclude that such pits, with their vertical sides cannot be regarded as hitherto as pit dwellings The burnt material adduced as evidence of hearths, it has been shown at Woodbury by intensive study *in situ* was not formed in the pits, but was thrown into them The discovery of a similar enclosure on a hill above Harnham about a quarter of a mile away leads to the suggestion that the site now occupied by Salisbury was surrounded by a ring of such enclosures There are others at Cockey Down and north east of the aerodrome at Old Sarum The complicated nature of the site will probably necessitate a second season s excavation, although the duration of the present term of digging will depend upon the funds available towards which contributions are needed These may be addressed to the Hon Treasurer Department of British and Medieval Antiquities British Museum, Bloomsbury London W C 1

Destructive Earthquake in Greece

ON July 20 about 2 15 a m Athens was shaken by an earthquake which lasted about 10 seconds and probably had its epicentre in the Island of Eubœa (Negroponte) in the Ægean Sea The depth of focus appears to have been normal (10–15 km) and the area in which the earthquake was destructive was about 5 000 square miles Eight villages near Oropos were seriously damaged, seventeen people were killed, and about eighty injured There appears to have been some fault displacement near Halcoussie No damage appears to have been done in the capital Greece is well known to be a centre of seismic activity in historic times though of recent years the epicentres have been chiefly about 38 5 N lat, 22 5 E long which is north west of Athens Very close to the present epicentre was an earthquake which occurred on April 27, 1894, and which did damage over an area of 3 000 square miles Permanent surface movement in this 1894 shock was for thirty five miles along a well known fault parallel to the Gulf of Eubœa The ground to the north-east side of the fault was moved slightly to the north west and depressed by varying amounts from place to place, but never greater than 5 ft

Earthquakes in India

The Times correspondent from Bombay reports that several earthquake shocks have been felt daily between July 5 and July 9, with epicentres near Paliad, a town 64 miles from Bhavnagar, near the west of the Gulf of Cambay Paliad is being deserted by its population of approximately 5,000 in consequence of these shocks This area cannot be said to have been greatly affected by earthquake shocks in the past, and there is no record of one at all in Miss E F Bellamy's catalogue for the years 1913 1930 There was some destruction of property in this district at the time of the Great Cutch earthquake of June 16, 1819, which was attended by what was probably the greatest vertical surface displacement resulting from any earthquake in India The ground to the north was uplifted by 15 20 ft whilst that to the south was depressed between 10 and 15 ft When further reports come to hand, it will be interesting to see whether this epicentre is a south easterly migration of the great earthquake of more than a century ago or whether it is purely a local surface phenomenon

Science and Mankind

In his presidential address to the Society of Chemical Industry at Ottawa on June 20 on the relation of science to the world of to day, Viscount Leverhulme reminded his audience that science recognizes no political frontiers and accepts as her servants those in all countries who are engaged in the search after truth and who are working to increase mankind's knowledge of natural phenomena Discussing the relation between mankind and science, he suggested that possibly we ask too much of science and apply new methods in fields where they have only a limited application The man of science approaches all problems with the one purpose by observation, measurement and comparison to discover truth The quest is dispassionate, and though a utilitarian purpose or a commercial motive might inspire the research, that does not affect the scientific approach to the problem which characterizes the scientific worker Nearly all the contributions of science to our comfort and welfare can be traced to the quest of knowledge for its own sake

The scientist as such is not concerned with ethical and moral problems, or with the political issues which may surround developments arising from his work When, however, so many scientific discoveries having a practical application can be used destructively as well as constructively, the significance of the remark made by Lord Leverhulme's father that the greatest problem in the twentieth century would be the man behind the machine becomes apparent Lord Leverhulme, indeed, suggested that just as the ethical development of the human race has not reached the point where it can safely be given aeroplanes and high explosives, so the human mind, in the mass, has not reached the point when it can adjust itself to the new revelations of physical and astronomy If mankind is to become worthier of the gifts and opportunities science is giving him, Lord Leverhulme suggested that we must depend on forces and guiding principles at present outside the range of science Even psychology, which is giving us a deeper understanding of man's mind and emotions and behaviour has its limitations and man cannot impartially demand of science the answer to every question and expect of her the solution of every problem We should abandon the conception of science as an invading army that has ravaged and laid bare the spiritual In the daylight of true proportion and perspective science should be welcomed as a friend by those who work for the progress of humanity in other spheres of life

Science and Industry

The Messel Memorial Lecture of the Society of Chemical Industry for 1938 was delivered by Dr L H Baekeland on June 21 Dealing generally with 'Science and Industry', Dr Baekeland sketched more particularly the growth of chemical industry first in Europe and then in the United States The value of chemical industry was only fully realized in the United States with the outbreak of the Great War, and Dr Baekeland described how Mr F P Garvan's appreciation of the dependence of the United States on Germany for dyes, intermediates, photographic chemicals, medicinals, etc led him to organize the Chemical Foundation, of which he remained president until his death Any *bona fide* American chemical manufacturer or company can become a stockholder, but can only subscribe for a limited number of shares Every stockholder has the opportunity of acquiring licences by paying royalties on any patents owned by the Foundation The money thus collected is used for developing chemical education, research, and similar efforts for advancing knowledge in chemistry and for the development of chemical industries Generous support is furnished to many societies for the advancement of science and industry and medical research Garvan also recognized the possibility of much closer relations between chemical industries and agriculture, and instigated the formation of the National Farm Chemurgic Council to co ordinate agriculture, industry and science Few men, Dr Baekeland considers, had more influence in the United States on science and industry than Mr Garvan, and there is now a much wider appreciation of the importance of scientific research in industry

International Astronomical Union

The triennial conference of the International Astronomical Union, representing 27 countries, will be held at Stockholm during the week August 3–10 under the presidency of Prof E Esclangon, director of the National Observatory of Paris After the usual opening meetings, the conference breaks up into a number of committees at which astronomical problems, especially those calling for international co operation, are discussed Draft reports from no fewer than twenty nine such committees have been distributed a month in advance to those attending the meeting Among the topics to be discussed are standard notations in astronomy—a provisional list of suggested symbols has been circulated in advance—air almanacs, the publication of classical works of astronomy which are untranslated or difficult of access, the sources of error in observations with meridian telescopes and the distribution of fundamental stars for observation to different observatories, co-operation in cinematography of solar prominences to cover longer intervals of time than are available for one observatory, wave-length standards in the laboratory and the solar spectrum, the zero point of photographic magnitude and colour index, problems of stellar statistics and the absorption of light in interstellar space. Reports will be received on the present position of the "Carte du Ciel", of the observations of Eros at the opposition of 1931 and of the observations of radio signals at 71 different observatories in the world scheme of 1933. General discussions will take place in the different special committees on the past and future co-operation in the observations of stellar parallaxes, proper motions, variable stars and novæ, radial velocities, solar phenomena and cometary spectra and magnitudes.

It seems indicated from the reports that there may be discussions on such questions as the origin and maintenance of stellar energy, the hydrogen content of the sun and stars, the theory of the Fraunhofer lines, the source of the far ultra-violet solar radiation, problems of spectrophotometry (of interest to a wider circle than that of astronomers alone) and instrumental questions such as the use of the Schmidt camera, the aluminizing of mirrors and of pyrex matrices for gratings: the work of Prof. R. W. Wood on these lines suggests the ultimate replacement of prisms by gratings for stellar work. The reports of the committees give clear evidence that the conference will be helpful, stimulating and useful, and there is every reason to expect a good attendance from Europe and America. South Africa has recently rejoined the Union and will be represented. Among the less arduous features of the Congress may be mentioned visits to the Observatory at Saltsjöbaden and to the Planetarium, also an excursion to Uppsala. His Majesty the King of Sweden will give a reception at the Royal Palace. The general secretary of the Union is Prof. J. H. Oort, of the Leyden Observatory.

British Museum (Natural History): Acquisitions

The two most important additions to the Mammal Section of the Zoological Department during the present month are—the bequest by the late Mr. Norman B. Smith of his collection of Rhodesian, East African, and Sudanese game trophies, and a collection of mammals from South-west Africa presented by Major P. H. G. Powell-Cotton and Mr. Christopher Powell-Cotton. An important addition to the Osteological Section is the skeleton of a Hunter's hartebeest (*Damaliscus hunteri*) from the Tana Valley. The increasing scarcity of this species makes this specimen of special value; it is the gift of Messrs. Rowland Ward. The Museum has acquired from Lieut.-Colonel F. M. Bailey, who has just vacated the post of British envoy to the Court of Nepal, a large collection of birds made in that country. There is still much to be learnt concerning the distribution of Himalayan birds. Many species found in the Eastern parts do not occur in the Western, and the question as to how far east or west in Nepal they extend will, to a great extent, be solved when Colonel Bailey's collection has been properly examined. A further valuable selection of Swiss minerals, numbering 618 specimens from 59 carefully recorded localities, has been presented to the Department of Mineralogy by Mr. F. N. Ashcroft. The Department has purchased a large portion of the oldest meteoric stone, the fall of which is recorded. It fell in 1492 at Ensisheim, Alsace, France. For a long time the meteorite, which originally weighed 236 lb., was suspended by a chain from the vault of the choir of the parish church of Ensisheim, Alsace.

Geological Museum: Recent Acquisitions

Among the recent acquisitions of the Geological Museum is a large geological relief model of the London basin, measuring about 10 ft. by 5 ft. This is constructed on a scale of 1 in. to a mile, vertical heights being exaggerated about six times, and it includes an area extending from Foulness in the east to the Vale of White Horse in the west, and from Baldock in the north to Leith Hill in the south. The model illustrates clearly the main synclinal structure of the London basin, from the chalk rocks of which London draws so much of its water supply. Details of this structure of the solid rocks are accentuated by the colouring of drift and other surface deposits by various shades of stipple superimposed on the solid geology. A second relief model just placed on exhibition illustrates the glacial lakes of Cleveland, on a scale of 1 in. to a mile. This reconstruction, which is based on the work of the late Prof. P. F. Kendall, shows the glaciers, ice-dammed lakes, and drainage system of the Cleveland area at the time of the maximum extension of the Pleistocene ice-sheets. Among the dioramas recently added to the displays is one of an Anglo-Iranian oil-field, presented by the Anglo-Iranian Oil Co. This is the second experiment in a type of diorama in which the foreground is cut away to a depth of several thousand feet to show the geology. Two diamonds of unusual crystal form from Atian Kama, Akim, Gold Coast, have been given by Mr. G. P. Ashmore. Some five hundred varieties of marble used in decorative work in western Europe are now being exhibited.

The Science Museum

The report of the Science Museum for 1937 again directs attention to the urgent need for the rebuilding of the centre block and for the extension of the Library. Four years ago, the Advisory Council estimated that the book-stores would be filled by the end of 1938 and gave a warning that further storage room was essential. The Library is the most valuable of its kind in the country and great use is made of it by those engaged in research, and if it is to perform its functions properly it is necessary that books and periodicals should be arranged so that they can be issued to readers with the least possible delay.

It is to be hoped therefore that immediate steps will be taken to adopt the suggestions of the Advisory Council The report refers with satisfaction to the general work of the Museum and the special exhibitions which have become a feature of its activities With the advance of discovery invention and industry it is unavoidable that the collections should *increase rather rapidly* and there *is every justification* for the demolition of the old centre galleries and their re erection in keeping with the eastern block

Research on Potatoes

DURING the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 21 the chairman of the Council Dr R N Salaman reviewed the Institute s work on potatoes during the past twenty years The tests for immunity from, or susceptibility to wart disease has materially assisted the breeders efforts towards raising only immune varieties the critical examination of the many thousands of seedlings entered for these tests has led to a rapid elimination of useless varieties and the work of the Potato Synonym Committee has resulted in the almost complete elimination of synonyms The large scale demonstrations at the Potato Testing Station Ormskirk have proved that it is possible for farmers in Great Britain to grow and maintain virus free stocks for seed purposes He estimated that the loss in yield in Great Britain alone from the use of virus infected stocks *for seed purposes is in the nature of a million tons a* year With regard to potato breeding Dr Salaman thinks it very unlikely that any outstanding varieties will be produced until new methods are introduced breeding stocks require the injection of fresh blood by the use of wild tuber bearing species of *Solanum* In conclusion, Dr Salaman stressed the importance of reorganizing and regularizing potato seed production, that being the basic element in potato culture and of the utmost importance in time of war Our immediate need is a scientific organization of the industry from the production of seed at one end of the scale to the dish of potatoes on the table at the other Virus disease and blight cost the nation about five million pounds a year loss caused by the former could largely be avoided by the proper organization of the seed trade and further research might well eliminate the latter

Scientific Aspects of Refrigeration

ON July 12 a conference on Refrigeration organized by the British Association of Refrigeration was held in the rooms of the Royal Society On the previous day, meetings of the Technical Board and *Commissions of the International Institute of Re*frigeration were held at which eighteen countries were represented The first paper to the Conference was presented by Dr A K Balls of the Food Research Division, U S Bureau of Chemistry and Soils It dealt with enzyme action in food products and at low temperatures In the subsequent discussion Dr L J Harris of the Nutritional Laboratory, Cambridge, Dr Katherine Coward of the Pharmaceutical Research Laboratory and Miss M Olliver took part Prof Prescott of Boston presented a paper prepared by Messrs R R Jenkins and D K Tressler of the N Y State Agricultural Experimental Station, Geneva N Y and G A Fitzgerald of the Birdseye Laboratories U S A on vitamin C in vegetables storage temperatures for frosted vegetables Dr Kidd *of the Low Temperature Station* Cambridge, read in abstract a paper by himself and Dr Moran on atmospheric control in the preservation of food stuffs

In the afternoon the session was opened by a paper by Mr Edgar A Griffiths South Africa on the design and operation of large gas stoves Following a brief discussion on air conditioning there were three contributions from Germany Dr Plank of Karlsruhe dealt with the ideal comparison cycle of refrigeration for international use Dr F Altenkirch of Berlin read a report on an international unit of refrigeration and Dr E Schmidt of Braunschweig discussed the question of preparing standard tables for the properties of refrigerants The Conference was presided over by Dr Ezer Griffiths and Mr A R T Woods past president of the British Association of Refrigeration The papers in abstract and the discussions are being published in *Ice and Cold Storage* and other journals

Leverhulme Research Fellowships

THE following Leverhulme research scholarships among others have recently been awarded for research indicated Dr W Cule Davies (University College Cardiff) organic compounds of nitrogen phosphorus and arsenic Dr S Goldstein (University of Cambridge) turbulent motion of fluids Dr F C Happold (University of Leeds), nutrition of the three types of *C diphtheriae* in its relation to toxin production Dr M W Jepps (University of Glasgow) structure and life cycles of certain marine Protozoa Dr W H S Jones (St Catherine s College Cambridge) Greek medicine and Greek thought from 500 to 300 B C , A King (Imperial College of Science and Technology London), leader of expedition to carry out a biological, geological and physical examination of Jan Mayen Island in the Greenland Sea D A O Duffy (Bahrein Petroleum Company) lubrication problems at high pressures and temperatures , Dr O A Oeser (St Andrew s University) the combined method in the social sciences Dr G B B M Sutherland (Pembroke College, Cambridge), application of infra red spectra to structural problems in chemistry and physics , Dr W Taylor (The Polytechnic London), substitution mechanisms in aliphatic compounds , Dr B Thomas (London School of Economics and Political Science) post War migration of population within the British Empire and as between the Empire and the rest of the world Dr W H Thorpe (Jesus College Cambridge) physiology of African tropical Homoptera , R Wilson (University College Swansea), nature and position of the singularities of a function in relation to the coefficient theory of its Taylor series

The Night Sky in August

THE moon is full on August 11^d at 6^h and new on August 25^d at 11^h No star brighter than magnitude 5 3 is occulted this month Lunar conjunctions with the planets occur as follows August 12^d 7^h with Jupiter, August 16^d 5^h with Saturn, August 28^d 23^h with Venus (In New Zealand and other parts of the southern hemisphere the planet is actually occulted by the moon) Venus the disk of which is slightly gibbous, is an evening star increasing slowly in brightness to its maximum (mag -4 3) in mid October On August 31, the planet is near the first magnitude star, Spica Jupiter visible throughout the night, is in opposition on August 21 when its distance from the earth is rather less than 373 million miles Saturn, the ring system of which is fairly well open, rises about 21^h in mid August The distant planet, Uranus, now in Aries, is occulted by the moon on August 18, the occultation, however, is not visible from the British Isles, but is possible to observers in Canada On August 15, α Lyræ is on the southern meridian at 21^h 0 5^m This star together with α Cygni and α Aquilæ, make a conspicuous triangle, with the Milky Way for a background Between β and γ Lyræ, the Ring Nebula may be located with slight optical aid The variable star Algol in Perseus is coming into convenient position for observation Its variability may be observed about two hours before and after the following epochs August 18^d 2^h, 20^d 23^h, 23^d 20^h The Perseid meteors characterized by their yellowish colour, rapid flight and trains in their wake, reach a maximum about August 10 The above times are given in U T, add 1^h to convert to Summer Time

Announcements

PROF C R Harington, professor of pathological chemistry, and Prof W W C Topley, professor of bacteriology and immunology in the University of London, have been appointed members of the Medical Research Council, in succession to Prof A J Clark and Sir John Ledingham, who retire in rotation on September 30

THE following elections to the Paris Academy of Sciences have recently been made Prof T H Morgan, For Mem R S, director of the Wm G Kerckhoff Laboratories of the California Institute of Technology, Pasadena, foreign associate, in succession to the late Lord Rutherford, Prof T Levi Civita, For Mem R S, emeritus professor of mechanics in the University of Padua, foreign associate, in succession to the late Dr G E Hale, Prof E G Barrillon, professor of the theory of navigation in the Ecole d'Application du Génie Maritime, Paris, member of the Section of Geography and Navigation, in succession to the late Dr Ch Lallemand

MR J J MACGREGOR has been appointed advisory economist for the West Midland Province at the Harper Adams Agricultural College Mr MacGregor graduated in agricultural science at the University of Glasgow in 1928 and has since been continuously engaged in the study of the applications of economics to the problems of agriculture He has held appointments in agricultural economics at Seale Hayne Agricultural College and the University of Cambridge, and for the past three years has been on the staff of the Oxford branch of the Dartington Hall Economics Research Department

LIEUT COLONEL W L HARNETT, formerly professor of surgery in the Medical College, Calcutta, and recently reader in surgery at the British Postgraduate Medical School, has been appointed medical secretary to the Clinical Cancer Research Committee of the British Empire Cancer Campaign The scheme of clinical cancer research, which has already commenced, will embrace approximately seventeen thousand fresh cases of cancer annually occurring in the teaching hospitals and the specialized hospitals of the London area and the hospitals of the London County Council and the Middlesex County Council

THE Royal Astronomical Society recently decided to publish a small circular entitled *Occasional Notes*, containing short articles written in non technical style It is hoped that three or four a year will be issued, and they should prove useful to those Fellows who find the *Monthly Notices* too specialized to read with profit The first number, June, 1938, contains an account of the minor planet Hermes, discovered on October 28, 1937, and also a description of the quartz clock developed at the National Physical Laboratory, Teddington A similar clock for the Royal Observatory, Greenwich, is in process of construction

THE third International Congress for Microbiology will be held in New York City on September 2–9, 1939 It is requested that those who contemplate attending the Congress should send their names to Dr R St John Brooks, secretary of the British National Committee (Lister Institute, Chelsea Bridge Road, London, S W 1)

THE fifteenth Annual Conference of the Association of Special Libraries and Information Bureaux will be held at Lady Margaret Hall, Oxford, on September 23–26 Joint Sessions with the International Federation for Documentation will be held on September 24 and 25 Further information can be obtained from the General Secretary, Association of Special Libraries and Information Bureaux, 31 Museum Street, London, W C 1

THE Joint Committee on Materials and their Testing is organizing a meeting which will be held at the Institution of Electrical Engineers on November 25 next under the auspices of the Institution to discuss non destructive testing The subject has been divided into three sections, namely magnetic and electrical methods, X and gamma rays, acoustical and general methods Each section will be dealt with by authorities from Great Britain, the Continent and the United States The meeting will be held under the presidency of Dr A P M Fleming

ERRATUM In the inscription of Fig 1*b* in Prof Ruggles Gates' letter on "Chromosome Structure" in NATURE of July 23, page 157, the words "split satellite" written by him were, we regret, printed as "split chromosome"

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 214

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Heat Transport in Liquid Helium below 1°

EXPERIMENTS by Pickard[1], which will shortly be published, have shown that the specific heat of liquid helium becomes roughly proportional to T^3 at about 0·9°–0·8°, that is, that the anomalous part of it has died out This fact suggests that the other properties depending on the transition of atoms or groups of atoms into a state of higher energy which is responsible for the λ phenomenon—will also disappear in this region The most conspicuous property of this type is the anomalous heat conduction which has lately been investigated by various authors[2] The presumption that this anomalous conduction would vanish at very low temperatures was supported by a casual observation we found that if a capsule[3] of the type used in magnetic cooling experiments contains insufficient helium to cover the salt completely, temperature differences within the capsule equalize only very slowly. One might have expected, remembering the well-known characteristics of liquid helium II found by Rollin[4], that a film of helium would cover the salt and bring about rapid equalization of temperature

We have carried out some experiments on the heat conduction of the liquid in the following manner two containers—each holding about 1 gm of powdered iron alum—are connected by a capillary and this 'twin capsule' is filled with liquid to a level above the salt in the upper part The temperature of each part could be measured separately As the heat capacities of the salt and helium are known, we could determine the amount of heat flowing from one part to the other, if a temperature difference between them was established either by a differential heat influx from outside or deliberately by radioactive heating. We used a capillary of 18 mm length and 0·5 mm. diameter and worked with temperature differences not exceeding 0·1°. The experiments were restricted to the region between 0 2° and 0 5°, as experimental difficulties prevented us obtaining good results at higher temperatures For reasons which we shall discuss in a detailed publication, the absolute value of the temperature may be wrong by about 10 per cent. If the results are expressed in terms of a heat conductivity (κ), one obtains the following values

$T°$	κ
0 5	2 2 × 10^{-3} cal deg $^{-1}$ cm $^{-1}$ sec $^{-1}$
0 4	1 4 ,, ,, ,, ,, ,,
0·3	0·7 ,, ,, ,, ,, ,,
0 2	0·2 ,, ,, ,, ,, ,,

These values are of the order of magnitude of normal conductivities To give an idea of the times necessary for obtaining a decrease of a temperature difference to its e^{th} part in our experimental conditions, we mention that they amount to about 1, 2, 7, 50 minutes at 0·5°, 0·4°, 0·3° and 0·2° respectively. (This is in agreement with a preliminary experiment carried out with Rollin[4b] using a wider capillary and less salt; see also the remark of Shire and Allen[5].)

Our value at 0 5° is smaller by a factor 10^4 than the smallest value measured by Keesom[6], and it appears impossible to obtain Keesom's figure by extrapolating our curve This, as well as the fact that our values are nearly proportional to Pickard's 'normal' specific heats seems to justify the assumption that we are concerned here solely with 'lattice' conduction Heat conductivity can be represented quite generally[7] as the product of a specific heat, a velocity and a mean free path Assuming that in our case heat is transported by elastic waves, we can calculate from the specific heat and the velocity of sound[8] that the mean free path of these waves is of the order of 10^{-3} cm Owing to the approximate proportionality of κ and C_v, it is nearly constant in the temperature region in question, a fact suggesting that the mean free path is determined by the disturbances due to the zero point energy We shall investigate this point more quantitatively after having improved the apparatus We shall examine also at which dimensions κ begins to be dependent on the diameter of the capillary, as this would provide an independent means of determining the mean free path[9]

These results obviously imply that a rapid transport of heat by means of films will also cease at the temperatures in question (*Added in proof* experimental confirmation of this has now been obtained.) It may be mentioned that the investigation of the film phenomenon at very low temperatures has the advantage that—owing to the minute pressures of the gas—transport of heat by evaporation and recondensation is excluded. It should be noted also that our results indicate that it should be possible to employ liquid helium below 0 1°—using, of course, appropriate dimensions—in order to establish, or cancel at will, thermal contact, which is impossible in the region of anomalous conductivity This is important when working with a magnetic two-stage apparatus, as is necessary, for example, in trying to utilize nuclear paramagnetism in order to obtain still lower temperatures than can be achieved in the ordinary way

N. KÜRTI
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June 29

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[1] Pickard, G L, Dissertation, Oxford (1937).

[2] See, for example, Keesom (ref 6), Rollin (ref 4), Allen, Peierls, Uddin, NATURE, 140, 62 (1937), Cookcroft, *Nuovo Cimento*, 15, 35 (1938)

[3] Kürti, N, Rollin, B V, Simon, F, *Physica*, 3, 266 (1936)

[4] Rollin, B V, (*a*) Dissertation, Oxford (1935), (*b*) *Proc VII. Int Cong Refrig*, The Hague, 1, 187 (1936), (*c*) Ref 9 See also Daunt, J. G, and Mendelssohn, K, NATURE, 141, 911 (1938) and Kikoin, A K, and Lasareff B G, NATURE, 141, 912 (1938)

[5] Shire, E. S, and Allen, J. F, *Proc Camb Phil Soc*, 34, 307 (1938).

[6] Keesom, W H, Keesom, A P, and Saris, B F, *Physica*, 5, 281 (1938)

[7] Debye, P, "Vorträge über die kinetische Theorie der Materie und Elektrizität" (Teubner, 1914), 50.

[8] Burton, E F, NATURE, 141, 970 (1938).

[9] Casimir, H B. G, *Physica*, 5, 495 (1938).

Specific Ionization of Gases by Soft Cosmic Rays Residual Currents and Deep Water Measurements

IT was shown by J Juilfs and V Masuch[1] that the ionization by cosmic rays filtered at sea level through 10 cm lead is proportional to the gas density in the measuring chamber The same property was found by us to exist in the case of the soft cosmic rays in the upper layers of the troposphere The measurements were made during a balloon ascent on May 14 between 6 km and 10 km Two similar spherical ionization chambers were used one filled with nitrogen the other with krypton containing about 5 per cent of xenon The gases were kept under 16 5 atm pressure Lindemann electrometers controlled by a Weston normal cell were employed The results are shown in Fig 1 By multiplying the ordinates of the lower nitrogen curve by the relative density of the gases 3 06 one obtains points corresponding to the krypton curve With radium C gamma rays I_{Kr}/I_{N_2} was found to be 5 3 which value differs widely from that for cosmic rays

We would emphasize once more that neither in this flight nor in the flights of March 29 1936[2] and June 18 1936 did we find discontinuities such as those found by G A Suckstorff[3] and more recently by J Juilfs[4] This is why it seems to us difficult to admit the existence in the atmosphere of radioactive substances of extra terrestrial origin Not only are our curves continuous the curve of computed mass absorption coefficients is quite smooth (Fig 2) without any maxima contrary to the results of W Kolhörster[5] Our curves are much steeper than those of Kolhorster

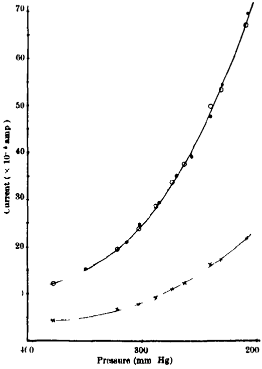

Fig 1

x NITROGEN o NITROGEN DATA × 3·06 ● KRYPTON

The residual currents of the ionization chambers were checked by us in a rock salt mine 406 m deep at Wapno (Province of Poznań) This rock salt mine is absolutely dry almost free from potassium salts and has a constant temperature of about 26° C One of the ionization chambers was filled with argon at a pressure of 30 atm It showed a residual current of about 1/320 of the value measured at earth surface Thus we had at a depth equivalent to 900 m of water a current of the same order of magnitude as that found by J Clay[6] at the deepest point (270 m) he reached in the Gulf of Aden Our residual currents showed remarkably large irregular fluctuations thus we think the anomalies found at great depths by J Clay as also those of A C Corlin[7] are not due to cosmic rays but to fluctuations of the residual currents The accidental character of these abnormalities is best seen from inspection of the ionization curves the rapid decrease of Clay s curve at 270 m being absent on the curve of Corlin

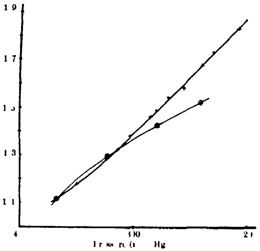

Fig 2

KOLHÖRSTER S DATA X PRESENT AUTHORS DATA

More detailed data concerning this work will be found in the paper which will appear shortly in the *Acta Physica Polonica* All expenses connected with the observations were covered by the Committee of the First Polish Stratosphere Balloon Flight Some apparatus was acquired thanks to a grant obtained by one of us (S Z) from the Ministry of Education and the Mianowski Foundation

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[1] Juilfs J and Masuch V *Z Phys* **104** 458 (193)

[2] Ziemecki S and Narkiewicz Jodko K NATURE **137** 944 (1936)

[3] Suckstorff G A *Phys Z* **35** 368 (1934)

[4] Juilfs J *Phys Z* **38** 691 (1937)

[5] Kolhörster W and Tuwim L Ergebnisse d Kosm Physik 1 151 (Leipzig 1931)

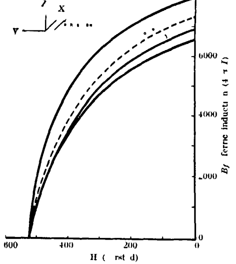
[6] Clay J *Physica* 1 373 (1934)

[7] Corlin A NATURE **133** 63 (1934)

Cooling of Permanent Magnet Alloys in a Constant Magnetic Field

THE investigations of Bozorth and Dillinger[1] show that very striking increases in maximum permeability may be obtained by applying a magnetic field to high permeability nickel iron alloys during cooling So far as we are aware corresponding investigations have not been made on materials of high coercivity

We have recently carried out experiments with positive results on permanent magnet alloys of the nickel aluminium iron Mishima type by cooling in a unidirectional magnetic field from 1,200° C , and then measuring the demagnetization curves at room temperature In general, we find the coercivity is not greatly affected, but that the remanence and the value of BH_{max} are increased In the two directions at right angles, the results are practically identical with lowered values of remanence and BH_{max} Typical results for Alnico (nickel 18 aluminium 10 iron 54, cobalt 12, copper 6 per cent) are given in the accompanying graph, which refers to some experimental cubes of 4 0 cm side Care was taken to ensure that so far as possible similar thermal conditions were observed in making the control experiment



In the direction of the field the true BH_{max} value increased from 1 5 × 10^6 to 1 8 × 10^6, or 20 per cent At right angles to the field direction it dropped to 1 35 × 10^6, or 10 per cent The field strength H was 4,400 oersted If I_r represents the remanent intensity of magnetization, and I_0 the saturation intensity, at room temperature then we have found the ratio I_r/I_0 to be 0 72 in the direction of the constant applied magnetic field, 0 61 transverse to the direction of the field and 0 67 for the control with no applied field during cooling

An interpretation of these effects can be offered on lines similar to that put forward by Bozorth and Dillinger in connexion with their results On cooling a ferromagnetic below the Curie point and through the temperature range in which plastic flow occurs the magnetostrictive strains are to some extent relieved, and the actual direction of magnetization of each domain becomes an energetically favoured direction of magnetization These directions would normally be at random through the material as a whole, but if a field is applied during cooling, they will be so distributed as to favour subsequent bulk magnetization parallel or antiparallel to the direction of the original applied field In the limit, the normal six or eight equivalent easy directions for each domain (for cubic structures) would be replaced by two, and (for a particular direction) the remanent magnetization would then be equal to the saturation magnetization

This state may be nearly approached with high permeability material With permanent magnet alloys for reasons which are qualitatively clear, the effect is relatively small but it is large enough to be of possible technological value and the determination of its magnitude may contribute to a more quantitative theoretical treatment of the properties of these alloys in relation to their structure[2]

We wish to thank Prof W L Bragg for his encouragement and for suggesting following up this line of investigation and Dr E C Stoner for helpful comments

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June 28

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[1] Bozorth R M and Dillinger J F *Physics* 6 279 and 285 (1935)

[2] Bradley A J and Taylor A Magnetism p 89 (Institute of Physics 1938)

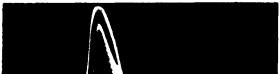
Electrical Impedance of Nerve During Activity

ALTERNATING current impedance measurements made over a wide frequency range show that the membranes of many living cells including those of several nerve fibres[1] have electrical capacities of about one microfarad per square centimetre The leakage conductance of the membranes of resting cells is small and there is considerable variation in the phase angle which is assumed to be a measure of the dielectric loss These same characteristics have been found from transverse impedance measurements made with the current flow perpendicular to the cell axis on the long single cell of the plant *Nitella*[2] and the giant nerve fibre of the stellar nerve of the squid *Loligo pealii*[3]

Because of their large diameters, it has been possible to observe and measure, in both these cells, the change in transverse impedance during the passage of the wave of excitation, which is the nerve impulse in nerve and its analogue in *Nitella* In *Nitella*[4], the membrane resistance falls from 10^4 ohm cm^2 or more to a minimum of about 500 ohm cm^2 while the membrane capacity decreases fifteen per cent with its phase angle unchanged In the squid nerve[5], the membrane resistance falls to about 100 ohm cm^2 and the capacity change is about a one per cent decrease without alteration of the phase angle

The time course of the impedance change is very similar in the two cells, although the *Nitella* is a thousand times slower For the squid fibre measurements, the amplified output of a Wheatstone bridge was applied to a cathode ray oscillograph which gave a narrow horizontal trace when the bridge was balanced and a sweep circuit moved the spot across the screen In the accompanying illustration, the nerve fibre was stimulated at one end and the band width is the record of a two per cent maximum unbalance of the bridge for a frequency of 20 kilocycles per second as the impulse came past the impedance electrodes For reference the action potential between an impedance electrode and an injured end was recorded on the same film immediately afterwards

It can be shown that the bridge unbalance is nearly proportional to the change in membrane conductance and the onset of the conductance increase here, as in *Nitella* occurs somewhat after the start of the action potential but coincides quite closely with the point of inflection on the rising phase At this point, the membrane current density reverses in direction, corresponding to a decrease of the membrane electromotive force, so that this E M F and the conductance are closely associated properties of the membrane, and their sudden changes are themselves, or are due to, the activity which is responsible for the propagation of the nerve impulse



IMPEDANCE CHANGE AND ACTION POTENTIAL OF THE SQUID GIANT NERVE FIBRE DURING THE PASSAGE OF A NERVE IMPULSE INTERVAL BETWEEN TIME MARKS AT THE BOTTOM IS ONE MILLISECOND

The capacity is probably a property of the ion impermeable aspect of the membrane, while the conductance is due to the ion permeability Since the maximum observed conductances are still far from a complete permeability and because the capacity changes are relatively slight, we have indications that the excitation does not involve a disintegration or destruction of the membrane

It is reasonable to suppose that similar changes occur in the membranes of smaller nerve fibres during excitation and the propagation of the nerve impulse

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[1] Cole, K S and Curtis, H J *Cold Spring Harbor Symposia on Quantitative Biology*, 4 73 (1936)

[2] Curtis H J, and Cole K S *J Gen Physiol* 21 189 (1937)

[3] Curtis H J, and Cole, K S *J Gen Physiol* July 20 1938

[4] Cole K S and Curtis, H J *J Gen Physiol* to appear September 20 1938

[5] To be submitted to *J Gen Physiol*

Reduction of Ions of Nickel, Cobalt, Iron and other Metals by Zinc Amalgam

THE statement that a metal will always displace any other metal below it in the potential series from solutions of its salts is well known not to be true in practice As an example the standard way of reducing ferric to ferrous ions in acid solution by zinc ought to fail because, according to the statement reduction should not stop at the ferrous stage, as it does but continue to the metal, zinc standing much higher in the potential series than iron In general it has been found that provided the displacing metal is not passive ions of metals of the *B* subgroup of the periodic classification conform to the simple statement and those of the metals iron, cobalt chromium molybdenum and other special steel metals do not Thus zinc instantly reduces to metal the ions of cadmium thallium and tin, but not those of chromium iron nickel, and cobalt, although chromium and iron are close to cadmium in the potential series, and nickel and cobalt lie below both thallium and cadmium The accepted explanation of this anomaly which preserves a belief in the potential series of metals is that with these ions the expected reaction is retarded or inhibited by causes involving the phenomena of passivity over voltage or polarization Experiments we have done seem to show however that the main cause of the anomaly lies in the existence of a protective ring of groupings around what is ordinarily regarded as the simple ion of a special steel metal

There is no doubt of the slowness of the reduction to metal of some ions In dilute sulphuric acid solution ferrous sulphate is at least a thousand times more slowly reduced by zinc amalgam than are cadmium or copper sulphate solutions under similar conditions Nickel and cobalt sulphate are from one hundred to five hundred times more slowly reduced than cadmium or copper sulphate This slowness does not seem to be primarily due to a metal surface or to the fact that the zinc is present as an amalgam or to reaction between a partially deposited metal and the electrolyte Similar differences in the rates of reduction are found when there is no metal present at all, when, for example, a solution of ter valent uranium sulphate or chloride is used This is the most powerful common reducing agent available as a solution, and reduces cadmium ions in dilute sulphuric acid instantly to metal Yet its effect on nickel and cobalt ions in dilute sulphuric acid is extremely slow, and on ferrous, divalent chromium, or ter valent titanium ions it is apparently nil

These observations suggest that the main cause of the slowness lies not in the reducing agent but in the state of the ions to be reduced This was confirmed by a number of experiments on cobalt, nickel, iron, titanium and other metal ions It was found that when nickel, cobalt or iron were in the form of complex anions, reduction to metal by zinc amalgam sometimes took place rapidly Thus from solutions containing ammonium sulphate and ammonium hydroxide in excess, nickel and cobalt are as rapidly reduced to metal by zinc amalgam as in like conditions is copper Again, from the blue solution of cobalt chloride in concentrated hydrochloric acid, where the anion is believed[1] to be $CoCl_4^-$, cobalt is reduced to metal from the moment the zinc amalgam is brought in contact with the solution (This is proved by the marked catalytic effect of metallic cobalt on the production of hydrogen from zinc and acid.) But the apparently simple cobalt ion of the pink, aqueous or dilute acid solution is not reduced when the complex anion is. As the former is believed[2] to be $Co(H_2O)_6^{++}$, it would appear that the groupings round the simple cation are the chief hindrance to the electrons which would convert the simple ion to metal atom. They guard the position which in the atom is occupied by the valency electrons. With complex anions on the other hand there is usually in equilibrium a small concentration of simple cation and this could be reduced to metal atom before it became ringed round with protective groupings.

That groupings surround the simple ions of metals like iron, cobalt, nickel, chromium, vanadium, titanium, etc., is on general grounds very probable. There is no difficulty in the reduction of any of the ions of higher state of oxidation of these metals. Quinque-, quadri- and ter-valent vanadium, for example, or ferric ion are, as is well known, easily reduced. But in these cases there are obvious vacant places inside the protected ion for the reducing electrons. It is at the final stage of reduction when the outer valency electrons have to be added that the protective effect of the groupings makes itself manifest.

From ammoniacal solutions only nickel and cobalt were found to be reduced by zinc amalgam. From strongly acid solutions, nickel, cobalt and iron may all be obtained. The other metallic ions tried—those of titanium, vanadium, chromium, molybdenum and tungsten—were found not to yield more of the metal than was sufficient to show catalytic action on the evolution of hydrogen from zinc and acid, in confirmation of earlier work[3]. In general, the nickel and cobalt combine rapidly with the zinc to form compounds containing no mercury of approximate formulæ ZnNi and ZnCo. The combination of iron with zinc occurs much more slowly. The product has the approximate formula $ZnFe_7$.

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[1] Donnan and Bassett, *J. Chem. Soc.*, **81**, 939 (1902).
[2] Howell, *J. Chem. Soc.*, 2039 (1927).
[3] Groves and Russell, *J. Chem. Soc.*, 2208 (1931).

Do Anthocyanins occur in Bacteria?

IT has frequently been stated that colouring matters of anthocyanin type are produced by bacteria, and as there does not yet appear to be any justification for this view, it may be desirable to correct an error which is finding its way into the text books[1]. In most of the alleged instances of the occurrence of anthocyanins in micro-organisms, the description of the colouring matters and that of their reactions does not afford a *prima facie* case for their identification as members of the anthocyanin group and there exists no example of the isolation and characterization from such sources of a substance which is undoubtedly an anthocyanin. Two publications, however, require more serious examination.

A. E. Kriss[2] has described a pigment of *Actinomyces Waksmanii* which is red in acid, blue in alkaline solution, and in these and other respects exhibits a superficial resemblance to an anthocyanin. We have made a culture of this or a closely related organism (probably *A. violaceus ruber* Waksman), and from this have isolated in a crude form a pigment tallying in all respects with the description of Kriss. The substance is not a glucoside and undoubtedly shows considerable superficial resemblance to an anthocyanidin (for example, malvidin chloride). It is, however, definitely not an anthocyanidin, and the conclusive proof of this is that its solution in aqueous sodium hydroxide is perfectly stable and maintains a pure royal blue colour after boiling for a considerable time. No substance containing a flavylium nucleus will withstand such treatment; the heterocyclic nucleus is invariably quickly ruptured by the action of strong alkalis with the formation of orange or yellow polyhydroxychalkone derivatives.

It should be noted that the chemistry of the flavylium salts, in so far as it relates to their behaviour in acid and cold alkaline solutions, is naturally very similar to that of other classes of basic dyes such as the oxazines, thiazines and azines, which contain a suitably constituted heterocyclic nucleus associated with hydroxylated benzene rings. Thus a polyhydroxyphenazine might simulate an anthocyanidin in respect of its indicator reactions, and there is little reason to doubt that this interesting pigment of Actinomyces is derived from one of these more stable types.

It has also been claimed[3] that when *Bacillus citrulli* Sartoryi is cultured in a synthetic medium containing glucose and asparagine as sole sources of carbon and nitrogen, a triglucoside of pelargonidin is formed. The pigment was isolated and analysed and the aglucone, supposed to be pelargonidin chloride, was also analysed, the results tallying closely in both cases with those demanded by theory. Nevertheless, there are certain features of the description that suggest that this identification is erroneous and no direct comparisons were instituted; the absence of nitrogen was assumed after the failure of a qualitative test.

The object of this note is to emphasize that there is, as yet, no clearly proved case of the occurrence of anthocyanins in micro-organisms.

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[1] Cf., for example, Buchanan and Fulmer, "The Physiology and Biochemistry of Bacteria" (London, 1928), and Anderson, "An Introduction to Bacteriological Chemistry" (Edinburgh, 1938).
[2] *C. R. Acad. Sci. U.S.S.R.*, **4**, 283 (1936); *Brit. Chem. Abstr.*, A, 99 (1937).
[3] S venet, J., Thesis, Strasbourg (1930).

Œstrogenic Activity of Esters of Diethyl Stilbœstrol

IT is a well established fact that the esterification of naturally occurring œstrogenic substances such as œstrone and œstradiol causes a marked alteration in their biological activity, particularly with regard to the duration of their action. It was therefore decided to investigate the biological activity of various double esters of the synthetic œstrogenic agent diethyl stilbœstrol previously described by us[1].

The quantity of material administered was dissolved in 3 c.c. of sesame oil and given night and morning on three successive days to ovariectomized, inbred Wistar rats. Smears were taken after the third day and at intervals as long as œstrus persisted. From the accompanying table, it can be seen that esterification reduces the activity but that the effect is prolonged It would appear that the maximum prolongation without undue reduction in activity resides in the dipropionate The very great prolongation of œstrus occurring when large doses of the dimethyl ether of the compound are administered is noteworthy. The œstrus appears to be almost indefinitely prolonged

It will be observed that there is a very considerable difference between the action of double esters of œstradiol and those of diethyl stilbœstrol In the former series, maximum prolongation of œstrus occurred with the esters of the higher fatty acids[2]

Name of substance	Melting point	Quantity injected (gamma)	No of days in œstrus
Di ethyl stilbœstrol	171°	1	4
		5	4
		10	5
Di ethyl stilbœstrol di acetate	124°	1	0
		10	21
,, ,, di propionate	104°	10	50*
,, ,, di *n* butyrate	88°	10	10
,, ,, di *iso* butyrate	86–87°	10	4
,, ,, di *n* valerate	89°	10	2
,, ,, di phenyl acetate	100°	10	4
		50	30
,, ,, di benzoate	210 211°	10	0
		100	30*
,, ,, di palmitate	77 78°	50	2
		100	30*
,, ,, di-methyl ether	124°	50	2
		1000	126*
		6000	180*

* Rats still in œstrus

The esters were prepared by the action of the appropriate anhydride on diethyl stilbœstrol, usually at 100°, or by the Schotten-Baumann reaction (dibenzoate, diphenylacetate)

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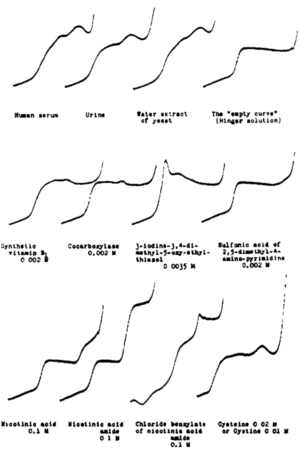
[1] Dodds, Golberg, Lawson and Robinson, Nature, 141 247 (1938)

[2] Miescher, Scholz and Tschopp, *Biochem J*, 32, 725 (1938)

Prague Sero Reactions for Cancer

During investigations of the Prague sero reactions for cancer we have tried to identify the substances in the serum, which give the typical polarographic curve when using the technique of Brdička described in our previous letter as preparation (*b*)[1] According to Brdička[2], this curve form is characteristic for compounds of cystine, the concentration of cystine must, however, be 100–1,000 times greater than that generally found in serum (1 mgm per cent[3]), if it is to be responsible for the heights of the curve, found by Brdička and ourselves in serum Furthermore, we have found similar curves by submitting urine to the polarograph instead of serum, and we find that the concentration of cystine in normal urine is exceedingly small

The sulphur-containing glutathione and methionine are scarcely of importance, as serum gives a stronger reaction than full blood The thiazol aneurine (vitamin B_1) might be of importance, it is present in serum and urine; and a water extract of yeast was found to give curves quite similar to those from serum and urine (see accompanying graph) We therefore examined the pure components of the vitamin *B*-complex: synthetic aneurin, cocarboxylase, the thiazole part of aneurin as methylated iodide (=quaternary nitrogen), the naked thiazole part (=ternary nitrogen), the pyrimidine part of aneurine as sulpho-salt, nicotinic acid, nicotinic acid amide (=ternary nitrogen), nicotinic acid amide as benzylated chloride (quaternary nitrogen), cystine, cysteine, riboflavin (=vitamin B_2), cozymase, distilled water and Ringer solution Examples of the results are given in the graph



Polarographic curves from 0 8 v to 1 9 v

Galvanometer sensibility, 1 in 200 Concentrations are those of original solutions before preparation for polarography Concentrations in the polarographic solution (ammoniacal hexamine cobaltic chloride) are 1 . 56 of the original solutions

Serum, urine and water extract of yeast give similar curves; distilled water, Ringer solution, the ternary thiazole, riboflavon and cozymase give 'empty curves', aneurin, cocarboxylase, the quaternary thiazole, cystin, cysteine, and the nicotinic acid derivatives give curves with deviations at the same potentials as the biological fluids; but great concentrations are demanded to get curves so high as given by the biological fluids, except by the quaternary thiazole; it is not known whether this substance is present in the free state in blood and urine.

The polarographic curves in the cancer reactions must be an additive expression of the substances mentioned plus something not yet elucidated The substance must be rather stable if we may take the polarographic curve as a criterion, it can stand boiling for hours in open vessels it cannot be extracted from acid neutral or alkaline urine by shaking with chloroform benzene, petrol carbon tetrachloride, trichlorethylene or olive oil By fractional addition of methanol ethanol or acetone the substance seems to be adsorbed to the precipitates in proportion to their amounts It can be adsorbed (though not quantitatively) on fullers earth at pH 4 6 and regained by elution at pH 7 by pyridine

The substance in serum does not pass a Cellophane membrane the substance in urine passes a Cellophane membrane but very slowly

Bile (from necropsies) gives very low curve and cerebrospinal fluid (from patients) gives almost empty curves

In a recent paper Waldschmidt Leitz[4] put forward the view that the cancer substance in serum may be a sulphur free mucoid we can confirm his experiments with fractional precipitation with ethanol but our experiments with urine scarcely support the mucoid hypothesis as normal urine does not contain mucoids and mucoids do not pass 'Cellophane' membranes

We wish to thank Dr Fritz Lipmann of the Biological Institute, Carlsberg Foundation who kindly sent us some of the synthetic compounds

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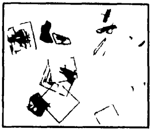
[1] Bergh Henriques Schousb NATURE 141 51 (1938)
[2] Brdička Acta Internat Verein Krebsbekampf 3 13 (1938
[3] Brown Lewis Proc Soc Exp Biol Med 36 18 (193)
[4] Waldschmidt Leitz Angewandte Chem 51 324 (1938)

Two Active Proteins from Rattlesnake Venom

WE have found the dry venom of the Brazilian rattlesnake (*Crotalus t terrificus*) to contain about 60 per cent of a neurotoxic substance and about 10 per cent of a blood coagulating principle The latter shows all the proteolytic as well as all the coagulating activity of the crude venom It was not possible to obtain this protein in a homogeneous state or to crystallize it, but we were able to achieve in the best case a tenfold increase of activity Since the blood coagulating and the proteolytic activity was always found in the same fraction even when prepared in different ways we believe that these two activities are due to the same protein It can be obtained by saturating the venom solution to 40 per cent with ammonium sulphate whereby it is precipitated adsorbed on inactive globulins When removing the ammonium sulphate by dialysis these globulins separate out and the supernatant solution contains the coagulating substance It can be obtained as a colourless material on evaporating the water in the high vacuum after freezing We were able further to purify the coagulating principle by redissolving it in distilled water and centrifuging off the undissolved material Once it is highly purified, it shows the properties of an albumin It can also be isolated from the mother liquors of the preparation of the neurotoxic principle

This neurotoxic substance we could obtain pure and in the crystalline state as will be described elsewhere in detail[1] It is the first proteinic toxin which has so far been crystallized It contains the whole neurotoxic and the whole hæmolytic activity of the venom These two properties of many snake venoms have hitherto been attributed to two different substances one an enzyme the other a toxin This substance we called *crotoxin* (*Crotalus t terrificus toxin*) Crotoxin can be isolated from the fresh venom secretion by heat coagulation precipitation at the isoelectric point and ammonium sulphate fractionation Crotoxin crystallizes from pyridine acetate solution in thin quadratic plates which aggregate in a very characteristic manner (see accompanying illustration) Repeated recrystallization does not alter the physiological properties or the analytical data



CRYSTALLINE CROTOXIN × 96

The analysis shows crotoxin to contain 4 0 per cent of sulphur which is more than in the crude venom It has been previously shown[2] that the sulphur in all venoms investigated here is bound at least partly in the form of S S bonds and that an opening of these linkages by reduction with cysteine (—SH) inactivates the venoms just as is the case with insulin

We have therefore determined the quantitative distribution of the sulphur in crotoxin and found the following facts the cystine content of 13 2 per cent corresponds to 87 4 per cent the methionine content of 1 36 per cent to 7 3 per cent of the total sulphur The cystine value is the mean of eight determinations using the Folin Sullivan and Baernstein methods All agreed within 0 3 per cent From the methionine value which is the mean of three determinations agreeing within 0 05 per cent a minimum molecular weight of 11,000 can be calculated The molecular proportion of methionine to cystine is exactly 1 6 One is tempted to believe that the actual molecular weight will be three or six times 11 000 A molecule of the weight 33 000 would contain eighteen cystines three methionines and possibly two more sulphur containing units which, however cannot be disulphides, thiols homologues of methionine or thiolactones

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[1] Slotta K H and Fraenkel Conrat H, *Ber dtsch Chem Ges* (1938)
[2] Slotta K H and Fraenkel Conrat H *Ber dtsch Chem Ges* 71 264 (1938)
[3] Slotta K H and Forster W *Ber dtsch Chem Ges* (1938)

Low-Voltage Electron Diffraction Tube

A SEALED OFF cathode ray tube for demonstration of electron diffraction patterns at low voltages (6,000 7,000 volts) has already been described by me[1] We have recently carried out experiments with this tube at lower voltages and have found that the electron diffraction patterns are quite visible on the fluorescent screen down to 4 000 volts and just visible down to 2 000 volts Photographic records of electron diffraction patterns could therefore be made using electrons of only 2 000 volts energy

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[1] *J Sci Inst* **15** 138 (1938)

Definition of Research Department Administration

I HAVE no desire to resuscitate or discuss law court cases in the correspondence columns of NATURE but in the summing up of a recent case which many readers of NATURE will have followed, the judge made the following statement Nobody suggested that [the plaintiff] was anything but a thoroughly perhaps exceptionally competent person in his scientific work but [the defendants] said that his incompetence lay in his failure to administer his department properly that is, to keep an eye on finance and to see that the machinery of the department was running with reasonable smoothness (*The Times*, July 22, 1938)

Quite independently of this particular law suit, and with no implication in respect of the judgment, I think that most lay readers would infer that this represents a correct and adequate definition of the duties in research department administration It will be sufficient in NATURE to mention the framing of research policies allocation of problems to the right people, co ordination, inspiration and the maintenance of a happy atmosphere as among the prime functions of the head of a department as such Moreover, the evidence in this case indicated that this extended definition was applicable to the department in question My principal point, however, is that there is a widespread tendency to regard administration as merely the supervision of office routine Any unnecessary perpetuation of this fallacy is highly injurious to efforts that are being made in connexion with administrative education which as this case so lamentably indicates, can be needed by both employers and employed

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Points from Foregoing Letters

EXPERIMENTS with liquid helium at temperatures between 0 2° and 0 5° K indicate according to Dr N Kurti and Prof F Simon, that the anomalous heat conduction and probably the surface film flow vanish at these very low temperatures

Prof S Szczeniowski, Prof S Ziemecki and Dr K Narkiewicz Jodko have measured during a balloon ascent ionization by cosmic rays at heights from 6 to 10 km Nitrogen and krypton ionization chambers, each filled with gases under pressure of 16 5 atm , were used The ratio of intensities of ionization in krypton and in nitrogen is equal to the ratio of densities of these gases The curves obtained show no irregularities, which is contrary to the results of some German authors A residual current in the above chambers observed at a depth equivalent to 900 m of water shows very marked fluctuations which may help to explain the anomalies of ionization by cosmic rays at great depths found by Clay and Corlin

D A Oliver and J W Shedden find that, on cooling permanent magnet alloys of the nickel aluminium iron Mishima type in a unidirectional magnetic field, the coercivity is not greatly affected but the remanence and the value of $BH_{\max}$ are increased , they suggest an interpretation of the results

Prof K S Cole and Dr H J Curtis have shown that there is a decrease in the alternating current impedance of the giant nerve fibre of the squid during the passage of a nerve impulse Analysis of the change shows that it is due to a decrease in the membrane resistance without an appreciable change in the membrane capacity

Dr A. S. Russell and J C Carver have investigated the reduction of solutions of nickel cobalt iron and other similar metals by zinc amalgam They find that reduction to metal occurs very much more readily from complex anions of these metals than from the cations They reject the view that the slowness of reduction of the cation is primarily due to a surface action at the reducing metal, and ascribe it to the existence of protective groupings surrounding the apparently simple cations

D Erikson, Dr A E Oxford and Prof R Robinson find that the pigment of *Actinomyces Waksmanii* maintains its blue colour when boiled in alkaline solution, and cannot, therefore, be an anthocyanin No anthocyanin they state, has yet been definitely demonstrated in any bacteria

A table showing the biological activity of various double esters of the synthetic œstrogenic agent diethyl stilbœstrol is given by Prof E C Dodds, L Golberg, W Lawson and Prof R Robinson Large doses of the dimethyl ether prolong the œstrus almost indefinitely

Polarographic curves (potential changes at a dropping mercury electrode) of various substances are given by F Bergh, Dr O M Henriques and C G Wolffbrandt They conclude that the curve previously obtained with cancer serum is due to a mixture of substances One of these can be adsorbed on fuller s earth and re extracted by pyridine

A crystalline toxic protein (crotoxin) of molecular weight 11,000, or possibly 33,000, has been obtained from the venom of the rattlesnake by Prof K. H Slotta and H Fraenkel Conrat Another active constituent of this venom which has proteolytic and coagulating activity has been separated in a tenfold increased concentration

Research Items

Stone Age Correlations in South Australia

THE stone age of Kangaroo Island off the coast of South Australia has been studied by Mr Norman B Tindale (*Records S Australian Mus* 6 1 1937) with a view to its place in the mainland sequence and its relation to the stone ages of Tasmania Sumatra and Malaya In the course of a search for stone age sites on Kangaroo Island however a number of implements were found of a type differing from those of the indigenous culture which it was concluded were of Tasmanian origin and had been made between 1819 and 1836 by Tasmanian women introduced on the island by white men They belong to the later of the two phases differentiated in Tasmanian culture The Kangaroo Island stone industry includes a number of types including sumatras an elongated pebble core implement, so called here from its resemblance to an implement of the Upper Palæolithic series of Sumatra and the Malay Peninsula a discoidal flake implement resembling but distinct from the Central Australian *arapia* the horse hoof hammerstones and simple flakes Implements of the Kangaroo Island type have been found on sites on the mainland such as at Balcoracana Creek and on the old land surface at Fulham Types resembling those of Fulham have been discovered at Hallett Cove Similar implements come from Tasmania possibly from sites on which the usual Tasmanian types are not found It thus becomes evident that the Kangaroo industry belongs to an old culture having affinities with the Upper Palæolithic of Malaya A tentative correlation with the succession which has been established on the Murray River suggests that it may be similar to the culture brought to Australia from Malaya by the first native visitors and that these may have been the ancestors of the Tasmanians

People and Culture in Pukapuka

A COMPREHENSIVE study of the ethnology of Pukapuka, Cook Islands since 1914 under the administration of New Zealand, has been made by Ernest and Pearl Beaglehole, on a Bishop Museum fellowship (Bernice P Bishop Museum, Honolulu *Bull* 150, 1938) The population of the Island in 1935 was 632 In 1904 it was 435, since when it has increased consistently except in 1916, when a drop in numbers was due to the effects of a tidal wave Records for 1933 and 1934 show a total of 41 births as compared with 22 deaths Anthropometric measurements were made on 230 living and have been forwarded to Dr H Shapiro for examination The amount of racial or early inter island admixture is not great The stature for men and women is less than for other Polynesian groups Face type seems to vary between a narrow, long face with long nose and a wide face with short broad nose It is possible that analysis will reveal two physical types based on this distinction Skin colour is light brown becoming very dark on exposure to the sun Little sex differentiation is observed in motor habits Although social structure has not been much affected by cultural contacts, except in regard to the power of the chief, behaviour has been made, outwardly at least, to conform to missionary standards This gave rise to certain difficulties in the way of investigation, which however ultimately were overcome The importance of this lies in the fact that for the Pukapukan all activities led naturally to sex Whatever the purpose of a chant all came sooner or later to the fact of sex and triumphs and skill were woven harmoniously into a context that stressed the greatest joys of Pukapukan life It is important to stress the simplifications inevitably introduced by the limitations of an atoll environment This is most noticeable in material culture (witness the absence of bark cloth manufacture) but environmental influence also affects social organization Absence of kava means the non development of elaborate kava ceremonial Limitations in food resources means that much time must be spent by both men and women in procuring food There are therefore no leisured chiefs who could afford the luxury of supporting skilled artisans and craftsmen

Insect Vectors of Beet Curly Top Virus

THE relations between a virus and its insect vector are complex and but little understood at present Messrs C W Bennett and Hugh F Wallace have studied the transmission of the curly top virus of sugar beet by the leaf hopper *Eutettix tenellus* They publish some interesting and illuminating conclusions in a recent paper (*J Agric Res* 51 1 31, Jan 1938) *E tenellus* is the only vector of curly top virus in North America though other insects feed readily upon the beet plant The virus is shown to enter the bodies of all these insects but the vector species is the only one which can re infect Virus is present in the blood and the salivary glands of *E tenellus* but the available evidence suggests that no multiplication of virus takes place within the insect Experiments on transmission of the disease by fasted insects are reported The results would seem to show inactivation of the virus by one of the digestive enzymes secreted by the insect Many other findings are given and the paper opens several hopeful lines for further research

The Soybean in South Africa

DR J VILJOEN has recently published an interesting analysis of the possibilities of the soybean for South Africa (*Sci Bull* No 169, South African Dep Agric and Forestry) Pointing out the great increase in the cultivation of this bean in the United States (in 1921 the area under soybeans already exceeded three million acres representing probably the greatest change in an agricultural practice in the history of Corn Belt Agriculture) Dr Viljoen emphasizes the fact that the bean may act as a restorative crop adapted to local conditions which can be grown in rotation with maize A study was therefore made of the composition of the most important South African variety and of their expressed oils The oil proves to be nearly identical with that from the American bean Soil fertility seems to have little influence on the composition of the bean , on the other hand climatic effects are considerable, minimum temperature influencing considerably both the percentage of oil and the protein content The effects of various fertilizers upon the yield and composition of the soybean are also analysed very fully

Pasture Improvement in Australia

THE recent issue by the Australian Council for Scientific and Industrial Research of two publications (Melbourne Government Printer) dealing with different aspects of pasture improvement, illustrates the importance attached to the subject in the Commonwealth Pamphlet No 77 A Study of Persistency Productivity and Palatability in some Introduced Pasture Grasses by A McTaggart gives an account of the characteristics of some thirty four varieties or strains of grasses obtained from other countries The climatic regions of Australia vary so widely that contacts have been established all over the world on the chance of finding some strain the introduction of which would materially benefit the native pastures the northern areas in particular being in need of some such improvement The second publication (Bull 116) The Relation of Phosphate to the Development of Seeded Pasture on Podsolised Sand , is by H C Trumble and C M Donald This report discusses work forming a part of a co operative programme of investigations carried out by the Waite Agricultural Research Institute the Carnegie Corporation of New York and the Australian Council for Scientific and Industrial Research Pasture establishment in South Australia depends largely on an increase in the available phosphate content of the soil together with seeding of suitable legumes and grasses Podsolized soils due to their excessive leaching are specially low in available phosphate and nitrogen and the investigations described in the bulletin show that the dressings of superphosphate usually given should be considerably increased if the maximum economic returns of the subterranean clover pastures are to be realized 2 cwt of superphosphate per acre annually for the first three years is recommended The incorporation of grasses into the clover pastures is also discussed

Vegetative Propagation in Leafy Liverworts

W DEGENKOLBE has recently surveyed the various organs serving for vegetative reproduction in the foliose liverworts (*Annales Bryologici* **10**, 1937) Deciduous branches and thallose outgrowths are new types not previously described The author finds the type of vegetative propagation very characteristic and often of greater systematic significance than details of the perianth Gemma production is associated with leaves of a definite age and the effect on leaf production is characteristic of the type of gemma produced and upon the species In some cases, the same species may develop more than one kind of organ for propagation for example, deciduous leaves and marginal gemmæ , in some the production of deciduous leaves is periodic Vegetative propagation in this group is not antagonistic to the production of sexual organs The paper also includes a discussion of the relationship of the various types of vegetative reproductive structures to one another

Plant Pathology at Seale Hayne

THE fourteenth annual report from the Department of Plant Pathology, Seale Hayne Agricultural College, contains much useful and practical information After a general survey of the pests that occurred during the year under review on the various agricultural and horticultural crops of the district, certain problems are treated in detail Investigations have been made concerning the dwarfing disease of plants, especially polyanthus and cyclamen, from which it appears that the malformation is not necessarily associated with eelworm infestation, but that bacterial trouble may be the cause , the nature of the attack however is not yet understood The hot water treatment of narcissus bulbs for controlling eelworm is a further subject which has received much attention Although satisfactory as a method for controlling the pest damage to the flowers in the succeeding season has often occurred The temperature of the water and the time of the year at which the treatment is carried are both exceedingly important The period during which the bulbs are in a state of full dormancy is comparatively short but it is the only safe time at which to carry out hot water treatment Varieties differ considerably as to the length of this safe period and their sensitivity to hot water and the behaviour of many well known varieties is described in detail for the guidance of the grower The handling of the bulbs after treatment is also important drying on trays being preferable to sacks Further, the rate of cooling must not be too rapid, particularly in the case of bulbs treated early, or damage to the flowers will result Dry planting appears to be preferable to planting in a wet condition but if there is no storage accommodation dipping the bulbs in a fungicide after the hot water bath will reduce the likelihood of decay

A Link Between Zygomycetes and Oomycetes

THE life history of *Dicranophora fulva* a fungus belonging to the Mucorales has recently been studied by Dr C G Dobbs (*Trans Brit Mycol Soc* **21** Pts 3 and 4 167 , June 1938) This mould is of somewhat rare occurrence but has several interesting features It forms sporangia only when illuminated and zygospores only in the dark It has sexual reproduction by conjugation but the male and female gametes are recognizable structurally Contents of the male also migrate into the female gamete at fertilization there is no equal fusion as usually happens in conjugation The fungus is homothallic and female gametes may moreover, be formed without the stimulus of any opposite male *D fulva* is undoubtedly a member of the Zygomycetes where conjugation is the rule , but it is also a link between that group and the Oomycetes where a large sedentary egg is fertilized by small motile male spermatozoa

An Egyptian Mould Fungus

A MOULD fungus *Penicillium egyptiacum*, isolated from soil in Egypt is described in a recent paper by Younis S Sabet (*Trans Brit Mycol Soc* , **21**, Pts 3 and 4, 198 , June 1938) The chief characteristic of this species appears to be that it forms ascigerous fruiting bodies with readiness upon most common media Mycelium of the fungus is homothallic, and the perithecia appear under wide variations of temperature, relative acidity and atmospheric pressure, though humidity has a slight effect upon their formation The species should provide very convenient material for teaching

Soil Erosion in Tanganyika

AN interesting memorandum on soil erosion, by E Harrison, director of agriculture Tanganyika, has been issued by the Government of the Territory A representative committee appointed to advise on the problem formed the opinion that the primary method of attack should be educative rather than ameliorative, and with this end in view the already existing authorities, such as forestry, veterinary and agricultural officers, were instructed to demonstrate the serious nature of the loss caused by soil erosion and to arouse interest in the methods by which it could be checked In some districts the systems of land management evolved by the native cultivators were practically ideal counters to water erosion, but in others considerable time and patience will be required before the value of and necessity for, adopting entirely new practices is realized The relations between over stocking and soil erosion are particularly intricate The native husbandman is only capable of maintaining large numbers of cattle on land more or less denuded of persistent vegetation as otherwise he incurs the ravages of ticks, flies and worms, and these are just the conditions which accelerate soil erosion In view of this the director of the veterinary services has outlined a scheme by means of which overstocking may be relieved The chief items are expansion of a rotational grazing system, increased water supplies and the control of the type and number of stock carried, and control of grass burning Application of scientific knowledge coupled with some form of legislation is regarded as the best way of furthering the interests of the native Anti erosion rules have already been drawn up in a number of districts with considerable success

Structure of Pepsin

The cyclol structure C_2 containing 288 amino acid residues is proposed for the molecule of pepsin by D M Wrinch (*Phil Mag*, **24** 940, 1937) In this structure the mid points between adjacent atoms lie on the faces of a truncated tetrahedron which would account for the globular form of the molecule and the molecular weight of 39,200 The dimensions of unit cell in the crystal lattice as determined by X ray investigations, are *a* 67 A, *c* 462 A Taking the density as 1 32 this gives a cell molecular weight of 1,434,000 Since half the weight of the crystals is made up of water removable at room temperature, then the number of molecules per unit cell must be 1,434 000/(2 × 39 200) 18 3 X ray evidence has also suggested that the unit cell is a nine layer structure, hence there must be two molecules to each layer, each of which is associated with (say) 2 350 water molecules From the dimensions of the crystal cell, the size of the cyclol C_2 molecule and the possible arrangement of the 18 molecules in a nine layer system in the cell, it is deduced that the molecules must lie some distance apart, the distance between parallel faces of adjacent molecules being sufficiently great to suggest co ordination through the R groups of the molecules Co ordination of carboxyl groups (from the glutamic acid residues) with water molecules as intermediaries and of amide groups (from glutamine residues) are both suggested as possible The great mass of the water molecules associated with the pepsin molecules in the crystal may form mega clusters between the layers of pepsin molecules resulting in a crystalline arrangement of atoms throughout the lattice The presence of such clusters and of water molecules in the co ordination bridges would imply a collapse of the structure if the water were withdrawn and would fit with the well-known fact that pepsin crystals lose their stability on drying

Physical Investigation of Metallurgical Problems

A review dealing with the applications of magnetic determinations to the study of the structure of binary alloys of which one of the components is ferromagnetic has recently been published by W Gerlach (*Naturwiss* 26 369 1938) The problem particularly considered is that of precipitation hardening that is, the hardness of crystals formed by deposition from a supersaturated solution of one metal in another The author shows how a study of magnetization temperature curves, and coercive force temperature curves enables the phases to be analysed illustrating this by the consideration of the curves for nickel beryllium and nickel gold alloys The determination of the electrical resistance of alloys with and without the application of a magnetic field also yields results the same as those obtained by the former method Investigations of the paramagnetism and diamagnetism of alloys may also be used and Auer's work on the variation of susceptibility of a supersaturated mixed crystal system of copper and aluminium with time during which hardening is taking place at different temperatures is reviewed

T Cassiopeiæ a Temporary Reversal in its Curve

Mr F M Holborn has recently published a paper with this title (*J Brit Ast Ass* 48 8, June 1938) in which he discusses small drops in the magnitude of this star while it is on the rise Not only has Mr Holborn recorded these drops his observations have also been confirmed by others who have devoted much of their time to this subject such as Prof A A Nijland and Mr N F H Knight Mr W M Lindley a well known variable star observer, has added some remarks on Mr Holborn's paper and agrees with him that long period variables should be watched very closely for subsidiary phases and that observers should not hesitate to record such

Ellipticity of Close Binary Stars

Mr J Luyten has recently published a paper on this subject (*Mon Not Roy Astro Soc* **98** 6 April 1938) in which he attempts to estimate the degree of central condensation in close binaries from their observed ellipticities Three ellipsoidal variables are considered ζ Andromedæ b_1 Persei and π_5 Orionis the photo electric light curves of which have been determined accurately by Stebbins and Huffer spectroscopic orbital elements for the primaries have also been found If ε represent the rotation effect and φ is the ratio of the centrifugal force to gravity at the equator of the primary the values of ε/φ are found to be 45 2 7 and 7 4 respectively for the stars referred to In the case of the average star, ε/φ might be expected to be about 0 6 and the discrepancy shows the difficulty of accepting light variation as due to ellipticity of figure The paper deals also with those eclipsing binaries where estimates of the ellipticities have been made and in this case the position seems more hopeful Stars of the W Ursæ Majoris and Beta Lyræ type where the two components are almost equal in size and are revolving nearly in contact, have a mean value of 0 57 for ε/φ, indicating a central density condensation a little greater than that for the planet Saturn Many of the Algol stars utilized in the work show that the mean value of ε/φ is 0 71, corresponding to a central density concentration intermediate between Saturn and Jupiter As there are so many uncertainties involved in the computations it is impossible to say definitely what the real internal density concentration is. It may be some satisfaction to know that the results are not at variance with expectations, but beyond this it is impossible to go

Research and the Amenities of Railway Travel

WE live in an age of rapid change, due largely to the increasing readiness and rapidity with which the results of scientific progress and research are applied to the conditions of life , and, in addressing the Institute of Transport on April 11, Sir Harold Hartley showed how the amenities of railway passenger travel are being improved He confined his remarks to the aspect of the comfort of the passenger rather than to such desiderata as increased speed and safety After indicating the several conditions which together determine the comfort of a railway journey at modern speeds, he proceeded to detail the steps being taken to ensure their maximum effectiveness

Absence of vibration or irregular motion is probably the most important factor so far as the passenger's comfort is concerned, and although the difficulty of eliminating these increases greatly with increase of speed, much has been done in recent years to mitigate them Smooth running depends on the design of rolling stock and railway track and on their maintenance, and was dealt with under three aspects the motion of the wheel on the rail, the springing and coupling of the vehicles and the effect of the permanent way Over many years, a large number of experiments have been made with various designs of bogies and various conings of wheels in order to discover which type gives the best riding and the least wear, and standard practice has been based on the results

More recently a complete theoretical and experimental investigation has been carried out in the Engineering Department of the University of Cambridge by Prof C E Inglis and Dr R D Davies, as a result of which the form of the sinuous path traversed by a pair of coned wheels and their axle has been determined The results of their calculations were confirmed both in the laboratory and on the track and their theory suggests that, instead of coned wheels, cylindrical tyres should give complete immunity from lateral oscillations and 'bogie hunting' In agreement with this theory are the results of the cinematograph record taken by the Chicago, Milwaukee and North Shore Railway, which also showed that with the cylindrical wheel there was no regular oscillation and its flange rarely struck the rail Experiments in the case of the L M S train, *Coronation Scot*, with various conings and with cylindrical tyres proved the excellent riding qualities of the latter, and it was with these that the train was fitted when the record run from Euston to Crewe was made on November 16, 1936 Excessive flange wear, however, necessitated the trueing of the wheels after 20,000 miles service on the London-Glasgow run, and a compromise was then made of using a 1 in 100 coning, which gives almost as good riding at high speed without the disadvantage of excessive flange wear Another method of avoiding oscillation is to mount the wheels so as to rotate independently This eliminates 'bogie hunting', there is no sliding motion on a curve and the riding of the coach is excellent, but the construction is much more complicated and the cost correspondingly high

Coaches are also subject to oscillations due to impacts at rail joints and to other track irregularities A combination of helical and laminated springs is used to damp out these , the former give elastic support while the latter damp out the vibrations In addition, rubber is being used in seat and bed construction to eliminate vibration, the most effective material being rubber and metal or wood in alternate layers Also associated with comfortable travel is the correct balance and centring of the coaches and the correct construction of the coupling and buffing gear holding the vehicles together and preventing surging and transverse oscillation Accurate records of the riding qualities of different types of construction and of the deterioration due to wear are obtained by means of the Cambridge accelerometer which, by the movements of two weights held between stiff springs, prepares a graph of vertical and transverse oscillations and has thus helped greatly in effecting positive improvements

The maintenance of the permanent way is an important factor in ensuring the comfort of the passenger At high speeds, irregularities of the track lead to impacts which react so as to produce greater irregularity Here, the Hallade recorder is used to give a continuous record on a strip of paper of the horizontal vertical and rolling movements of the vehicle as it passes over the line and so shows where adjustment of the track is necessary The Hallade method was used in improving the track for the accelerated timings of the *Coronation Scot* and, as a result, not only had the cant of rails to be readjusted to balance the centrifugal force but also the line had in places to be slewed to improve the alignment and transition curves had to be lengthened so that the train could take the curves smoothly and without rolling at high speed On the rail joint problem, a mathematical and experimental research is being carried out at Cambridge, and its results are looked forward to with much interest, for each of these joints is a point of weakness in the track

The reduction of noise is also receiving constant attention and is being effected, so far as possible, by eliminating its production, by absorbing it at its source, by avoiding its entry to the compartment, and by absorbing quickly such noise as does enter Streamlining of coaches, welding of the track, the use of absorbent material for a top dressing on the track are some of the means in use Heating and ventilation offer opportunities for the introduction of further amenities The only satisfactory method of attaining steady conditions is by a closed system of air conditioning, but the weight and cost of the plant only justify its use in very hot and dry climates Two proprietary systems of forced air ventilation are in use on main line trains in Great Britain Indirect lighting is coming into use and the crack train of the Victorian Railways—the "Spirit of Progress"—has indirect lighting for general purposes and shoulder lights for reading

Of the improvements made in the æsthetic and general amenities the public is no doubt well aware. The more attractive external appearance of the trains, the materials and decorations used inside, the large windows, reduction of draughts, size and easy form of seats, all add to the enjoyment of the passenger, so that, in these unsettled hustling days, a long railway journey may be in some measure a comfortable relaxation and an escape from the disturbances of the world

Clines: an Auxiliary Taxonomic Principle

By Dr. Julian Huxley, F.R.S., Zoological Society, Regent's Park, London

MODERN taxonomy, after a phase of splitting, adopted the integrating principle of geographical replacement, thus uniting numerous forms previously styled species as geographical races or subspecies of a polytypic species or *Formenkreis*[1]. It seems desirable, however, to go still further in the direction of synthesis. The naming and description of subspecific forms, however necessary, is not sufficient. Further, if not supplemented by some other method, it has two actual disadvantages—it focuses undue attention on named forms as against those which remain unnamed, even when the degree of distinctness is only slightly less in the latter; it also conveys a false impression of uniformity within the named group, and thus tends to inhibit the study of intra-group regularities of variation.

Some special term seems desirable to direct attention to variation within groups, and I propose the word *cline*, meaning a gradation in measurable characters. This, being technical, seems preferable to such a term as character gradient or phrases such as 'geographical progression of characters', used by W. F. Reinig in his recent book "Elimination und Selektion". (Naturally, when it can be shown that such characters are non-genetic in origin, they will be valueless for taxonomic purposes.) Prefixes can be used to denote clines of different types: for example, ecocline, genocline (gradient in genes), geocline (geographical cline), chronocline (paleontological trend), etc. The term could be extended if desired, for example, ontocline for regular trends in individual development.

Clines may be of inter- or intra-group nature. Inter-group clines connect the mean values of the subspecies of a polytypic species (or of the species of a geographical subgenus or *Artenkreis*[1]). Numerous regularities of this sort are known, for example, the Rules of Bergmann, Gloger, Allen, etc. Rensch[1,2] has recently summarized the subject. Good examples affecting colour or size are found in many birds represented in Britain (wrens, puffins, spotted woodpeckers, bullfinches, tits, etc.). An illuminating case is that of the wrens inhabiting Fair Isle[3]. These are not sufficiently distinct to be given a separate subspecific name, but are intermediate in character as well as in position between *T. t. troglodytes* of the mainland and the Orkneys and *T. t. zetlandicus* of the Shetlands. To subsume these facts by a cline is to direct attention to a regularity that is concealed if we restrict ourselves to specification by the naming of areal groups.

Intra-group clines concern continuous variation within a population. Relatively little work has as yet been done on this laborious subject, for example, tongue length in bees[4], percentage of 'spectacled' forms in guillemots, fin rays in fish[5], pattern in lady beetles[6], vertebræ in fish[7], temperature resistance in *Drosophila*[8], etc. Sumner[9], in a coastal subspecies of deermouse (*Peromyscus*), has shown that the adaptively cryptic colour of the pelage changes gradually as one passes inland from white sand to dark soil. Still further inland there exists a distinct and much darker subspecies on very dark soil, which also shows a colour cline, though less pronounced. Where the two meet, there is a narrow zone about three miles wide where the mean colour changes very rapidly, and the variability is much higher. Off the coast, on an isolated island of white sand, lives a much paler subspecies. Here we have, first, an inter-group cline comprising three subspecies, and also intra-group ones within the two inland groups. These run in the same direction as the inter-group cline but are much less steep. These two geographical clines are separated by a very steep genetic cline (genocline) at the inter-breeding zone.

In plants, ecological clines appear to be the commonest type. Gregor[10], in *Plantago maritima*, has shown that each ecological habitat selects out a particular assemblage of genetic types, so that a regular ecocline will run from more to less saline surroundings. It is probable that similar ecoclines are to be found among land snails (Rensch[1]).

It is in no way intended that specification by clines should replace any of the current taxonomic methods. It would constitute a supplementary method which, it is suggested, would correct certain defects inherent in that of naming areal groups, notably in stressing continuity and regularity of variation as against mere distinctness of groups. It is important to note that clines for different characters may run in different directions (shrikes[11], fox sparrows[12], lincoln sparrows[13], etc.).

It would seem certain that, once attention is concentrated on this subject, regularities of intra-group variation will be found to be common—the rule rather than the exception. The correlation of these with environmental factors will undoubtedly often not be easy; and where the environmental factors vary in a complex way, the mere detection of regular phenoclines may be difficult, though not impossible[14]. However, if the study of such regularities is actively pursued, I would prophesy that we shall eventually gain a new picture of species. In many cases at least, the species will prove to consist of a population showing adaptive clines running in various directions; the continuous gradation will be broken up by various forms of isolation, which, by impeding interbreeding and the free flow of genes, will accentuate the mean adaptive differences between adjacent groups, as well as in some cases introducing non-adaptive differences[15]. The term cline is put forward as a step in this direction.

I have to make grateful acknowledgments to a number of systematists with whom I have discussed the subject, and who allow me to say that they believe that the use of the concept in taxonomy would be useful, notably Mr. M. A. C. Hinton, Mr. N. D. Riley and Mr. J. R. Norman of the British Museum (Natural History), Mr. J. S. L. Gilmour and Dr. W. B. Turrill of the Royal Botanic Gardens, Kew, Mr. B. W. Tucker of Oxford, the Rev. F. C. R. Jourdain, and the Committee on Comparative Systematics of the Association for the Study of Systematics I have also to thank Dr J Ramsbottom for suggesting *cline* as the best term to denote gradation

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The Geological History of Northern Central Africa

UNTIL quite recently the interior of that vast tract of Africa which lies north of the equator and west of the Nile was virtually *terra incognita* to the geologist During the last few years however, geologists of several nationalities, particularly French and Belgian, have been actively engaged in the survey of various portions of this area As a result a considerable amount of information on the geology of the region has become available, but is scattered among numerous publications many of which are not easily accessible to British students The literature is, moreover, somewhat bewildering owing to the numerous unfamiliar stratigraphical terms which have been introduced

A well condensed and useful synthesis of existing information on this subject has recently been published by Dr K S Sandford (*Quart J Geol Soc*, 93, 534, 1937) who was attached to Major R A Bagnold s expedition in 1932 for the survey of the north western frontier of the Anglo Egyptian Sudan, and so has been able to approach the subject from the point of view of one whose own field work has taken him into almost the very centre of the area

In the geological history of this area as a whole continental conditions have prevailed over long intervals of time but three main periods are recognizable when considerable transgressions of the sea took place An Archæan basement complex of highly metamorphosed rocks is covered discordantly in most districts by pre Cambrian sediments, probably largely of marine origin Still in pre Cambrian times, these rocks were subjected to intense folding and considerably metamorphosed by pressure which came mainly from the east and west In many districts these movements were accompanied by igneous intrusion These ancient rocks, which are exposed over large areas at the present day, form the foundation of the African continent

The Lower Palæozoic was a period of marine transgression, no Cambrian rocks have been discovered anywhere in the area, but it is probable that in the Ordovician and Silurian the sea covered most of Africa north of the equator and west of the present continental watershed The occurrence of graptolites, brachiopods, calcareous algæ, and other organisms at a number of localities enables the beds to be dated with some degree of accuracy South of the great ridge joining Abyssinia to the Gulf of Guinea, however, the rocks of the Katanga System, which are at least in part marine, have yielded no fossils except obscure algal remains The dating of these rocks is, therefore, still largely a matter for dispute As shown by Dr Sandford, most workers favour the reference of at least the upper part of the succession (the Kundelungu Series) to the Palæozoic The possibility of a pre Cambrian age for the whole system cannot, however be considered to be definitely excluded Glacial tillites, absent from the Palæozoic of the more northerly region occur here at more than one horizon

Caledonian movements were mainly limited to simple elevation, so that the Palæozoic strata, in general, have remained unfolded In the central Sahara however, broad Caledonian folds have affected the Devonian beds, while in the south the beds of the Katanga System are involved in severe folding which may have occurred in Devonian times These movements resulted in the progressive exclusion of the sea in later Palæozoic times, thus inaugurating a period in which the interior of Africa was once more a vast continental region undergoing denudation

To this period belong the deposits of the Karroo System—the Lualaba and Lubilash beds of Belgian geologists—which cover wide areas in the Belgian Congo Unlike the contemporaneous beds of South and East Africa, these are poor in fossils To the north and north east the Karroo deposits pass laterally into beds classed as 'Nubian Sandstone Further information is desirable about certain beds near Guider (Léré) in the Cameroons where brachiopods (afterwards lost) are reported to have been found by O Mann associated with fish remains described by E Hennig as *Lepidotus manni* A Jurassic age has been suggested for these beds, but there is no other evidence of a marine invasion of the area in Jurassic times

In Cretaceous times, a renewed transgression of the sea took place, more restricted than that of the Palæozoic but resulting apparently, in a temporary connexion between the Tethys and what is now the Gulf of Guinea In the Eocene the sea appears to have covered much the same area as in the Upper Cretaceous although there is usually a discordance between the beds of the two periods Except marginally and very locally the sea has been excluded from the whole area in post Eocene times Alpine orogenic movements affected only the northern marginal belt of the Continent but in the interior differential movements gave rise to a series of lake basins the deposits of which, sometimes silicified, are now being recognized The Upper Tertiary was a period of much volcanic activity, which has persisted almost to Recent times

The long list of recent publications which accompanies Dr Sandford's paper should prove most useful to those seeking further information on the area

The Control of Water Supplies

THE first report of the Central Advisory Water Committee, just issued from the Ministry of Health (H M Stationery Office, 6*d* net) summarizes the conclusions arrived at by the Committee on a number of suggestions submitted to it for new legislation to facilitate the conservation and supply of water and the co ordination of water interests The most urgent of these questions, in the Committee's opinion were proposals for (*a*) the control and conservation of needed underground water resources and the protection of underground water from pollution, (*b*) the planning of water resources and supplies, and (*c*) the modernization of the existing law relating to the supply of water by local authorities and water companies

With regard to the first matter, the approved findings of a special underground water sub committee are given in which it is recommended that control should be exercised only in defined areas in which the conservation of underground water is shown, after investigation, including public inquiry to be necessary in the public interest, with the further recommendation that the Minister of Health should be empowered either on his own initiative, or on the application of any interested regional advisory water committee or person, and after consultation with the Central Advisory Water Committee, to make orders defining areas in which control of the abstraction of underground water is necessary in the public interest These with certain other recommendations relating to waste and pollution of supplies it is noted, will entail substantial amendment of the existing law under which owners have the unrestricted right to abstract water from under their land, or to allow underground resources which they have tapped to run to waste they affect also, to some extent, the powers of owners to dispose of waste matters which may cause pollution The Committee is satisfied, however as to the necessity and value of the suggested provisions

The second of the questions under consideration, namely, the planning of water resources and supplies, forms the subject of another special report by a sub committee in which it is pointed out that the regional planning of public water supplies by joint committees of water undertakers is of comparatively recent origin There are now nine regional committees in existence comprising areas with a total population of some fifteen millions Although the central committee is satisfied as to the need for regional planning by regional committees, it considers the existing procedure should be amended and that in place of voluntary assistance in their researches, the regional committees should be empowered by statute to make precepts on constituent authorities for their expenses and to obtain necessary information of consumption and resources The Minister of Health should, in the Committee's opinion be empowered to require all persons abstracting water to furnish returns of any water abstracted and not returned to the stream from which it was taken an exception being made in favour of private individuals who abstract water for their own domestic use With certain reservations in regard to details these returns should be made public to the extent of affording information in the aggregate of the quantity of water abstracted in suitable areas

The reconstitution of the regional committees is advocated in order to obtain greater efficiency, a limit of 10 members in each being considered desirable, inclusive of an independent chairman The lack of contact between water undertakers and other interests is met by the recommendation that it should be obligatory for the committees to consult all interested bodies, including catchment boards fishery boards harbour and navigation authorities and industrial users, before definite proposals are formulated in which the interests of these bodies are likely to be affected Other recommendations are made for increasing the powers of the Minister of Health in regard to the formation or alteration of joint boards and the amalgamation and acquisition of water undertakings As regards the modernization of the law relating to water supply, it is stated a consolidation bill is in course of being drafted for submission to the Minister of Health B C

The Museums Association

Annual Conference at Belfast

THE forty ninth Annual Conference of the Museums Association was held in Belfast in the week commencing July 4, and was attended by representatives of museums of all parts of Great Britain and by a number of delegates from overseas The president, Dr R E Mortimer Wheeler, announced that Her Majesty Queen Mary had graciously consented to become the patroness of the Association

In his presidential address, Dr Wheeler dealt with a number of current museum problems, and referred especially to the need for folk parks in England, and for the preservation, either there or elsewhere, of historic horse drawn vehicles which have now become obsolete

A large part of Dr Wheeler's address was concerned with air raid precautions in museums and art galleries The Museums Association has held a meeting on this subject, and has approached the Standing Commission on National Museums for advice Museum buildings may be reinforced, deep basements or country house storage may be provided for objects of primary importance, and a plan prepared for immediate action in case of emergency. Any person, Dr Wheeler said, who is directly or indirectly responsible for a museum or art gallery is neglecting an essential part of his duty if he is not taking all feasible steps to protect his collections from possible war risks

A discussion on museums and field archæology opened by Sir Cyril Fox, director of the National Museum of Wales, led to a general agreement that field work is a most important part of the training of museum officials who are in charge of archæological material Not only does it enrich the museum, but it also provides officials with personal contacts and a background of knowledge that is invaluable in the study of their own collections Curators should be given facilities to take part in excavations as an official part of their museum work In the same discussion Mr Christopher Hawkes of the British Museum directed attention to the need for a national archæological survey with centralized records

Youth in Museums was a subject of three papers by Miss Mary S Shaw, Miss C Mirèio Legge and Miss Bertha Hindshaw, all of Manchester who, from the point of view of an Egyptologist a zoologist and the curator of a children's museum, discussed the way in which museum collections could be used for vivid educational work

Mr Trevor Thomas, of the Liverpool Public Museums, read an original and stimulating paper on the æsthetics and technique of museum display—a subject which is, perhaps of little obvious concern to the scientific worker, but which is, nevertheless of the very greatest importance if museum exhibits are to appeal to the visitor whose attention is arrested by vigorous display, in which the objects are grouped and arranged in an attractive manner In this connexion, the results of experimental psychology should not be neglected

Mr Frank Pick, of the London Passenger Transport Board, gave a vigorous address on the form and purpose of a local museum, which was illustrated by many comparisons between museums in Britain and those in other countries The primary question is, he said, to whom or to what is a museum directed ? It is necessary for every museum to work to a specific aim and purpose and specialized museums are needed , for example, Britain has no museum giving a synopsis of the history and development of agriculture, nor is there one dealing with the history, meaning and purpose of clothes A museum can justify itself only as it establishes relationships with current life, and its administration is work requiring great imaginative activity

Among other papers at the Conference, Mr E Rimbault Dibdin discussed the question Are Art Galleries Obsolete ? , Mr J H Hewitt talked of the place of reproductions in the gallery , Mr A F Reeve Fowkes made a plea for a circulating national gallery, and Mr J A S Stendall described museum methods in Scandinavia A film on the work of the Royal Scottish Museum was presented by its director Mr T Rowatt

Mr S F Markham discussing the future of the museum movement in Britain made an informative and practical contribution His views will no doubt be found expressed in detail in the report on this subject which he is preparing for the Carnegie United Kingdom Trustees

About two hundred and thirty delegates attended the Conference, and were entertained by the Lord Mayor of Belfast by the Belfast Museum Committee, and by Queen's University There were excursions to the Giant's Causeway, to Armagh, and to archæological sites in Northern Ireland

Next year's Conference will be held at Cheltenham in the week commencing July 3 , it will be the jubilee of the Museums Association, and will be under the presidency of Viscount Bledisloe

International Physiological Congresses

THE sixteenth International Physiological Congress which will be held in Zurich on August 14–19, may be considered to mark the fiftieth anniversary of the first congress, which was held in the same country In honour of the occasion, F J Franklin has written a fascinating history of these congresses, which is published in *Annals of Science* (3, Part 3) It is illustrated with thirty five photographs of presidents of the congresses and others who have contributed to their success Copies are to be presented to all members

Dr Franklin gives a large number of details of the organization of these congresses which will be very useful to those responsible for congresses in the future, but he has done far more than this He has managed to catch and convey something of the enthusiastic spirit which animated the early congresses, when about a hundred keen workers met together to demonstrate experiments to one another Every effort was made to keep the arrangements as simple as possible and particular stress was laid on the importance of demonstrations There was at one time a movement in favour of abolishing other forms of communication altogether, but this was thought to be impracticable

The first congress was the result of a letter sent by the Physiological Society, London, to 109 physiologists in 1888 It met the next year in Basle, and Dr Franklin quotes interesting reminiscences of several of the eleven survivors This congress was so successful that it was decided to hold similar congresses every three years and they met successively at Liége Bern, Cambridge, Turin, Brussels, Heidelberg, Vienna and Groningen (1913) Speeches were made which emphasized the international spirit of science and it is sad to remember how this spirit was forgotten in the years of the Great War The congress in Paris in 1920 was confined to physiologists from allied countries, and the next truly international congress was held in Edinburgh three years later Since then congresses have been held in Stockholm, Boston, Rome and Leningrad The membership has grown to about 1,500 and the scientific demonstrations have tended to be overshadowed by the banquets, concerts and sight seeing expeditions which have been generously provided by the Governments of some of the countries which have acted as hosts

An attempt is being made this year to return to the simplicity of the early congresses Membership is limited to genuine physiologists and their families, and the social entertainments will be less elaborate, but physiology itself cannot be made simple again The number of communications is large, and it is still necessary to hold meetings simultaneously in five lecture rooms

The Swiss organizing committee is introducing important innovations Fifteen discussions have been organized on the kidney, the regulation of the circulation, the chemical transmission of nervous impulses, oxidation, the permeability of the skin electro physiology, steroids, fœtal respiration, nutrition, the control of respiration, the adrenal cortex, the anterior pituitary, the analysis of speech, the potential action of drugs and vitamin B_1 The contributions of the two openers of each of those discussions have already been circulated with the general programme of the meeting The opportunity *to study such documents in advance is a great boon*, but it has only been granted once before There is every reason to hope that this congress will be remembered for the high value of its scientific meetings

J H GADDUM

Beit Memorial Fellowships for Medical Research

AT a meeting of the trustees of the Beit Memorial Fellowships for Medical Research held on July 13, it was reported that F R Winton (fellow, 1927 31) had been appointed to the professorship in pharmacology in the University of London, held at University College, G R Cameron (fellow, 1930–33) to the professorship of morbid anatomy in the University of London, held at University College Hospital Medical School, A R Todd (fellow, 1935–36) to the professorship of chemistry in the University of Manchester, and that R J Kellar (fellow, 1935–37) had been appointed reader in obstetrics and gynæcology, University of London, at the British Postgraduate Medical School, London

The total number of fellowships held by full time workers during the year 1937–38 was 23 The number of candidates at the present election was higher than usual, five applied from Canada and three from Australia Fortunately, reserve funds made it possible to award more junior fellowships than are ordinarily given each year, and the election of twelve new junior fellows brought the total of those elected since the beginning of the Trust in 1910 to be exactly 200 A fresh edition has been printed this year of the 'Green Book" which summarizes briefly the after careers of fellows and their present position in research

The following elections were made, the subject and place of research being given after each name

Senior Fellowship (value £700 a year) Dr D E Green, to continue research on the role of vitamin B_1 in the oxidation of pyruvic acid, and to study a new flavin protein compound in milk (Institute of Biochemistry, University of Cambridge)

Fourth Year Fellowship (value £500 a year) Dr M H Salaman, to continue research on vaccinia and animal pox viruses (Lister Institute of Preventive Medicine, London)

Junior Fellowships (normal value £400 a year) Dr G Bourne, director of the Department of Experimental Biology, Australian Institute of Anatomy, Canberra, 1935–36 and biochemist, Commonwealth Advisory Council on Nutrition, 1937—significance of vitamin C in the endocrine system (Department of Human Anatomy, University of Oxford), Dr A L Chute, of Toronto General Hospital—experimental studies in metabolism of the brain (Department of Physiology, University College, London), Dr R O L Curry—physiology of speech disorders by photographic study of laryngeal movements (University College London), Dr J F Danielli, demonstrator in biochemistry and biophysics University College, London permeability of normal and denervated muscle to metabolic products and to drugs (Institute of Biochemistry, University of Cambridge) Dr J G Dewan, assistant physician, Toronto Psychiatric Hospital 1933 35, and since 1936 research worker at the Institute of Biochemistry, Cambridge insulin shock treatment of schizophrenia by experimental studies of brain metabolism (Institute of Biochemistry University of Cambridge), Dr Catherine O Hebb, since 1937 research assistant, Department of Physiology, McGill University—effect of thoracic sympathectomy on the activities of the lung (Department of Physiology University of Edinburgh), Dr B Katz since 1935 research worker in biophysics, University College, London—electric excitation and transmission of impulses in nerve and muscle of animals (Department of Biophysics, University College, London), J H Kellgren, resident appointment, University College Hospital, London, 1935–36, and since 1937 research worker in its Department of Clinical Research—painful conditions of the limbs and back (Department of Clinical Research, University College Hospital, University of London, Dr J J D King, house surgeon, Dundee Dental Hospital 1931 32, since 1936 research grantee of Medical Research Council—dental caries and parodontal disease (Medical School, University of Sheffield), Dr H Lehmann, research worker, Physiological Institute, Heidelberg, 1934 36, since 1936 research student of Christ's College, Cambridge—blood sugar in animals, and iron metabolism in plants (Institute of Biochemistry, University of Cambridge), W J O'Connor, resident medical officer, Adelaide Hospital, 1936, lecturer in human physiology and pharmacology, University of Adelaide, 1936 37—effect of strophanthin on the oxygen consumption of the heart (Laboratory of Pharmacology, University of Cambridge), H Scarborough, house physician, Royal Infirmary, Edinburgh, since 1934 assistant in Department of Therapeutics, University of Edinburgh—mode of destruction of vitamin C in the human body (Clinical and Chemical Laboratories, Royal Infirmary, Edinburgh)

All correspondence of fellows and candidates should be addressed to Prof T R Elliott, honorary secretary, Beit Memorial Fellowships, University College Hospital Medical School, University Street, London, W C 1

Science News a Century Ago

Faraday and Schönbein

ON July 30, 1838, Faraday wrote to Schönbein My dear Sir You know how I value your letters and may conclude that the last was very pleasant to me, though there is always a feeling of deep regret that the treasures which accompany your communications being in the German language are sealed up to me You mention Fechner s objections to my theory [of the voltaic pile] and I am exceedingly anxious to see and consider them but do not know whether they are acceptable to me or not I am very anxious to know of all important objections but I do not mind about slight ones Many have been made to me which been left to themselves have disappeared in a few months from the minds of the objectors themselves, but good and valid objections are of great importance and often I think prove the key to new discoveries Dr Poggendorff who was here lately told me of Fechner s objections but when he learnt from me that I by no means go the length of De la Rive and that I admit *many other modes of electrical excitement* besides chemical action, I thought he seemed to think that Fechner s objections were rather against De la Rive than me

Fossils of Great Britain

ON August 2, 1838, under the title Fossil Remains', *The Times* printed a petition which had been addressed to the Chancellor of the Exchequer relating to the decision not to purchase for the British Museum the two valuable collections illustrating the geology of an important portion of England formed by Mr Mansell and Mr Hawkins The petitioners stated that the collections were of peculiar value as demonstrating the subterranean structure of Great Britain, that it would be conducive to the honour and scientific reputation of England if they were placed in the British Museum, that their formation had resulted from a concurrence of rare opportunities and extraordinary qualifications in the individuals who had made them, and that if the collections were not then secured for the nation the chance of doing so might be lost for ever There were eighteen signatures to the petition, among them being those of Buckland Sedgwick Owen Murchison and Darwin

Opening of the Polytechnic Institution

ON August 2, 1838, the Polytechnic Institution, 309 Regent Street London was opened for a private view by supporters of science, and four days later it was thrown open to the public, a shilling being charged for admission The extensive building had been erected to provide reading and lecture rooms and demonstration galleries for illustrating the principles upon which every science was based, and the processes employed in arts and manufactures When ready for opening it contained a printing press, an optician s workshop, a rotatory steam engine, power looms, a diving bell, a model canal and docks, electrical and astronomical instruments, etc

Owing to financial losses the Institution was closed in 1859, but in the following year it was reopened by a new company In 1872 the classes were formed into a college which was inaugurated by the Earl of Shaftesbury In 1882 it was purchased by Quintin Hogg and opened as the Polytechnic Young Men s Christian Institute

University Events

EDINBURGH —The laureation and graduation ceremony on July 20 was also the occasion of the installation of the chancellor Lord Tweedsmuir Governor General of Canada, who had been elected by the graduates to succeed the late Sir James Barrie After conferring the honorary and ordinary degrees mainly in medicine and law the chancellor delivered his address in which he discussed the functions of a university under modern conditions In the course of this he stated The instruction of a University must be in the general principles the fundamental propositions the theory of any discipline It cannot profess to teach the practice of a profession for it cannot keep step with its rapid changes So one should regard as a *primary function* of a university the trusteeship of humane learning, the guardianship of the central culture of mankind Its task is to pursue truth by research by experiment, and by speculation and in so doing to inspire its members young and old with the love of truth, which includes the love of beauty, and with that spirit of disinterested inquiry which means intellectual freedom

Among others, the honorary degree of doctor of laws was conferred on the Right Hon Sir John Anderson, M P for the Scottish Universities, the Right Hon Walter Elliot Elliot Minister of Health Sir Alexander Gibb, the Right Hon William Shepherd Morrison Minister of Agriculture and Fisheries the Right Hon Lord Eustace Percy rector of King s College, Newcastle and pro vice chancellor University of Durham

The degree of D Sc was conferred on A D Buchanan Smith for the thesis Studies on the Inheritance of Yield and Quality of Milk in Dairy Cattle

For the first time the University awarded the degree of B Sc with honours in pharmacology which was gained with first class standing by the Earl of Suffolk and Berkshire

LONDON —The following titles have been conferred in respect of posts held at the schools of the University indicated professor of anatomy, Mr E P Stibbe (King s College), reader in clinical pathology, Dr Montague Maizels (University College Hospital Medical School), reader in demography, Dr R R Kuczynski (London School of Economics), emeritus professor of electrical engineering, Prof J T MacGregor Morris, on his retirement from the University professorship of electrical engineering at Queen Mary College, emeritus professor of organic chemistry, Prof J F Thorpe, on his retirement from the University professorship of organic chemistry at the Imperial College—Royal College of Science, emeritus professor of physical chemistry, Prof J C Philip, on his retirement from the University professorship of physical chemistry at the Imperial College—Royal College of Science

The degree of D Sc (engineering) has been conferred on Mr A G Pugsley (Battersea Polytechnic) and Mr J E P L Vigoureux (Imperial College—City and Guilds College)

SHEFFIELD —The following appointments have been made J R Grimoldby, to be demonstrator in anatomy, G E Cooke, to be assistant lecturer in civil engineering

Dr J E Smith, lecturer in zoology, has resigned

Societies and Academies

Dublin

Royal Irish Academy, June 27.

WINIFRED E. FROST · River Liffey survey (2) The food of the brown trout (*Salmo trutta*, Linn) from acid and alkaline waters. Brown trout from acid waters are usually small and slow-growing compared with those from alkaline waters Two stations were selected on the River Liffey, one Ballysmuttan acid water, the other, Straffan, alkaline water Stomach contents of 349 brown trout from Ballysmuttan and 228 from Straffan were examined Seasonal nature of the food consumed is described. Quality and quantity of different food organisms eaten are compared Some comparison of food available at the two stations is given It seems possible that the amount of food available is not responsible for difference in growth rate and size of Ballysmuttan and Straffan trout

Paris

Academy of Sciences, May 30 (*C R*, 206, 1601-1688).

ALEXANDRE GUILLIERMOND and **ROGER GAUTHERET** Culture of plants in media containing colouring matters The degree of toxicity of the colouring matters A table of results with twenty-seven dyes is given showing the toxic effects on wheat seedlings neutral red is the least toxic, while at the other end of the scale come malachite green and aurantia

ANDRÉ BLONDEL The influence of the definition of magnetic losses on the properties of the circular diagram of induction motors.

KENTARO YANO The projective space of D. van Dantzig

ALEXANDRE FRODA Topological properties of functions of real variables

BERNARD SALOMON . Dynamic reductors of oscillations particularly applicable to machine shafts

GÉRARD DELANGHE On certain general properties of balancing piston machines, according to the method of symmetrical rotating vectors

HENRI MINEUR The gravitation potential of the galaxy.

EMILE SEVIN · The problem of thermal agitation in the presence of a field of gravitation.

PIERRE MONTAGNE · The use of ammonia as a fuel in explosion motors.

MLLE SUZANNE VEIL Silver and platinum and silver and nickel in aqueous potassium iodide and their electrostatic aspect

MME. NIUTA WINTER-KLEIN · The influence of strains on the variation of the refractive index of glass.

PAUL GESTEAU · Method for the qualitative and uantitative study of sources of radiations and of hotographic emulsions in the field of the ultra-olet.

MAURICE BILLY and **ALAIN BERTON** · Absorption ectra by reflection of solid substances in the visible nd ultra-violet regions Absorption spectra by reflection can be used to supplement other methods of nvestigation of solid bodies, such as diffraction spectra and the X-rays

PIERRE MESNAGE : The band spectra of the iodides of the alkaline earths.

PIERRE JACQUINOT : The Zeeman effect of an abnormal argon series.

MME. ARLETTE VASSY : The absorption coefficients of ozone in the region of the Chappuis bands.

RENÉ AUDUBERT and **J MATTLER** The action of gases on the photogenic reactions accompanying the thermolysis of sodium azide

ANDRÉ GUINIER A new type of X-ray diagrams

MME IRÈNE CURIE and **PAUL SAVITCH** The nature of the radio-element of 3 5 hours period formed in uranium irradiated by neutrons

MME S COTELLE and **MOÏSE HAISSINSKY** The preparation of thin layers of thorium and of actinium by electrolysis in ethyl alcohol.

RENÉ DELAPLACE : The thermal conductivity of gaseous hydrocarbons and the atomic polarization

GUSTAVE RIBAUD and **HUBERT GAUDRY** The influence of the value of the pressure on the velocity of propagation of flame under constant pressure, in uniform régime, in mixtures of air with propane and with coal gas

MME NATHALIE DEMASSIEUX and **BASILE FEDEROFF** The dehydration of the double sulphate of nickel and potassium

MME RAYMONDE DUVAL The stereoisomerism of the cobaltitrinitrotriammines

ARMAND GROSS Explosive decomposition with the acetylene flame

MME RAMART LUCAS The structure and absorption of the triphenylmethane amino colouring matters

MME YVONNE KHOUVINE and **GEORGES ARRAGON** The nitric oxidation of the methyl derivatives of sorbose

CHARLES PRÉVOST and **OU KIUN HOUO** A decomposition of the primary and secondary β ethylenic alcohols.

LOUIS MARGAILLAN and **XAVIER ANGELI** The passage from stearic acid to oleic acid by catalytic dehydrogenation Methyl stearate carried as vapour in a current of ethylene over reduced nickel at 220°C is partly reduced to methyl oleate

ERNEST CHAPUT The Permian and the Eocene in the south-west of the interior of Anatolia

SOUBHI NAZLOUM The analysis of the components of Afrine at Midanki

LOUIS GLANGEAUD A method of studying the mud in suspension in estuaries and rivers.

RENÉ BERNARD The formation of free atoms of sodium in the upper atmosphere

MLLE ALINE DUSSEAU · First cultures of fungi on 'Cellophane'

EMILE MICHEL-DURAND The principles of pollen containing phosphorus

JOSEPH LEFÈVRE The normal presence of indolic acids and especially of 3-indol acetic acid in various higher plants

JACQUES LUCIEN MONOD and **MLLE YVETTE NEEFS** The extraction and estimation of the eye pigment of *Drosophila*

MAURICE FONTAINE and **RENÉ GUY BUSNEL** · The distribution of flavine and of substances with a blue fluorescence in the skin and scales of fresh-water fishes

ALBERT PEYRON · The presence of primordial genital cells in the embryonic buds of parthenogenetic embryomes in man

PHILIPPE L'HÉRITIER and **GEORGES TEISSIER** : The hereditary transmission of sensibility to carbon dioxide in *Drosophila*

MARIUS PIÉRY, JEAN ENSELME and **MLLE SIMONE PETEL** Researches concerning the subject of the influence of mineral waters on tissue respiration. Function of potassium ions and of ferric ions. The action of a ferruginous mineral water

Jean Cuillé and **Paul Louis Chelle** Is *tremblante* of the sheep determined by a filtrable virus ?

Moscow

(*C R* 19, No 1-2, 1938)

N Smirnoff Application of the Fourier integral to the integral non linear equations

A Chepelewskij The stochastic scheme of Pearson's equation

L Keldych The grids defining measurable entities *B*

N W Adamoff Investigation of periodic solutions of an ordinary differential equation of the first degree by the method of successive approximations

N Lusin Existence of algebraic surfaces without continuous network

I I Privalov The principle of maximum generalized for subharmonic functions

N Rein (1) Development of the method for the evaluation of the period of solution of a restricted problem of three bodies (2) A simplified scheme of an elliptical restricted problem of three bodies

K Ogorodnikoff Theoretical analysis of the Wolff's method of star counts in dark regions

A B Severny The Compton scattering of radiation within a star

L Grošev and **I M Frank** Angular distribution of pairs in krypton

S Rodionov, E Pavlova and **N Stoopnikov** A new anomalous effect in the short wave end of the solar spectrum (1)

S Rodionov and **E Pavlova** Contribution to the problem of the Umkehr effect (2)

A A Novitskij Researches on the periperic visual adaptations during twenty four hours

N Ageev Unlimited solubility of metals in the solid state

B A Petrushevsky The domes of the region near the Dzhezkazgan

D S Beliankin, V P Petrov and **R P Petrov** First nepheline syenite in Transcaucasia

A S Serebrowsky Genes Scute and Achaete in *Drosophila melanogaster* and a hypothesis of gene divergency

E D Levina A chemico genetic study of the plum

A N Lutkov Tetraploidy in *Linum* induced by high temperature treatment of the zygote

J M Kabak Antigonadotropic serum

F P Mazanko (1) A new method of tau saghyz exploitation (2) Rubber formation in tau saghyz

T J Zarubailo Response of unripened wheat grain to yarovization effect of chilling

M Ch Čaylachjan and **L P Ždanova** Hormones of growth in formation processes (1) Photoperiodism and production of growth hormones

I D Romanov A new form of the embryo sac of the *Adoxa* type in *Tulipa tetraphylla* and *T ostrovskiana*

M I Kniaginichev and **T M Gorelkina** Structural peculiarities of starch in the cereal and the leguminous seeds

K A Brodsky Contribution to the ecology and morphology of *Calanus tonsus* Brady (*Calanus plumchrus* Marukawa) of far Eastern seas

N. V Nassonov Morphogenesis following the insertion of parts of various organs under the skin of the axolotl (1) Lung as organizer (2) Small intestine as organizer (3) Gills as organizer.

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Professor of Archæology in the University of Malta (to act also as secretary of the British Institute at Malta)—The British Council 32 Chesham Place London S W 1 (August 6)

Assistant at the Royal Aircraft Establishment South Farnborough Hants—The Chief Superintendent (August 6)

County Instructor in Poultry Keeping in the Kirton Agricultural Institute Boston Lincs —The Principal (August 10)

Lecturer in Mathematics in the University of Reading—The Registrar (August 19)

Assistant Lecturer in Mechanical Engineering in the Bradford Technical College—The Principal (August 20)

Principal of Hendon Technical College—The Secretary of the Education Committee Education Offices 10 Great George Street Westminster S W 1 (August 27)

Head of the Marine Engineering Department University College Southampton—The Registrar (August 31)

Biochemist in King s College Hospital Denmark Hill London S E 5—The House Governor (September 1)

Professor of Inorganic and Physical Chemistry in the Egyptian University Abbassia Cairo—The Dean of the Faculty of Science (September 15)

Director of the Indian Institute of Science Bangalore India The Registrar (September 15)

Senior Lecturer in Economics in the University of the Witwatersrand Johannesburg—The Secretary Office of the High Commissioner for South Africa South Africa House Trafalgar Square London W C 2 (October 1)

Lecturer in Forestry in the University of Aberdeen—The Secretary (October 31)

Physicists at the Shirley Institute (British Cotton Industry Research Association) Didsbury Manchester—The Director of Research

Lecturer in Chemical Engineering in the University of Sydney The Secretary Universities Bureau of the British Empire 88A Gower Street London W C 1

Lecturer in Geography in Raffles College Singapore—The Secretary Universities Bureau of the British Empire 88A Gower Street London W C 1

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society Vol 22 (N S) No 5 Subaqueous Transpiration By Prof H H Dixon Pp 55 58 (Dublin Hodges Figgis and Co Ltd London Williams and Norgate Ltd) *6d* [187

Permanent Consultative Committee on Official Statistics, Guide to Current Official Statistics of the United Kingdom Vol 16 (1937) Being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1937 Pp 406 (London H M Stationery Office) 1*s* net [187

North of Scotland College of Agriculture Guide to Experiments and Demonstration Plots at Craibstone 1938 Pp xii + 64 (Aberdeen North of Scotland College of Agriculture) [187

Other Countries

Report of the Twenty third Meeting of the Australian and New Zealand Association for the Advancement of Science Auckland Meeting January 1937 Edited by F J A Brogan Pp xlv + 500 + 17 plates (Sydney N S W Australian and New Zealand Association for the Advancement of Science) [147

American Philosophical Society Year Book 1937 Pp 433 (Philadelphia Pa American Philosophical Society) [187

Proceedings of the Second Meeting of the Animal Husbandry Win of the Board of Agriculture and Animal Husbandry, held at Madr from the 14th to the 16th December 1936 with Appendices Pp v + 284 (Delhi Manager of Publications) 3 10 rupees 6*s* 3*d* [

Further Zoological Results of the Swedish Antarctic Expedit 1901 1903 under the direction of Dr Otto Nordenskjöld Edited Sixten Bock Vol 3 No 4 Ascidiacea, Part 1 By A Arnbäc Christie Lund Pp 54 + 4 plates (Stockholm P A Norstedt a Söner) [18

Ministry of Public Works Egypt Physical Department Climatological Normals for Egypt and the Sudan Cyprus and Palestine Pp xv + 148 + 6 plates (Cairo Government Press) 40 P T [19

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Jaarverslag 1937 Pp 26 (Batavia Koninklijk Magnetisch en Meteorologisch Observatorium) [197

Sborník vysoké školy zemědělské v Brně Sign. C 34 Biometrický příspěvek k otázce vlivu individuality na délku doby březosti klisen Napsal Dr Zdeněk Munk Pp 53 Sign D 25 Los evropský [*Alces alces* (L)] v Polsku, Východních Prusích a Pobaltí (The European Moose-deer [*Alces alces* (L)] of Poland, East Prussia and Baltic Lands) Napsal Karel Kostroň Pp 99 (Brno A Píša) [197

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Science and a World Foundation

ON several occasions, attention has been directed in NATURE to the important work undertaken by the Committee on Science and its Social Relations, set up by the International Council of Scientific Unions, and views have been expressed upon the desirability of establishing an organization for the study of the social relations of science (see Supplement to NATURE of April 23, 1938). Briefly, the function of the former is to survey the scientific work done in certain fields, with a view to the issue at intervals of a report, with bibliography, concerning the influence of science on human society and the reaction of scientific study to the social environment, while the latter body would seek to advance knowledge on these matters by research and by the discussion and publication of papers, as well as in other ways It is generally agreed that both bodies should be careful to avoid propaganda and endeavour to be strictly impartial in the exercise of their judgment Scientific workers are rightly jealous of the high reputation they have earned for their purely objective approach to the questions they study, and it would be lamentable if any ill-considered action resulted in the devaluation of so precious a heritage.

On the other hand, men of science do not spend the whole of their lives in their laboratories They live at least as great a concern as others in the outcome of their labours, and it should be possible to satisfy these wider interests and aspirations without prejudice to the character or standard of their work. In considering the fit application of the results of their researches, especially in their bearing upon the relations between different countries, a general guiding principle has been enunciated to which the great majority of scientific workers would readily assent : that *the welfare of humanity and the interest of the whole community of nations should be placed before the narrower interests of any individual nation* Such a principle could scarcely be held to conflict with that objectivity of outlook which men of science endeavour to maintain On the contrary, to reach this ideal calls for a mental poise and freedom from bias which anyone might be proud to achieve It is certainly true to say that, whatever may have been the intentions of individuals, whether as private persons or as the representatives of their countries, its attainment has not proved easy in the past Frequently, failure has resulted from putting a lower in front of a higher loyalty, the protagonists of different Governments—and it may be doubted if any have been invariably blameless in this respect—when an important crisis has arisen, have adopted too parochial and partisan a conception of their responsibilities

This fact is brought out convincingly by Senor de Madariaga in "The World's Design", a penetrating analysis of post-War international politics. The author writes with unrivalled authority For more than six years he was head of the Disarmament Section of the League of Nations Secretariat, and later for about the same length of time he was his country's delegate to the Council, the Assembly, and the Disarmament Conference of the League The conclusion to which he came as the result of this experience is, therefore, highly significant He believes that the rivalry between nations will never be resolved until we succeed in convincing those who are in control of affairs that, whether we be Britons or Germans, Frenchmen or Italians, Americans or Japanese, we are all members of one world body, that consequently "there should be no schism in the body, but that the members should have the same care one for another The eye cannot say unto the hand, I have no need of thee And whether one member suffer all the members suffer with it, or one member be honoured, all the members rejoice with it" This surely must be the basis of the appeal made even to those who lay particular stress on the virtues of some nations and races at the expense of others, indeed the necessity to win their approval for that doctrine is the more urgent since our own good is so intimately bound up with theirs If we ourselves are driven, for the sake of petty retaliation or from a mistaken sense of what constitutes security to adopt a narrow self centred course of action we shall merely prolong and embitter the misunderstanding between nations

One aspect of an alternative and constructive policy, that relating to trade is rightly stressed in a report recently prepared by an expert committee of economists, bankers business men and others for a widely representative Conference on Peace and Economic Policies held at Washington in the spring of this year As it illustrates the trend of an important section of American opinion, an extract from it is worth quoting Urging their Government to make every effort to promote a greater interchange of goods and services between the nations generally, they say 'Trade can be called the world's most potent instrument of peaceful change Abundant trade between nations lessens the economic importance of boundaries removes most of the causes of complaint about lack of access to raw materials that can justly be made by any State on grounds of peace time needs, eases tensions over colonies in so far as those tensions are really rooted in economic grievances and are not simple matters of pride and prestige lessons the likelihood of exploitation of consumers by foreign or domestic monopolies, makes debt payments easier for debtors and more probable for creditors, facilitates thousands of everyday adjustments that in turn prevent the development of social conflict within nations and between nations" All this is sound sense, but how is the objective to be achieved ? Madariaga's proposal is that, instead of working within national environments which are inevitably influenced by national interests and outlooks, we should start from the other end, from the conception of world unity, and work back to differences in national policy, using this central conception to throw new light on the problem in hand

What part then can men of science play in hastening the desired evolution towards this world outlook in international affairs ? In the first place they can play an extremely important part by contributing to an expert and impartial survey, qualitative as well as quantitative of the world s resources in land and people raw materials and manufactured articles, buildings and technical equipment It is essential that we should begin by ascertaining these fundamental facts, if we are to seek to satisfy the basic needs of all nations and to make adequate provision for a rising standard of life notably in the more backward countries Already, much valuable research has been carried out along these lines by responsible bodies such as the League of Nations the International Labour Office the Royal Institute of International Affairs and the Institute of Pacific Relations But it is necessary to go further If such inquiries are to become really effective, they must be co ordinated, and public attention must be focused upon the conclusions reached

One example may be given to illustrate their vital importance and their possible repercussions upon events in the international sphere It is well known to men of science but not to the general public that nickel is an essential component of all steels used for armaments as well as for other purposes, and that practically the whole of the world's supply comes from a relatively small area in Canada Putting these two facts together, can we not draw the inference that it should be possible to limit the manufacture of armaments by controlling the distribution of nickel ? Surely here, actually in the hands of the British Commonwealth of Nations, is a powerful lever which has not been sufficiently explored for regulating international relations and securing peace, and unless world peace is assured, all hope of human progress and prosperity is dimmed What is true of nickel is true, in greater or less degree, of other important minerals and foods In fact the United States and the U S S R ar the only two great powers which do n customarily import large quantities of ess tial raw materials, and even they lack son commodities indispensable to normal economi life

It is for reasons such as these that the formation of a Scientific Section of Madariaga's World Foundation (see NATURE, June 18, p 1074) would be welcomed by many leading men of science A group of this character would be able to guide research into problems of world import and be a fitting medium for making the results public In this way scientific workers would have what they at present lack, opportunity for making the full weight of their collective opinion, based upon an authoritative and impartial study of the facts, felt in the councils of the nations A lead would thus be given which would no doubt be followed by other groups, drawn together, like men of science, on a functional basis It has been suggested, for example, that heads of universities and colleges might also combine to form a section of the World Foundation ; and possibly bankers and economists might form another Such a formation would have the advantage that the members of each section would know and could establish contact with distinguished workers in the same field in other countries Associated nuclei of thinking men and women would then be found throughout the world, all of whom would be contributing in their several ways to the education of public opinion directed to the same great end —the transformation of a League composed of a few nations into an effective World State

L 65/43

"La critique est la vie de la science"

The Grammar of Science

By Karl Pearson. (Everyman's Library, No 939) Pp xxv + 359. (London J M Dent and Sons, Ltd , 1937) 2*s* net

THE previous editions of the "Grammar of Science" were published in 1892, 1900 and 1911 They have been exhausted for a long time, but, whenever the question of a new issue was mentioned, Karl Pearson used to answer that the old text was out of date and that he was too busy with other work to undertake the necessary revision. It was never undertaken, and the present posthumous edition reproduces the chapters of the original one of 1892, using, however, their text as it was prepared for the edition of 1900

We must agree with Karl Pearson that some points in the "Grammar of Science" are out of date now. The progress in all branches of science during the forty-five years since its first appearance has been enormous, and many theories which then appeared as new are now obsolete or nearly so. Nevertheless, the book is worth preserving It sets out undying principles, and any book that does that must live The advance of science beyond where it had got when the book was written will appear far less important a hundred years hence than it does to-day, for the changes of the past forty years will have been changed. Looking back now, we see how the state of knowledge—or "belief"—in 1770 is little different from what it became in 1820, though in 1820 the difference seemed very important

But the "Grammar" does not represent any sort of text-book designed to provide information as to the actual state of science. It is just the *grammar* of science, or perhaps, of thought, and just here rests its permanent importance The purpose of the "Grammar" is indicated in the motto which is used as the title of the present article and is explained in the preface, where Pearson says, "There are periods in the growth of science when it is well to turn attention from its imposing superstructure and to carefully examine its foundations. The present book is primarily intended as a criticism of the fundamental concepts of modern science ."

The contents of the book are in harmony with the above announcement Reviewing the *principia*, the fundamental conceptions of science which were at the time either generally accepted or being introduced, Karl Pearson analysed carefully their real meaning He showed the reader how to distinguish between what is known and what is only believed in, what is a dogma and what is a generalized formula invented to put into a systematic order a number of sequences of sense-impressions Using simple examples, he explained that 'exact sciences' deal only with abstract conceptions which may or may not correspond to realities without losing their importance and usefulness For example, in physics and chemistry, we speak of electrons as of realities and probably there are realities corresponding to the concept of the electrons , however, even if there were none, nobody would deny the utility and the importance of the concept But between the world of concepts and the 'real' world of sense-impressions, there is a chasm which can be only bridged by a more or less accurate correspondence Geometry as a mathematical science deals with conceptions of planes, lines, etc. It is not concerned with dots which we may make on a sheet of paper or with the poles erected by surveyors. Still there is a correspondence—not an identity—between the two and such things as the configuration of dots and holes are the origin of geometry and also the practical part of its ultimate aim

In 1892 there was much confusion about these and similar points and as Pearson put it it was difficult to imagine anything more hopelessly illogical than the statements with regard to force and matter current in elementary textbooks Later on in 1900 Pearson recorded a considerable improvement and expressed the hope that the science of the future while agnostic as to the supersensuous will replace *knowledge* by *belief* in the perceptual sphere and reserve the term *knowledge* for the conceptual sphere—the region of their own concepts and ideas—of ether atom organic corpuscle and vital force—of physical and plasmic mechanics

There is no doubt that Karl Pearson s hope is by now fulfilled in many quarters For example the opinion that geometry is concerned with discovering the properties of a really existing space would probably be generally considered to day as very naive Yet the clarification of ideas about science has not affected all its branches to the same extent Paradoxically enough the very branch which was recently developed largely under the direct influence and inspiration of Karl Pearson himself is not in a very satisfactory situation I mean of course mathematical statistics Before Karl Pearson it could scarcely be considered as an independent science Since his writings however a great number of authors all over the world have been attracted by the subject and to day statistical literature concerned both with the theory and with its applications is enormous

Repeating the usual phases of development of all mathematical sciences mathematical statistics started with solving various particular problems having in view some immediate practical application One can easily understand the enthusiasm of the authors discovering more and yet more distant fields where their results could be usefully applied But this enthusiasm and the rapid and in many respects brilliant development of mathematical statistics could not escape certain dangers The rapidity of the development in width so to speak was associated with a much slower process in depth When reaching some result promising an important practical application the authors did not care to make much effort to put it into precise terms distinguishing clearly the conceptual and perceptual spheres of thought or to give satisfactory mathematical proofs

At the early stages such an attitude was understandable forgivable and probably even useful But it has established bad habits It is only in exceptional cases that present day authors think of distinguishing between what they have to say about observable facts and the conclusions deducible from postulates The two spheres are usually mixed

It would be easy to illustrate this but any example of importance and its subsequent discussion would take more space than an article like the present can afford to give It is therefore hoped to illustrate the problem in more detail elsewhere But to indicate what I have in mind I may quote a minor misunderstanding contained in a short passage from an important article published recently Unimportant as the example is it provides a remarkable illustration of the confusion of the perceptual and the conceptual spheres of thought The normal or Gaussian law of error rests partly on a particular hypothesis about the nature of error that the error of any individual observation is the resultant of a large number of comparable and independent components and partly on comparison with frequencies in actual series of observations Both arguments are defective If the Gaussian law rests on some hypothesis or other then these words are meant to denote merely some mathematical theorem But then any comparison with the results of actual experiments would be irrelevant On the other hand if the law is meant as a description of some observational facts then it could not rest on a hypothesis

Even when authors write on what purports to be the mathematical theory of statistics they do not aim at the accuracy of proof and presentation to which we have been accustomed in other branches of mathematics for many generations Lack of clear and systematically arranged definitions (for example some authors prefer to arrange them in alphabetical order !) makes it difficult for one statistician to understand another and their *knowledge* being mixed with *beliefs* they frequently engage in acute and fruitless disputes Unusual passages to the limit integration term by term of divergent series hidden and inadmissible differentiations under the sign of the integral are very common and the theorems purported to be rigorously demonstrated prove to be inapplicable in this that and some other particular case

To put it shortly it seems to me that with mathematical statistics we are to day in a period when it is well to turn attention from its imposing superstructure and to carefully examine its foundations The whole body of statistical knowledge should be revised and criticized including of course the work of Karl Pearson himself That statistical literature of the present day contains a considerable amount of criticism in general and of Karl Pearson in particular is true But this criticism is of a specific kind What is wanted is not attacks on particular authors but a dispassionate and constructive review of the whole body of our knowledge of mathematical statistics Owing to the work of the French School and of such writers as A Kolmogoroff and H Cramér the theory of probability is already on a proper level Similarly we have good expositions of the elements of statistical theory such as books by W P Elderton and by G Udny Yule and M G Kendall covering roughly what was thoroughly worked out either by Karl Pearson himself or by what may be called the first team of workers inspired by him Now is the time to set to work so that we may put in order what has been done of recent years to apply in fact to mathematical statistics the principles that Karl Pearson applied in the Grammar of Science to science generally By reminding us of these principles the new edition of the Grammar should do much to create among the theoretical statisticians the necessary critical spirit

J NEYMAN

Structure, Properties and Uses of Timber

(1) Timber
its Structure and Properties By H E Desch Pp xxi + 169 + 27 plates (London Macmillan and Co Ltd 1938) 12s *6d* net

(2) Timber Drying and the Behaviour of Seasoned Timber in Use
By R G Bateson Pp xiv + 138 + 7 plates (London Crosby Lockwood and Son Ltd 1938) 10*s* *6d* net

(3) Wood Preservation
By George M Hunt and Prof George A Garratt Pp ix + 457 (New York and London McGraw Hill Book Co Inc 1938) 30s

(4) Timber Products and Industries
the Harvesting Conversion and Marketing of Materials other than Lumber including the Principal Derivatives and Extractives By Prof Nelson Courtlandt Brown Pp xviii + 316 (New York John Wiley and Sons Inc London Chapman and Hall Ltd 1937) 17*s* *6d* net

THERE have recently appeared four manuals two published in Great Britain and the other two in the United States which deal with wood and its technical properties which with the exception of timber mechanics cover most of the available knowledge on the subject

(1) Desch has attempted to assemble all available information and in so doing has rendered a service as the literature available on the subject is at present scattered through many reports bulletins, records and pamphlets issued by research organizations and individuals

The author has divided his subject into four parts, dealing first with the structure of timber followed by a short treatise on its gross features Part 3 discusses the properties of wood, basing the information largely on investigations carried out in more recent years both in Great Britain and in the United States Seasoning of timber is dealt with under the heading Considerations influencing the Utilization of Timber the subject matter is good and it might more suitably have found place in Part 3 The book runs for 169 pages with ninety good illustrations The work is the first of its kind and should be useful

(2) Bateson s book is a complete treatise on the subject and is a welcome addition to the literature on timber technology especially as it incorporates all the most recent results of research The book opens with a discussion on the necessity of seasoning timber before use followed by a detailed description of what takes place as the wood loses its moisture which discussions lead on to methods of air and kiln seasoning

It is noticeable the practical way in which the author has approached his subject always keeping in mind the many difficulties the operator may encounter especially in kiln seasoning As an example may be cited the inclusion of drying schedules to assist those dealing with the more common timbers in use in Great Britain The descriptions of various types of drying kilns is fully gone into as also control instruments The chapter dealing with prevention of splitting and warping is instructive and it is shown how these defects may be greatly minimized by a little fore thought and expense The book ends with an engaging chapter on the future of seasoning timber in Great Britain in which the author is perhaps over sanguine as to extension of kiln seasoning The work is well illustrated and contains 131 pages of letterpress

(3) Wood Preservation , by Hunt and Garratt is a work of mark as might be expected from two authors with such wide experience As a text book it should admirably fulfil its object which is stated to be for the use of forest and engineering schools and for those employed in treating and using processed timber All factors governing antiseptic

treatment of timber are dealt with primarily referring to the industry in the United States while from the text it is very apparent that much of the data given and facts recorded are from observations made and results obtained in the laboratory and field by the authors themselves

The problems involved in wood preservation are discussed and two chapters are devoted to deterioration of wood which is estimated to amount in the United States to fifty million pounds sterling annually Both in Great Britain as in America and the Continent many hundreds of wood preservatives have been tried in the last eighty years but coal tar creosote and its derivatives may be said still to hold the day though latterly in the United States and in India creosote has been mixed with petroleum oils primarily with the object of reducing costs Much stress is laid by the authors on seasoning timber before treatment—and rightly so

The processes of treating timber are described but nothing very strikingly new is recorded Probably the most original part of the work is the chapter dealing with the economic aspect of preserving timber The end is a treatise on fire retarding treatment of wood in which it is stated that the industry has not developed rapidly in the States The book is of 457 pages and is illustrated by clear photographs and figures

(4) In Timber Products and Industries by N C Brown it is stated that the object is twofold to give in detail the many uses and processes of manufacture of wood in the United States and throughout to stress ways and means of reducing waste The author argues—and rightly so—that by grouping several wood working industries in the vicinity of large forests intense utilization of the crop may be ensured

The book is divided into seven parts commencing with constructional material and going on to chemically derived products—an interesting chapter In describing in great detail the naval stores industry which is the largest in the world and located in the Southern States the author continually uses the term gum for resin which would appear to be the common term used in the United States though curiously incorrect In connexion with this industry it would appear that by far the greatest quantity of resin is distilled in direct fired stills whereas in France and in India the process of distillation is carried out under vacuum in steam stills no doubt due to the fact that the resins contain higher boiling point oils The chapters dealing with mechanically reduced products and wood fuel charcoal briquetting and wood gas are of interest and worth study

The work covering 316 pages is extensively illustrated though the plates are in some cases neither clear nor sharp R S P

Current Physics

The Physical Society
Reports on Progress in Physics Vol 4 General Editor Allan Ferguson Pp vi + 389 (London The Physical Society 1938) *20s* net

A RAPIDLY changing science such as physics sets a difficult task to those attempting classifications or the preparation of annual reports Favoured classifications may be almost as numerous as the classifiers In any one year the amount of new results published in each of the main divisions of physics varies considerably Most of the results fit into one of two classes

In the larger class a physical constant or group of constants which has already been determined for n substances is determined for the $n+1$th substance These research papers are easy to classify to abstract and to tabulate It may well be doubted whether an ordered story of this kind of research helps either the research worker or the scholar The data are more readily accessible if presented in tables or in such a scheme as the card index system of the Science Museum library What is new in type in this class of researches is usually a matter rather of technique than of result

In the second type of research new properties of substances already examined by older methods are studied by placing the substance in a new environment where it is subjected to new physical conditions These researches are much fewer and are far more difficult to abstract to classify or to deal with in reports There can be little doubt however that all would wish to see them in annual reports both for their intrinsic interest and for the relevance of their results to work in progress

In this fourth annual volume of the Physical Society s reports the editor Prof Allan Ferguson explains in a preface the aims and objects of the reports The original suggestion was that each annual report would cover the main branches of physics and that one or two articles dealing with prior developments in some special subject would be included The policy of the Society is not however, fixed and immutable and the present volume shows a welcome increase in the number and extent of these special articles dealing with subjects as widely varying as the measurement of time supersonics in relation to molecular constitution refrigeration the application of Fourier series methods to molecular structures and the diamagnetic and paramagnetic anisotropy of crystals

There is in most of the sections a welcome unbending by the writers of even the most highly technical articles in that the standard terms of their subject are carefully explained For example on pp 339–40 Dr J M Robertson explains the term structure factor before dealing with the most complex crystal structure determinations

Biological factors are gradually receiving recognition and study in physics chiefly in applied physics They are unavoidable in musical acoustics and Dr F G Richardson in his general article on sound includes a section called conventionally Subjective Aspects containing reference to work on aural flicker In refrigeration the biological properties of food to be stored are briefly discussed by Dr Ezer Griffiths Mr W H Ward deals with electrical oscillation and biological materials

In all these subjects the relevance of biological properties of the material studied is readily apparent It is less apparent in general physics where its recognition might help clarity For example the observer is referred to in two quite different articles In a fascinating article on the measurement of time the Astronomer Royal has much to tell of the use of the eye and ear and of observations made by different observers Although he starts in astronomical style by stating that The measurement of time depends fundamentally upon the rotation of the earth on its axis it is clear from the subsequent discussion that he might equally well have started in biological style by declaring that The measurement of time like every other measurement depends fundamentally upon human judgment of coincidence The research worker is usually satisfied to take his time from standard time signals clocks and tuning forks Dr Spencer Jones here gives a clear and concise account of what has to be done by the astronomer to give these trustworthy standards The essential part played by the human observer is quite definitely stated

The second article referring to the 'observer' seems to leave the reader in some doubt as to the nature of the observer In his article on the beginnings of the new quantum theory Dr H T Flint explains that the behaviour of particles may be studied by means of the wave equation Reference is then made to observers When observers have made experiments and eliminated their own vagaries and those of their apparatus, they will come to the conclusion that in particular circumstances they have been able to locate a particle By using coincidence observation experimental physicists can locate tiny drops of oil in the Millikan experiment or of water in a Wilson cloud chamber or tiny fragments of sulphur in a Brownian motion experiment But none of these tiny objects is a particle They each have dimensions On p 166 it is stated that If we wish to locate a particle by any optical method as accurately as we can we illuminate it with very short wave length and look at or photograph the object using a microscope to help us Apart from the reference to a particle this statement suggests laboratory operations carried out by human observers

The Astronomer Royal leaves us in no doubt that he is writing about human observers with eyes ears hands and even initials (p 6) Dr Flint s exposition leaves the relationship if any, of his observers to the type discussed by the Astronomer Royal in considerable doubt

In general character the volume is similar to the *Reviews of Modern Physics* but with a wider scope than any one volume of the American publication The most striking omission is an index A classified annotated analysis of the year s physics books compiled from the monthly lists given in NATURE might be very helpful to those physicists who cannot use the larger libraries

At the end of his preface Prof Allan Ferguson for once seems to give up a little of his broad mindedness in order to warn reviewers against discussing co ordination in such work as the preparation of annual reports Nor is it a matter for grave concern if an article on recent advances in nuclear physics appears simultaneously with an article having the same title and published under the auspices of say the Zetetic Society Must scientific workers then like politicians wait until a matter is one for grave concern before doing anything about it ? If so they may at least deeply deplore the lack of co ordination In any case the present reports are published primarily in the interests of the Fellows of the Society Yet co ordination of the essential but non creative part of scientific work is surely in the interests of the members of any society The jovial personality of the present editor could secure co operative effort if it were humanly possible We may hope, therefore that in a future preface he will tell something of the avenues explored and the stones turned in the effort to secure co operation

W H GEORGE

Cryptogamic Botany

Vol 1 Algæ and Fungi By Gilbert M Smith Pp viii+545 24s Vol 2 Bryophytes and Pteridophytes By Gilbert M Smith Pp vii+380 18s (McGraw Hill Publications in the Botanical Sciences) (New York and London McGraw Hill Book Co Inc , 1938)

THESE two volumes together form a good general review of the Cryptogams in which representative series in each of the major groups are described in detail Though most of the types chosen are those found in the United States the majority are so very widespread that students who adopt these books for their reading in cyptogamic morphology need not necessarily be confined to the United States Thus, the work should be welcomed by British students, since though the major groups of Cryptogams are well reviewed in separate British text books, there are few satisfactory single works which cover all representative Cryptogams

Vol 1 opens with a discussion of the classification of spore producing plants The author gives cogent reasons for not recognizing the Thallophyta as a division of the plant Kingdom, but prefers to split the Algæ into several distinct divisions He also gives reasons for considering the Fungi as having evolved from Protozoa rather than Algæ, and therefore keeps them apart Following this discussion are descriptions of various types of Algæ Fungi, Fungi Imperfecti and Lichens

Vol 2 considers the Bryophyta and Pteridophyta The Bryophyta are considered in the evolutionary series—Hepaticæ, Anthocerotæ and Musci , thus the author follows Howe's suggestion that the Anthocerotæ (consisting of a single order—Anthocerotales) be placed in a special class co ordinate with the other two The Pteridophyta are divided into the more generally accepted classes—Psilophytinæ Lycopodinæ Equisetinæ and Filicinæ

These two volumes can be warmly recommended to students of cryptogamic botany In themselves, there is enough material for students reading for a general degree, whereas for the benefit of honours degree students and research workers there are about two thousand references

The Petrology of the Sedimentary Rocks

By Dr F H Hatch and Dr R H Rastall Third edition, revised by Maurice Black (Text Book of Petrology, Vol 2) Pp iv+383 (London George Allen and Unwin Ltd 1938) 15s net

MUCH research on problems connected with the sedimentary rocks has been carried out since the publication of the last edition of Hatch and Rastall's text book, in 1923 The appearance of a revised edition is therefore timely The author and subject bibliographies with which the latest edition is provided reveal the extent of the literature on sediments, and it is noteworthy that a very considerable proportion of the papers cited have been issued during the last fifteen years The task of revision, which has been carried out by Mr M. Black, must therefore have been no light one Actually a great deal of the text has been re written and the general arrangement of the subject matter has been modified Apart from the incorporation of new material, an important change is the omission of the chapters on metamorphism These, it is claimed would now be superfluous, owing to the publication recently of Dr A Harkers' book ' Metamorphism On the other hand, Mr T Crook's useful appendix on the minerals met with in the loose detrital sediments, which was excluded from the second edition has been re introduced in modified form

Mr Black has carried out his task very thoroughly and few omissions of any importance were noted It is perhaps to be regretted that a substance of such economic importance and scientific interest as bauxite should not have received fuller treatment and it is rather surprising that no reference is made to the limestone deposits known as cornstones that are so well known in Britain These, however, are minor blemishes in what is, to all intents and purposes, an entirely new text book, filling a definite gap in British geological literature Both Mr Black and the publishers are to be congratulated on its preparation

Rainfall and Tree Growth in the Great Basin

By Ernst Antevs (American Geographical Society, Special Publication No 21) Pp v+97+2 plates (Washington Carnegie Institution , New York American Geographical Society, 1938) n p

IN recent years drought has become a major problem in the western States, and it is important to study the variations of rainfall over as long a period as possible In this region there are few rainfall stations with long records—scarcely any before 1871—and the author accordingly set out to supplement these with data from other sources, such as historical records of rains and droughts, crops, the levels of lakes and rivers and especially the annual growth rings of trees

The area studied includes a number of lake systems in the Great Basin, mainly in Oregon, northern California, Nevada and Utah Each area is discussed in considerable detail and the results are expressed in curves and tabulations back to about 1850, with curves of tree growth permitting general estimates for longer periods The results of this detailed study are then combined in a summary of the major fluctuations of rainfall since 1801, from which the author draws some hopeful inferences as to a future improvement in the water supply In order to find a parallel to the drought of 1924–34, he has to go back to the 1840's Since 1887 there have been nearly three complete minor oscillations, but it is doubtful if these are truly periodic, and the predictions of water supply based on them are to that extent uncertain The final chapters give the curves of tree growth back to 1450 and discuss their significance

The book is a most interesting study of historical climatology, bringing together and interpreting several different lines of evidence in a sound and critical way

The Application of Moving Axes Methods to the Geometry of Curves and Surfaces

By Dr. G S. Mahajani. Pp vii+60 (Poona Aryabhushan Press, 1937). n p

APPARENTLY Routh was the first to turn to account the fact that the curvature and torsion of a space curve represent the components of rotation of the fundamental axes as they move along the curve. It was Darboux, however, who developed fully this application of kinematics

In the tract under notice, Dr Mahajani, employing vectors, derives a compact and manageable notation for the equations of relative motion The Serret-Freult formulæ form a special case, in the author's notation

$$\frac{d}{ds}(l_1, l_2, l_3) = \begin{vmatrix} l_1, l_2, l_3 \\ -\tau, \theta, \kappa \end{vmatrix},$$

where obviously the symbol on the right is to be read in a special manner. By assigning appropriate motions to the representative point, he succeeds in outlining much of the material discussed by means of these formulæ in the usual introductory course, including some results in the theory of curves on surfaces

The essay shows that, at any rate within the limits which its author has set himself, the method can be an elegant one. It may well appeal to those who find that their need of the subject is not continuous enough to enable them to memorize completely the calculus of the unit vectors *t*, *n*, *b*. A clearer exposition than Dr Mahajani's could not be wished for

Observationes Anatomicae Selectiores:

Amstelodamensium 1667–1673. Edited with an Introduction by F J. Cole. Pp. xi+45+59+4 plates (Reading: Prof F J Cole, University, 1938.) n p.

THIS beautiful little book, of which not more than a hundred copies are to be printed for sale, emanates from the Department of Fine Arts of the University of Reading, and represents a faithful reprint with the preservation of all grammatical, typographical and engraver's errors of two little tracts of the Private College of Amsterdam, copies of which in Great Britain were hitherto only to be found in the British Museum, the University of Glasgow and the Bodleian libraries In his excellent introduction, Prof. F. J. Cole states that these tracts are the rarest and least known of all the early literature of comparative anatomy The first tract printed at Amsterdam in 1667 contains notes on the anatomy of the calf, horse, bullock, sheep, swan, duck and dove, and the vivisection of a dog and frog, while the second tract published in 1673 deals mainly with the pancreas of fishes such as the sturgeon, herring, cod, turbot, pike, perch and trout. Of special interest to the biologist are the descriptions of injection of the branchial artery of a calf with mercury, the air sacs of the swan, duck and pigeon, the palatal organ of the carp, the swim bladder and pneumatic duct of the carp, pike and herring, and the ligamentous spiral valve or 'skrew gut' of the sturgeon.

Civilization and Disease

By Dr C P Donnison Pp xv+222. (London: Baillière, Tindall and Cox, 1937) 10*s* 6*d*

THE author, whose work is based on his experience as medical officer in charge of a native reserve in Kenya as well as in private practice in England, maintains that in a small but important number of diseases which can be divided into two groups a relationship can be traced between civilization and the disease The first group comprises four diseases, namely, high blood pressure, diabetes mellitus, exophthalmic goitre and peptic ulcer, while the second group consists of functional disorders usually known as psychoneuroses High pressure, it is shown, is rare in primitive races and its incidence increases with development in towns and with education, while it is common in the African in America and very prevalent in Europe and the United States The same holds good with regard to diabetes mellitus, exophthalmic goitre, peptic ulcer and psychoneuroses In other diseases, according to the author, there seems to be some relationship with civilization, but the evidence is too inadequate to justify any definite conclusions

Primitive Races of To-day

By J W Page Pp 348. (London George G Harrap and Co, Ltd, 1938) 8*s* 6*d* net.

ANTHROPOLOGISTS may cavil at Mr Page's use of the term 'primitive' as applied to existing peoples of the simpler cultures; but they will not quarrel with the acumen with which he has chosen his authorities, nor the ability with which he has singled out for mention the significant details in the various modes of life and their relation to environment, in these accounts of typical examples of food gatherers, hunters, cultivators and nomadic herdsmen The peoples whom he has elected to describe range in distribution from polar snows to the tropical forests of the equator and the islands of the Pacific Not all still exist to-day as described here, and others, as Mr Page notes, have long been diminishing in numbers, while rapid changes in culture are universal.

Mr Page's illustrations are well chosen, and his sketch maps, rough as they are, useful.

Applied Mycology and Bacteriology

By L D Galloway and Dr R. Burgess. (Modern Chemical Industries Series) Pp ix+186. (London. Leonard Hill, Ltd, 1937) 10*s*

THIS little book fills the need for a simple introduction to the study and control of bacteria and fungi. The treatment given herein is lucid, comprehensive and accurate The book may be cordially recommended, therefore, to those, such as chemists and others, having interests in the supervision of foods, water, textiles and perishable goods generally, who wish to obtain some understanding of the agents of decay and how to circumvent them. Even the specializing microbiologist can learn of developments outside his own sphere. Production is good, and misprints are all but absent. H. N.

Fundamental Aspects of Erosion

By Dr. E. G. Richardson, King's College, Newcastle-on-Tyne

EROSION is a problem of considerable complexity which cannot readily be expressed in terms of known physical laws Up to the present, it has lain mainly in the sphere of the engineer, who has evolved a number of empirical laws for predicting its magnitude It is evident by the disagreement not merely in coefficients but even in the functions on which the erosion is made to depend, that these rules are designed only to fit the conditions which fall within the experience of particular engineers and have no universal application Before further progress can be made in combating the evil, one must attempt to reduce the problem to its simplest proportions

Pioneer fundamental research in the subject was carried out by Gilbert in 1914 in America, while recently Hjulstrom[*] in Sweden and I myself[†] in Great Britain have independently carried out laboratory and field experiments in which the question has been studied under conditions which reduce the variable quantities to a minimum The factors which then remain can be grouped under two headings first, those which concern the eroding stream—whether it is in steady motion or turbulent and in particular the value of the gradient of stream velocity at the surface of the soil , secondly, the nature of the soil bed, the size, shape and density of the grains and whether they are closely or loosely compacted.

In field experiments, all these factors intervene in a fashion which does not allow of the separation of their respective contributions It is desirable, as a basis for establishing the laws of erosion, to make experiments first in artificial channels, using a bed of loosely compacted and nearly homogeneous particles so that the factors just enumerated can be varied one at a time. Measurements are then made of the mean quantity of silt transported at various heights above the bed and of the gradient of mean velocity transverse to the stream in the same vertical section I have made such observations in a glass-sided channel having a wooden floor on which a bed of sand, graded within fine limits by sieving, was laid The velocity of the stream along the channel was measured from point to point by a hot-wire anemometer, while the silt concentration at any level was measured photo-electrically in terms of the absorption which a narrow beam of light cast athwart the stream suffered in virtue of the intervening sand carried in suspension Although the experiments were actually carried out in water, there is no essential difference between the behaviour of air and water in this respect, due regard being paid to their relative viscosities and to the relative buoyancies of the eroded material in the two media

The disturbing influence on the soil which lifts the grains into the stream is in the main due to the shear on it, that is, the product of viscosity and the velocity gradient at the bed, while the restoring force is determined by the natural rate of sinking of the grains Under the combined action of erosion and gravitational force, the grains are so distributed that the silt concentration at any level fluctuates about a mean the value of which falls off exponentially with height, at least over the major part of any vertical section. If the bed be changed for one of coarser but still homogeneous particles, the exponent in this relation and with it the total quantity of silt carried in suspension diminishes in consequence of the faster rate of free fall of such particles If then one plots the height against the logarithm of the silt concentration, a line is obtained which is almost straight (except near the bed) and the slope of which can be taken as a measure of the erosion coefficient For a given velocity gradient, provided the stream is sufficiently turbulent to afford adequate mixing, this coefficient is found to be inversely as the grain size, bearing out theory in this respect

Similar considerations apply in natural streams, where the bed, of course, is not homogeneous. Samples taken out of the River Tyne in flood at various depths and analysed in respect of size-frequency give a series of curves the mean slope of which for each size follows the same law Occasionally it is reported by hydraulic engineers (who measure in terms of surface velocity and slope of bed) that 'colloidal' particles are less easily eroded than somewhat larger ones, so that in a mixed bed there is maximum rate of erosion occurring for a diameter round about one tenth of a millimetre. This anomaly is usually attributed to the superior cohesion which a clay sludge possesses. The exception, however, disappears if one reckons erosion in terms of the velocity gradient instead of surface velocity for it is well known that the distribution of velocity across a stream carrying finely divided or colloidal material is not the same as that in homogeneous fluids or in those in which large crumbs of sparsely distributed soil are in suspension

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[*] *Bull Geol Inst Uppsala*, **25**, 221 (1935) This paper contains a bibliography of erosion Other more recent accounts of (gross) silt transport will be found in *Water Pollution Research, Tech Paper* No. 7 (1937), *U.S Waterways Expt Stat. Paper* No 17; *U S Geol. Survey Water Supply Paper* No 797; Y L Chang, *Proc Amer Soc Civ Eng*, Nov (1937).

[†] *Phil. Mag.*, **17**, 769 (1934), *Proc. Roy Soc*, A, **160**, 583 (1937).

The extent to which the soil allows the fluid to permeate it has probably the most important influence in loosening the bed prior to actual erosion When water passes over the soil a certain amount of chemical action may take place particularly when the surface soil is a limestone formation but whether this occurs or not once the water is able to break up the soil into smaller crumbs or to encircle those which already existed before its passage it can exert pressure to move the formerly coherent grains which then become potential silt Sometimes an actual lifting force may be exerted that is to say the line of action of the pressure may be inclined upwards instead of along the bed This happens notably when a grain is lying a little higher than its fellows on the bed and its foundations are partially or completely undermined by the fluid The local velocity at the top of the grain is then greater than that beneath so that the force towards the underside may exceed the total of gravity and the downward force on the top Such a state of affairs often occurs where a pebble is resting on a sandy bottom and the resultant force may lift it momentarily into the body of the stream As soon however as it has risen above the boundary layer of fluid in which the major part of the gradient of velocity is found the lift is lost and it sinks back

This accounts for the series of long hops by which the heavier particles follow the stream and the ultimate formation of ridges or dunes but this process does not in my observation contribute markedly to the silt load of the stream itself which is a function merely of the degree of turbulence velocity gradient and grain size Penetration of the soil by the eroding fluid can nevertheless change the distribution of velocity near the bed—in fact at a sandy bottom the gradient of velocity may show a point of inflection separating the domain of quasi fluid motion above and quasi solid flow below—and in this way react on the silt load carried in suspension

How, then, do the means commonly adopted for the prevention of erosion stand in the light of these results ? Attempts to lower the overall slope of the land by farming on the terrace system or by obstructions in the form of vegetation would seem to be but partial palliatives at least so far as water action is concerned since when the water level is low the gradient at the bed may still be large while if the water level is high over soil of small permeability and the slope or obstruction is effective in keeping down the erosion coefficient it will hold up the run off and leave the land waterlogged What the water engineer requires is a system which will keep the shearing force on the bed small while not unduly impeding the run off above In the case of a river this desideratum may be secured by a series of check dams or shallow weirs placed at short intervals across its bed In this way the stream goes down a shallow staircase the main flow is unretarded but the motion near the bed is almost at a standstill Such a device is already in use to a certain extent on the Continent and the accompanying photograph shows how it is applied to the River Alp in Switzerland To combat sheet erosion on farm lands application of the same principle suggests the close sowing of dwarf herbage to impede the action of wind or rain within an inch of the soil while leaving free circulation above

CHECK WEIRS ON THE RIVER ALP SWITZERLAND

To measure the efficacy of such remedies it is necessary to take hourly or at least daily readings of the total silt load of rivers and farm drains and to correlate these with local rainfall Assuming the exponential relation between silt concentration and depth already noted it appears that measurement of concentration at two levels will suffice to determine the erosion coefficient this together with the average stream velocity, will determine the total rate of silt transport and hence the net total erosion above the observation station I have employed an apparatus for this purpose in the Tyne at Newcastle consisting of a pair of light beams and photo-electric cells placed at one third and two thirds of the depth below the surface, the mean flow being measured at the same time on a meter of the rotating vane type Hjulstrom has made measurements to the same end by actual weighing of silt samples taken out of the River Fyris at Uppsala It is really surprising what large silt loads can be carried annually by comparatively sluggish rivers. Thus Hjulstrom estimates that the Fyris—normally quite translucent—carries away more than 60,000 tons of material—soluble and insoluble—from its basin every year past the bridge at Uppsala. The figure for the more turbid and fast-running Tyne has not been precisely estimated; but it is considerably in excess of this

Research in Freshwater Biology in Great Britain

THE need for a biological station for research on problems connected with freshwaters was emphasized at the meeting of the British Association at Glasgow in 1928, and this led to the foundation of the Freshwater Biological Association of the British Empire in 1929 Two more years of active work on the part of the many men of science and others interested in the project elapsed before the laboratory was founded at Wray Castle on the shores of Windermere in 1931. At first there were but two members of staff, making the best of a few rooms without laboratory fittings, but from 1931 until the present year progress has been rapid, as is well shown by the recently issued sixth annual report*

The whole of Wray Castle is now occupied, there being on the ground-floor seven laboratories, fitted with adequate benches, sinks, electric light, power and gas, and upstairs a library, offices, and a number of living rooms capable of housing the unmarried members of the staff and up to a dozen scientific visitors There are now seven resident scientific investigators Dr E B Worthington (director), five assistant naturalists, and a bacteriologist, who cover all the major branches of the subject. These, together with secretarial and laboratory staff, should place Wray Castle among the foremost freshwater biological stations in the world, and make it capable of carrying out work of national importance

The interests most closely concerned with freshwater biology may be grouped into three categories—academic research, fisheries and water-supply—and each contributes materially to the finances of the Association. Accordingly, some limit has to be put to the scope of the work which is undertaken, those subjects being chosen which are likely to elucidate the factors which control the production of life, both qualitative and quantitative. The extent and variety of waters within easy reach of Wray Castle give ample scope for work on the many subjects involved

One promising line followed up during the past twelve months is connected with the bottom deposits of lakes With the co-operation of the Hydrographic Department of the Admiralty, a detailed bathymetric survey was made of Windermere by the new supersonic echo-sounding method The records revealed not only the depth of water but also the thickness of soft deposits overlying the glacial basin In addition, cores of the deposits have been obtained and appear to reveal a succession of cold and warm phases during the early history of the lake, so that a good opportunity exists for adding to knowledge of the post-glacial history of the district This research has more than historical significance because the use of the echo-sounding machine to demonstrate the thickness of soft deposits below a considerable depth of water has an immediate application to reservoirs, where the accumulation of mud may lead to greater production of algæ, and other troubles in filtration and purification of water for domestic purposes

Work in past years by Prof. W H. Pearsall, Mr R. Misra and others has demonstrated the great importance of the character of bottom muds in controlling the chemical (especially nitrogen) balance, and also the plant and animal associations Here an investigation at Wray Castle on the bacteriology of lakes, streams and bottom deposits, which is being financed by the Department of Scientific and Industrial Research, may be very significant Attention will be devoted by Dr. C. B. Taylor, who has been appointed to the new post, primarily to the part played by bacteria in the nitrogen and phosphorus cycles Closely linked with this is Dr. C H Mortimer's work on the chemical budget of a whole drainage basin. This has involved routine chemical analyses and the measurement of water-flows of rivers throughout the year, in order to estimate the quantity of different salts entering and leaving Windermere The effect of chemical factors on the growth of algæ is studied by Dr. M. Rosenberg by correlating the quality and quantity of algæ, as observed in natural conditions, with the chemical content of water at different depths and at different times of the year. In addition, many species of algæ have been taken into pure culture in the laboratory, where their reactions to altered conditions, in rate of multiplication and morphological change, can be studied under controlled conditions

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* The Freshwater Biological Association of the British Empire Sixth Annual Report for the Year ending March 31st, 1938. Price to non-members, 1s.

This brings us to the work on animals, and here freshwater biology is still suffering under a disadvantage because the basic faunistic studies, such as were characteristic of the early work in marine biology, have never been properly undertaken The taxonomy of the aquatic stages of winged insects, for example, is still in a lamentable state, although work at Wray Castle on breeding ephemerids, caddis-flies and stone-flies is now helping materially in this direction It is in the hands of Mr T T Macan, who is working on the ecology of the Invertebrata, devoting special attention to corixid water-bugs Such studies are specially necessary in view of the importance of most of the groups as fish-food

Of the fish themselves, most attention has been given in the past few years to the salmon, the freshwater life of which up to the stage when smolts reach the sea is being studied by Mr K R Allen By detailed work in three widely separated parts of the British Isles, the Lake District, the extreme north of Scotland, and the south of England, he is obtaining comparative data of value in determining the factors which control their growth-rate and behaviour A new fish study is concerned with the so-called 'coarse fish', which contribute so much to the health and recreation of a large section of England's population This investigation has been financed by the fishing interests, and Mr P H T Hartley, recently appointed to undertake the scientific work, has a sure backing from the National Federation of Anglers

There is another aspect of the Association's work, connected with parts of the Empire other than Great Britain Already Wray Castle has served some purpose as a centre for information on freshwater fisheries in Africa, where the director has had extensive experience of research Local problems of fisheries or water-supply are bound to become more numerous as Colonial development proceeds, so that the Freshwater Biological Association may have opportunities of extending its usefulness in this direction

Viewing these activities as a whole, it may perhaps be fairly claimed that the laboratory at Wray Castle, though still young, is well on the way to becoming a worthy partner of its elder brother—one might almost say father—the Marine Biological Association's Laboratory at Plymouth

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Analytical Methods in the Dating of Books and Documents

By Dr. Julius Grant

THE problem of establishing the date of origin of specimens of paper, for example, from books or documents, is one which arises frequently, but which is seldom solved without controversy In many such cases, suspected forgeries of valuable first editions of books are involved, whilst others are concerned with forgeries also, but possibly of greater criminological interest. Where written documents are in question, the ink expert has in the past usually been able to provide the strongest links in the chain of evidence, although with printed matter his contributions are necessarily restricted. However, since the date of the manufacture of the paper must always precede that of the application of ink (whether as handwriting or as print), the date arrived at as the result of an examination of the ink must always represent the paper as younger than it really is, and when the gap between the two dates is a big one, serious errors in dating may arise

In addition to that obtained from the ink, useful evidence has in the past also been drawn by the book expert from the nature of the type used, the format of the book, the binding, the illustrations and so on; these are all characteristics which demand an intimate knowledge of book production and its history In spite of this, there have been many instances where evidence of this kind, based as it must be largely on personal opinion, has proved inconclusive and even contradictory

The paper has, of course, also contributed its share of evidence, although not to the extent merited by the importance of the information it is capable of supplying This may have been due to inadequate co-operation between the experts on bibliographical and paper-making matters, and possibly to indifference to the interest and value of such studies on the part of the latter The importance of paper, particularly where the examination of first editions is concerned, depends to a great extent on the fact that, unlike printing type, the format of the book and so on, it is most difficult if not impossible to make a completely successful imitation of a given paper without employing the same materials and equipment as those used in the original Watermarks may be imitated, although these can now be detected with the aid of ultra-violet light (see J Grant[1]), and the character and appearance of a particular paper may be simulated, but as a rule a few comparatively simple analytical tests will reveal any essential points of difference.

Relatively new ground, therefore, was broken by J. Carter, and G. Pollard[2] when they used the fibre content of the paper as a means of dating it These workers were concerned principally with certain nineteenth century pamphlets, including works by Tennyson, Dickens, the Brownings and others, which were alleged to be genuine first editions Thus one particular case referred to a copy of Tennyson's "Morte D'Arthur" which was dated 1842 , when this was suspected, the fibre content of the paper was determined and was found to include esparto grass and wood pulp which had been prepared by a chemical process Since esparto was first processed in 1861 and wood some twenty years later, the forgery stood revealed without any doubt

It is apparent that the extension of this method of dating by reference to the introduction of a new raw material is full of possibilities, and since the work of Carter and Pollard this line of investigation has been pursued with highly successful results in many cases As explained below, however, there are many instances where the value of the method is only as a supplement to evidence obtained from the usual sources Two obvious conditions must in fact be satisfied in order that this type of test may be applied with any degree of reliability In the first place, the earliest date when the material in question was first used in paper-making must be known accurately , and in the second, a trustworthy method of establishing the presence of this material must be available Incidentally, as indicated below, one is not restricted to tests for the actual constituents of paper , new methods of manufacture serve the purpose equally well, so long, of course, as the two conditions specified above are fulfilled If enough characteristics of the above kinds can be assembled, it is conceivable that the date of origin of a paper may be 'sandwiched' between any two of them, and possibly be deduced to within a few years

There is no lack of suitable analytical methods for this work Unfortunately, there is less certainty regarding the years when some materials or processes were first used, and this places the principal restriction on the method Many innovations are not recorded in the literature, having been worked secretly in the first instance ; others are hidden in the obscurities of the early patent literature. In such cases, all that the method can do is to supply evidence that a paper which reacts positively to the test in question was made after the date of the earliest reliable record available. The importance of this proviso is greatest when papers made before the middle of the last century are under consideration, because the records of invention become progressively fewer as one goes back chronologically. In the future, on the other hand, this method of dating will become increasingly more valuable, because each year sees a fresh contribution to the technology of paper-making, and most of these can be detected and dated reliably.

Some examples of the application of these analytical methods will now be given. They fall into two main categories, namely, those involving the constituents of the paper, and those based on innovations in paper-making technique. As already pointed out, Carter and Pollard are the pioneers of the former method, although their work was restricted to tests for rag, wood and esparto fibres. This system may, however, be extended considerably, because several kinds of wood, as well as other fibres such as straw, are also used in paper-making

Up to the beginning of the last century, 'rag' fibres (that is, mainly linen or cotton) were the only materials of paper-making At about this time (1804) paper was first made by machine, as distinct from hand, and incidentally this is itself a reliable milestone, because a machine-made paper is easily recognized, and must be later than 1804 Owing to the rising standard of education, the demand for paper increased rapidly, and this led to an acute shortage of rags, the position being such that in 1854 a prize of £1,000 was offered by *The Times* for the discovery of a suitable substitute Straw was the first-comer in the field, and by 1860 mixtures of straw and rags were common , as they gradually declined in popularity (in Great Britain in any event) after the advent of esparto in 1861, such mixtures serve to date a paper as certainly later than 1855, and probably as between 1855 and 1870

Similarly, there was a transition period when mixtures of esparto and rag—a rare mixture nowadays—were quite common, and these serve to date a paper as certainly after 1861 and probably earlier than 1890 Wood was the next raw material, and of course in a relatively short time this became the most important of all fibres, at any rate so far as the cheaper grades of paper (for example, for books) were concerned ; full use of this is made by Carter and Pollard It should be pointed out, however, that within recent years the investigator has been enabled to distinguish between woods of different types and prepared by different processes, from a microscope examination of the disintegrated fibres of the paper. Incidentally, fluorescence microscopy in ultra-violet light (see J. Grant[1]) has proved of considerable assistance in this connexion It is thus possible to distinguish not only woods prepared by the mechanical process and by a chemical process but also woods prepared by different types of chemical processes (for example by the acid and alkali methods of digestion) and as the dates at which these processes were introduced are known accurately these analytical tests may prove of considerable aid in dating

Even to day new fibres continue to appear Bamboo is an example and it indicates that a paper is of Indian origin and probably later than 1930 Straw also can now be produced having a colour and degree of cleanliness which enable it to be used in fine papers and other recent additions to the paper makers fibres are bleached kraft alpha pulps and cotton linters these all have a certain amount of dating value so far as modern papers are concerned Incidentally the fibrous composition of a piece of paper may be ascertained by examination under the microscope of a few fibres scratched inconspicuously from the edge of the sheet this has obvious advantages where a valuable document is concerned

The fibres are not the only constituents of paper which have a dating value thus sizing materials loadings and colourings may all play a part Sizing provides an interesting example because there seems little doubt from the literature that rosin was first used for rendering paper non absorbent towards ink in about 1800 but that its use was confined to Germany until about 1835 Rosin in paper may be detected with relative ease and certainty and since the period around 1835 is one for which dating evidence is none too abundant this fills an important gap Loadings may be of interest partly because of their chemical nature and also by reason of the quantity present in the paper This is because when with the advent of machine made paper it became usual to sell paper by weight instead of by the sheet or ream many paper makers succumbed to the temptation to add to the former by the use of excessive quantities of loading The weakening effect on the paper was such that public opinion soon put a stop to this practice except for certain classes of paper (for example for the reproduction of illustrations) but there is a certain period (after 1820) when papers containing 30 per cent of loading were common Such papers are easily recognized because unless they have been stored under particularly favourable conditions the effects of ageing are strongly in evidence in many cases they fall to pieces at a touch (cf J Grant[4]) A recent addition to the loadings used in many papers is titanium dioxide and the white pigments associated with it these are easily detected and place the paper without any doubt as later than 1930

Coloured papers are seldom used for important documents although they can often supply very useful dating evidence Aniline dyestuffs for example were not used in paper to any great extent between the year of the discovery of the first of them (1856) and 1870 but after the latter date they became common The dating value in cases where the actual dye used can be identified is considerable because the patent records provide a trustworthy key to the history of the dyestuffs industry The mineral pigments used for colouring paper before the advent of synthetic dyestuffs also have a certain amount of dating value Ultramarine is the commonest of these and according to legend its use in paper originated from the mistake of a paper maker s wife who dropped her blue bag into her husband s pulp vat instead of into her own wash tub which stood adjacent to it in the home factory of those days Whatever the details of the discovery the date of its occurrence (about 1790) is known and as ultramarine is easily detected it may be used as an aid to the dating of blue papers of this period

Finally those improvements in paper making technique which have left their mark on the physical structure or character of the paper may have considerable dating value Watermarks provide one example although their importance as indicated above is limited The transition from hand made to machine made paper has also been mentioned while I have found that the use of the beater instead of the stamping mill to prepare the pulp is an important dating characteristic because it took place at a period (about 1670 on the Continent) for which little other dating evidence is available Unfortunately the identification of such paper which is carried out by examination of the fibres under the microscope is not always easy Calendered papers are however more easily recognized and date from 1830 and coated papers which are used for illustrations frequently serve to date the paper constituting the remainder of a book in which they are inset because it is known that they were first made in 1890

The examples given above might be supplemented considerably It is believed however that they suffice to indicate the possibilities of the application of analytical methods to the dating of paper As already pointed out the importance of the method should increase considerably as time goes on because of the increasing number of new methods and materials now being introduced into the industry and the fact that the dates of their introduction are known with accuracy

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Obituary Notices

Prof. J. J. Abel, For. Mem. R.S.

NEWS of the death of John Jacob Abel on May 26 last was received with the deepest regret by pharmacologists all over the world as well as by a much wider circle of those who knew the man himself and could assess the value of his work and influence in advancing medical knowledge generally. He was one of the few surviving links with the beginnings of pharmacology as a separate discipline.

Abel was born at Cleveland, Ohio, on May 19, 1857, and entered the University of Michigan at nineteen years of age. He obtained the degree of Ph.B. there in 1883, after which he spent a year in graduate study at Johns Hopkins University. In 1884–88 he studied chemistry, physiology, pharmacology and medicine in various universities in Germany, and in 1888 took the degree of M.D. of the University of Strasburg. He spent a further two years in Vienna and Berne, and in 1891 returned to America as professor of materia medica in the University of Michigan. Two years later he became the first professor of pharmacology in Johns Hopkins University, a position which he held with so much distinction until his retirement in 1932.

The first Institute specially devoted to pharmacology was founded at Dorpat in 1847 by Rudolph Bucheim. Bucheim was succeeded at Dorpat by his assistant Oscar Schmiedeberg who, in 1873, was called to the University of Strasburg, and there established an Institute of Pharmacology, which soon attracted workers from all parts of the world. Abel was one of these, and he had thus, through Schmiedeberg, connexions with the beginning of pharmacological laboratories. When new positions in pharmacology were first created, most of those who were called to fill them had worked in Schmiedeberg's laboratory, and Abel from his work in this and other European universities came to have a personal knowledge of those men who afterwards became the pioneers of pharmacology throughout the world. Another of Schmiedeberg's pupils, A. R. Cushny, was selected by Abel to succeed him at the University of Michigan, and these two men exercised a guiding influence upon the development of pharmacology in the United States.

In 1909, Abel founded the *Journal of Pharmacology and Experimental Therapeutics*, which was the first pharmacological journal published in English, and in the editorship of which he was later joined by Cushny. The journal is now the organ of publication for both the American and British Pharmacological Societies. In all that concerned the early development of pharmacology in English-speaking countries—in the establishment of new laboratories, in the selection and training of young men to fill newly created positions and in providing a channel for the publication of their researches—Abel played a dominant part.

This influence, however opportune and important for the development of pharmacology, could not have become so great had it not been supplemented and vitalized by the brilliance of Abel's personal achievements and by the example of his patient and persistent devotion to research. One of his earliest investigations was concerned with the occurrence of aliphatic sulphur compounds in the animal body. This experience helped him later in the successful crystallization of insulin, for he had found that fractions of insulin preparations contained labile sulphur in proportion to their hypoglycæmic power. He was one of the earliest workers on hormones, and succeeded in obtaining an active principle of the suprarenal gland in the form of a monobenzoyl derivative which he called epinephrine. Later Takamine obtained the free base, adrenaline. The determination of the chemical constitution of adrenaline and the discovery that it was a relatively simple body gave an impetus to that study of the constitution of other hormones which has developed so rapidly in recent years. Abel himself later found adrenaline in the secretion of the skin glands of the toad, *Bufo agua*.

In another direction Abel did pioneer work, in devising a method, 'vividiffusion', whereby blood from a living animal could be diverted through a dialysing apparatus and then returned to the body. A study of the dialysates showed the constituents that occur free in the blood.

Abel also studied the active principles of the poisonous mushroom, *Amanita Phalloides*, and found two active principles, a hæmolysin and a non-hæmolytic toxin, the latter being responsible for the toxic effects of the fungus when ingested. Abel and Rowntree investigated various phthalein derivatives with the primary object of obtaining a purgative suitable for hypodermic use. They found that phenolphthalein was excreted solely by the kidney, and this led to its use later as a test for the functional activity of the kidney. Halogen substitution products of phenolphthalein were found to be excreted in the bile only, and this led to the development of tests for liver function by such compounds.

Abel worked also on the action of convulsant dyes, on the physiology of the lymph hearts of the frog, and did some of the early work in the newer domain of chemotherapy in his investigation of the action of antimony compounds in experimental trypanosomiasis. His work covered a wide field, as did that of most of his contemporaries in pharmacology, and was always characterized by imagination as well as by the skill and tenacity with which he pursued a problem.

After his retirement in 1932, Abel still had a room in Johns Hopkins University and up to the end was actively prosecuting researches on tetanus toxin. I still retain a vivid memory of listening to Abel, three years ago, when he outlined the purport of this investigation with all his wonted enthusiasm and modesty.

Abel was the recipient of many academic honours and became honorary or foreign member of many learned societies in many countries Perhaps none would have given him greater pleasure and satisfaction than his election as foreign member of the Royal Society, which took place only a few days before his death

During the time in which pharmacology has been emerging as a separate science with its own laboratories and followers, Abel has been an outstanding personality to whom that science must for ever remain in debt His tall spare figure and genial presence will be sadly missed not only in his own country but also wherever men forgather who are interested in the progress of medical research J A GUNN

Sir Colin Mackenzie

WE regret to announce the death of Sir Colin Mackenzie, formerly director of the Australian Institute of Anatomy, at the age of sixty one years

Though Sir Colin gained great distinction as an orthopædic surgeon yet he devoted himself to anatomy with an enthusiasm that might be expected to flow only from great genius He was lecturer and examiner in anatomy in the University of Melbourne He was a member of the Anatomical Society, served eagerly the Zoological Society of his city, established and furnished a whole museum with dissections of marsupials, strove to secure the preservation of the Australian fauna, and wrote their comparative anatomy in four volumes His faith in anatomy induced the Commonwealth Government to erect in its Federal capital an anatomical institute under his direction

Sir Colin's book, 'The Action of Muscles', contains an epitome of his anatomical observations and ideas In about fifty pages, under the title of principles, he states what he has come to believe about muscles The reader is constantly referred to what happens in the wombat, frequently assured that the action of muscles can only be understood by an appeal to their evolutionary history, and is admonished to consider the behaviour of the primates and the assumption of the erect posture The principles which he enunciates owe nothing to these allusions to the primates or to the illustrations of marsupial anatomy The dissections of the wombat seem quite irrelevant to his principles of muscle action which have to do with the treatment of paralysis

More than thirty years ago, when the treatment of fractures and muscular palsies was very bad, Mackenzie was preaching and practising his principles He pointed out the error of describing a muscle as paralysed because it was unable to perform its maximum amount of work More careful inquiry might discover that such a muscle still had some power The muscles of the shoulder might not be able to lift the limb against gravity, yet perhaps could swing the arm from the side when the body was horizontal and gravity thus excluded Inflamed nerve cells like any other inflamed tissue must be put at rest A motor nerve cell could only be rested through its muscle A muscle is placed in a state of physiological rest when its antagonists are kept over stretched Thus by rest, and then utilizing the residual power left in an affected muscle, by patience and persistence he accomplished much Muscle and tendon transplants were advised only when re education seemed hopeful He cut through much that was unimportant in the teaching of muscle action by his blunt insistence that a muscle had always one prime action to perform and only co operated fully in other actions after its prime action had been fulfilled He insisted upon muscle re education and saw that this was only hopeful when the alteration of the attachments demanded the least change in function and when there was greatest cerebral control Thus the gain in usefulness was in general far greater in the arm than in the leg

His work in mitigating the terrible consequences of infantile palsy led to far greater interest in these matters His experience was made available in the orthopædic hospitals of Great Britain during and after the Great War In his own city more people skilful in these matters are available than perhaps anywhere else He deserves an honourable place amongst The Menders of the Maimed

Miss D M Liddell

WE regret to record the death, which took place on May 25 at the Old Rectory, Stratfield Turgis, Basingstoke, of Miss Dorothy Mary Liddell, well known as an experienced and fortunate excavator on archæological sites

Much of Miss Liddell s early experience and training in archæological work was gained by her participation in the excavation of the famous Windmill Hill site of neolithic culture, explored by Mr Alexander Keiller The effect of this training, combined with a natural flair for archæological work, were used to full advantage in her discovery and patient exploration of the Roman house at Lodge Farm, North Warnborough, and also in the discovery and examination under the auspices of the Hampshire Field Club of the extensive pit dwellings at Chosely Farm, Odiham Previously she had spent some seasons at work on Chilworth Ring, on Meon Hill Her most lasting contribution to archæological analysis, however, is probably the patient and detailed study she made of stamped impressions on neolithic pottery The results of prolonged examination of innumerable specimens of potsherds and of a prolonged series of experiments and photographic work were embodied in an article in *Antiquity* in 1929, "New Light on an Old Problem", in which the central idea of the use of bird bones as an instrument of ornamentation had been suggested to her by the discovery of a large quantity of "West Kennet" pottery associated with a small bird bone

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WE regret to announce the following deaths

Prof E W Brown, F R S, emeritus professor of mathematics in Yale University, an authority on lunar theory, aged seventy one years

Mr G Nevill Huntly, consulting chemist, on August 2, aged seventy one years

News and Views

L'Abbé Breuil

M. l'Abbé Breuil, professor in the Institut de Paléontologie Humaine and of prehistory in the Collège de France, has been elected a member of the Académie des Inscriptions et Belles Lettres. This signal honour is conferred in recognition of his work in prehistory and more especially of his studies of the art of the palæolithic age. The Abbé has now been recognized for nearly a generation as the foremost authority on prehistoric archæology not only in France, but also in the whole world; and his opinion on any disputed point is universally regarded as a court of final appeal. His election to the Academy is a matter of peculiar gratification to his colleagues in France, as it is the first occasion on which the study of early man and his culture has been honoured officially in this manner; for although de Quatrefages was a member of the Académie des Sciences and Hamy of the Académie des Inscriptions, while Cartailhac was a corresponding member at Toulouse of the latter body, they received these honours, as the editor of *L'Anthropologie* points out in the current issue (48, 1938, p. 391), not in virtue of their eminence in anthropological studies, but on the ground of other qualifications—de Quatrefages as zoologist, and Hamy for his work on the history of geography and geographical exploration.

Dr. Leo Jolowicz

On August 12, Dr. Leo Jolowicz will celebrate his seventieth birthday. For many years he has occupied an outstanding position in the German scientific book and publishing business, and has done very much to foster and promote the development and diffusion of the results of scientific research. About fifty years ago, he took over the book business of Gustav Fock in Leipzig, which under his leadership became the largest and best-known 'Antiquariat' of scientific books. Dr. Jolowicz founded the famous publishing house, the Akademische Verlagsgesellschaft. This firm publishes a large number of well-known scientific journals, including, for example, the *Zeitschrift für physikalische Chemie*, and many important standard works and reviews, among which may be mentioned the "Handbuch der Experimentalphysik", "Handbuch der Radiologie", "Rabenhorst Kryptogamen-Flora", "Bronns Klassen und Ordnungen des Tierreiches", "Ergebnisse der Enzymforschung", "Ergebnisse der Vitamin- und Hormonforschung", etc. Among the world's famous publishers who through their deep interest in, and knowledge of, science and learning and their enterprise and imagination do so much to promote the advance of civilization, Dr. Jolowicz occupies a prominent and honoured position.

George James Symons, F.R.S. (1838-1901)

On August 6, occurs the centenary of the birth of the distinguished meteorologist George James Symons, in whose honour the Symons Medal of the Royal Meteorological Society was founded. Born in Queen's Row, Pimlico, he was educated at St. Peter's School, Eaton Square, London, and at Thornton Rectory, Leicestershire, and passed through the Royal School of Mines. Having joined the British Meteorological Society in 1856, the following year he undertook the duties of meteorological reporter to the Registrar-General, and these he continued to discharge until his death. For three years, 1860–63, he also served under Rear-Admiral Robert FitzRoy in the Meteorological Department of the Board of Trade, which had been inaugurated in 1857. His services to meteorological science were many and varied. In 1860 he published the first volume of his "British Rainfall", which gave rise to the British Rainfall Organization, the work of which was transferred to the Meteorological Office in 1919, and in 1866 he founded *Symon's Meteorological Magazine*, which in 1920, with the *Meteorological Office Circular*, was incorporated with the *Meteorological Magazine*. For two periods he served as honorary secretary to the Royal Meteorological Society, and in 1880 and 1900 was the president. So early as 1876 he received a Telford premium from the Institution of Civil Engineers for a paper on floods and water economy, and in 1897 he was awarded the Albert Medal of the Royal Society of Arts for the service he had rendered engineers engaged on water supply problems. His death took place on March 10, 1900, and he was buried in Kensal Green Cemetery. The following year a fund of more than £700 was subscribed for founding the Medal bearing his name.

Sir James Barrett's Reminiscences

Sir James Barrett, chancellor of the University of Melbourne, has contributed to *The Herald* (Melbourne) during April and May of this year a series of reminiscences which deal with the history of old Melbourne and its University and Hospital, early days in London and on the Continent, recollections of the Great War, and education and university extension in Great Britain and the United States. Born and spending his boyhood in old Melbourne, when there were toll gates on the St. Kilda Road, Sir James entered the University there when he was fifteen years old, and graduated in the medical faculty in 1881. He recalls the kindly assistance given to students by Prof. Halford, who taught anatomy, physiology and pathology, at a time when the University had only two hundred students with five professors to teach them, and describes medical practice in Melbourne Hospital in those pre antiseptic days He proceeded to London in 1883, obtained the fellowship of the Royal College of Surgeons, London, became demonstrator of physiology in King's College, London, under Gerald Yeo, and commenced his career as an ophthalmic surgeon as assistant at Moorfields Eye Hospital Interesting recollections are given of Bowman, McCarthy and Michael Foster Gaskell and Langley, and Jonathan Hutchinson and Whittaker Hulke, all well known figures in the medical world of the time, he also visited the Continent, and met Koch in Berlin Then come recollections of the Great War, and the organization of the medical service in Egypt The organization of "bush nursing centres" in Australia is recounted, a scheme initiated in 1908 by the Countess of Dudley, and finally, Sir James has a good deal to say upon education and university extension, and recalls some of his meetings with British statesmen

The British Medical Association: Plymouth Meeting

DR COLIN LINDSAY presided at the one hundred and sixth annual meeting of the British Medical Association, held at Plymouth on July 19 and following days "The Profession and the Public" was the title of the address of Dr Lindsay, who pointed out that his remarks were based upon an experience of forty years as general practitioner and consulting physician He emphasized the need for continued education both for the public and for the practitioner, and the necessity that exists for a specialist service to supplement the service of the family doctor, for medicine has grown so enormously that it is quite impossible for any one person to be proficient in every branch He reminded the public of the unity and equality of the three main branches of the profession—the general practitioners, the consultants and the members of the public health service—which are essentially complementary, each requiring for its proper performance attainments of the highest order He desires to see more attention paid to the treatment of the so called 'minor ailments', for it has been estimated that forty per cent of all sickness is due to the patient's own action The principle of free choice of doctor' under National Health Insurance was stressed, and the Association's proposals for a general medical service for the nation were outlined, by which members of families within an income limit of £250 a year would be included Other topics dealt with were the fees to be paid for consultative work, the education of the public in the use of the doctor, and the countering of credulity on the part of the public

Lister Institute of Preventive Medicine

THE report of the Governing Body of the Lister Institute of Preventive Medicine, presented at the annual general meeting on June 2, gives an account of the researches carried out at the Institute during the past year. Several studies on viruses, vaccinia and others, are detailed, with an investigation on the problem of rheumatic diseases, in which virus like bodies occur. Dr Felix and others have continued their work on the antigenic constitution, virulence and immunizing properties of bacteria and Protozoa, and the chemistry of bacterial antigens has also been investigated The Svedberg velocity ultracentrifuge, installed some time ago, has given satisfactory service, and several proteins have been the subject of study with this instrument Many studies on vitamins, their chemistry and action have been prosecuted by Dr Harriette Chick and her co workers The Institute is the home of the National Collection of Type Cultures, and more than 6,000 cultures have been distributed to workers at home and abroad Sir John Ledingham, the director, his staff and attached workers may be congratulated on their fine output of work

Medical Classics

Two important medical classics which were recently published in the *Bulletin of the Institute of the History of Medicine* have just been reprinted in book form and thereby made accessible to a wide circle of readers The first of these, entitled 'On Thought in Medicine', is the address delivered by Hermann von Helmholtz on August 2, 1877, on the anniversary of the foundation of the Institute for the Education of Army Surgeons In this address, Helmholtz attacks the old educational system which he regards as pursuing a false idea of science, in which there is a one sided and erroneous reverence for the deductive method Medical education during the early part of the nineteenth century in Germany was based mainly on the study of books There were no physiological or physical laboratories, and microscopical demonstrations were infrequent in lectures It fell to Johannes Muller and his pupils, of whom Helmholtz was one, to stimulate the study of microscopical and pathological anatomy, experimental pathology and therapeutics and to substitute experimental research for untried and unconfirmed hypotheses

THE second volume contains a translation of Ivan Sandström's work entitled 'On a New Gland in Man and Several Animals (Glandulæ Parathyroideæ)", which was published in vol 15 of the Swedish journal *Upsala Lakareforenings Förhandlingar* for 1879–80, and represents the first detailed description of the parathyroid glands, based on the naked eye and microscopical examination of these glands in the dog, cat, rabbit, ox and about fifty human subjects It is noteworthy that whereas the translation of Helmholtz's address was published so long ago as 1893, the English version of Sandström's monograph now appears for the first time, and has been carried out by Dr Carl Seipel, who has also translated an account of Sandström's life and work by Prof A J Hamman of Stockholm

Jubilee of the Gypsy Lore Society

THIS year the Gypsy Lore Society celebrates the fiftieth year of its existence The occasion was marked by a jubilee dinner on June 11, over which Lady Arthur Grosvenor (president, 1913–14) presided in the unavoidable absence of the president, Mr. Augustus John, and at which fifty five members and guests were present. The Gypsy Lore Society was founded in 1888 by Charles Godfrey Leland ('Hans Breitmann') and David MacRitchie of Edinburgh. Leland's enthusiasm for gypsy studies, characteristically overpowering, dated from 1870, when he settled in England for a period of years. Although he wrote several books on the gypsies between 1873 and 1882, it was not until 1888, three years after his return to England, that his desire to promote a wider interest in the investigation of the gypsy problem took practical shape in the foundation of a society devoted to that object; and indeed its formation was owing largely to his association with the organizing ability and scholarly habit of mind of MacRitchie, to whom also was due, with John Sampson and R. A. S. Macfie, the resuscitation of the Society in 1907, when it had been dormant for a period of years through lack of funds. Among the eleven original members, who formed the nucleus of the Society, were H. T. Crofton, Elizabeth Robbins Pennell, Leland's niece, famous as an interpreter of Ibsen's heroines on the stage, the Archduke Joseph of Austria, a fluent Romani linguist, Sir Richard Burton, the famous, if difficult, orientalist and traveller, Paul Bataillard, F. H. Groome, most eminent of the early students of gypsy folk lore, and Walter Herries Pollock; while one of the earliest adherents in the United States was Mary Alicia Owen, later known as an authority on the folk lore of the American Indian, whose early studies of the traditional tales and beliefs of the negroes of Missouri, if modelled on the 'Uncle Remus' of Georgia of Joel Chandler Harris, were directly inspired by Leland's encouragement.

In an introductory article which opens a special jubilee number of the *Journal of the Gypsy Lore Society*, the editor, Archdeacon F. G. Ackerley, enumerates some of the more noteworthy contributions to the investigation of the gypsy problem which have appeared in its pages and elsewhere since the foundation of the Society. Among contributors to the *Journal*, the late Dr. John Sampson naturally takes a high place, not only on account of his linguistic studies, but also for his collection of Welsh Romani folk tales; but it will be generally agreed that the term 'epoch-marking' here applied to Prof. R. A. S. Macalister's collection of material bearing on the language of the Nawar of Palestine is appropriate in more than a conventional and complimentary sense. It gave a new orientation to the study of the gypsy problem. Outside its own publications, the influence of the Society is to be seen in Dr. John Sampson's "Dialect of the Gypsies of Wales" (1926), which has been termed "the best of all Gypsy linguistic studies in any language" and Prof. E. Pittard's "Les Tsiganes ou Bohémiens" (1932) in which "is presented once and for all the physical anthropology of the race". Two great services the Society has performed for gypsy studies: it has abolished the pseudo-romantic rubbish which formerly passed for gypsy lore, and it has exploded the popular association of gypsies with Egypt by laying down the true lines for the investigation of the problem of their origin. It is difficult to say which has been the greater service to learning.

Archæological Collections in Spain

Notwithstanding reports of damage sustained by archæological collections in the museums of Madrid, it is now announced that an official verification by the Ministry of Public Instruction and the Municipality of Madrid has established the fact that the collections of both the Archæological Museum and the Anthropological Museum of Madrid are intact. Prof. Bosch Gimpera, to whom the editors of *L'Anthropologie* (48, 3–4; 1938) are indebted for the information, goes on to add that the other museums of the area under the Republican Government have been preserved from damage, while the official departments responsible for antiquities are taking every necessary precaution for their safety. As regards the museum at Valencia and the Catalan museums, Prof. Bosch Gimpera, as head of the antiquities service, is able to give his own personal assurance of their safety to his archæological colleagues outside Spain.

Italian Anthropological Expedition to Erythraea

On his return at the close of last year from an expedition to the Tana basin of Ethiopia, Prof. L. Cipriani, director of the Anthropological Laboratory of the University of Florence, was forthwith placed in charge of an anthropological mission to northern Erythraea for the purpose of studying the little known peoples north of Cheren. This mission was under the joint auspices of the Royal Academy of Italy and the Bureau of Colonial Studies of Florence. The expedition lasted from December 1937 until March 1938. According to a preliminary note of the results (*L'Anthropologie*, 48, 3–4; 1938), anthropometric measurements were made of 450 subjects, of whom there were 70 Bogo, 94 Mària, 26 Habab, and 159 representatives of groups adjacent to the last-named. For purposes of comparison, measurements were also made of 29 Abyssinians, as well as 30 Baria women and 20 Rasciàida. The blood groups were tested in 110 subjects. A further result of the expedition was the discovery of a large number of rock paintings in the granite caves of Carora near the Anglo-Egyptian frontier, as well as of stone implements of palæolithic type, the first to be recorded in Erythraea. Finally the expedition brought back to Italy 68 masks taken from the living, and more than two thousand photographs of ethnographical and anthropological subjects.

Stone Age Village in Yorkshire

Now that archæological research aims at the reconstruction of a cultural phase as a whole, rather than at bringing to light by excavation individual antiquities of exceptional interest or artistic merit, the announcement of the discovery of a remote but complete village of the stone age at Rinyo on the Island of Rousay, Orkney (*The Times*, July 29) has an importance which transcends the intrinsic interest of any individual object likely to be obtained there

General Chemistry

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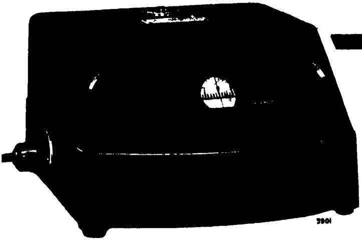

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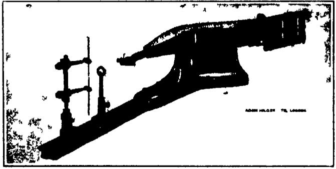

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In the present instance, there is added its bearing on the site of Skara Brae, the similar village discovered and excavated some ten years ago, of which the significance for our knowledge of stone age culture and more of life was such that Prof V. Gordon Childe at the time described it as a veritable Knossos of the north The new site defines more nearly the dating of the culture, left somewhat indeterminate, at Skara Brae The discovery of a portion of a beaker, in association with objects of the Skara Brae type, fixes the period of occupation at somewhere about the transition from stone to bronze in Great Britain, that is at about 1500 B C. Further the Rinyo village, being apparently complete, should supply details which at Skara Brae had been swept away by the encroachments of the sea on the sand dunes The Rinyo settlement has been excavated by Mr Walter W. Grant, with whom has been associated Prof Gordon Childe Below the floor in which the beaker fragment was discovered, traces of earlier occupation have been found These are in the form of commodious stone houses, provided with recesses for beds, built dressers and even a system of drainage In addition to open hearths, some of the houses have clay ovens, a novel feature It is anticipated that eventually excavation will give a complete picture of a whole stone age settlement, unique in Britain, and indeed in western Europe, and at the same time throw a new light on the social organization and economy of a neolithic community

Rhodesian National Museum

IN reference to the announcement of the proposed National Museum for Southern Rhodesia in the neighbourhood of the Zimbabwe ruins (see NATURE, July 9, p 65), Mr F M Collins writes to suggest the possibility of a confusion between the Victoria Falls and Fort Victoria, the township one hundred and eighty miles east of Bulawayo, near which the ruins are situated, while their distance from the Falls is by air approximately four hundred miles 'Proximity', however, the term in the comment in these columns to which Mr Collins takes exception, is, as he admits, relative, and as the general sense indicated was used in comparison with, for example, the distance from Cape Town, which would affect students and tourists, rather than in relation to absolute mileage

Science and the Way to Peace

AN "Appeal to the Scientists of the World" has reached us from India The author, Dr Bhagavan Das of Benares, a member of the Legislative Assembly of India, refers to the imminent peril of another world war, far surpassing the last in horror and destructiveness, and the frightful strain meanwhile imposed on mankind by preparation for defence He seeks to show that a heavy responsibility for this state of affairs rests on the learned world as a whole, partly because modern warfare owes its peculiarly devastating character to scientific research and the collaboration of men of science with the organizers of war and partly because the ideas that motivate wars are products of the speculations of philosophers and the vulgarization and misapplication of theories invented by men of science, notably that of the ascent of man through the struggle for existence and survival of the fittest. He quotes from the records of ancient Aryan wisdom: "Science (Vidya) came to the man of wisdom, the man of knowledge and purity, and said to him . guard me as a sacred trust, give me not to the wicked and sinful, but only to the pure of heart and large of mind, so only will I be strong to nourish mankind, otherwise I will only destroy thee and thy pupils and thy people" So in our own day Alexis Carrel in "Man the Unknown" writes. "The environment which science and technology have succeeded in developing for man does not suit him because it has been constructed at random without regard for his true self." Therefore, the appeal says, it is "up to" the learned world to get together and do something about it. Peradventure where politicians have failed men of science may find a way of approach to disarmament, military and economic

The Ontario Research Foundation

THE report of the Ontario Research Foundation for 1937 (Sessional Paper, No 52 Pp 35 Toronto King's Printer) refers to an increase in the amount of research work carried out in contact and in co-operation with industrial companies, the revenue received for services rendered to industry itself having increased by thirty per cent. The Textiles Department has during the year developed a launderometer for determining the fastness of dyed goods to washing, a fadeometer for determining the fastness of coloured fabrics to light, a crock meter for determining fastness of dyes to rubbing, and an autographic tensile strength and elongation tester for determining the strength, extensibility and yarn slippage of materials. The Engineering and Metallurgy Department continued its investigation on summer comfort standards for the Toronto district and also its study of the resistance to abrasion of iron and steel balls under the conditions existing in the grinding mills of mines In the Department of Chemistry, the development of a laboratory for the study of problems relating to paper, printing and adhesives has been completed Work on the transfer of pigments from aqueous pastes to an oily medium by methods which are commercially feasible has reached its final stages and in addition to the mechanical problem an emulsifying agent is required which is not detrimental to the final product The equipment and organization of a laboratory for the study of plastics has been commenced, and a new laboratory has also been inaugurated to study problems associated with the manufacture of waxed paper and similar products. The Department of Biochemistry has continued its investigations on a combined system of tannage for sole and belting leather and on problems connected with the Matzka process for the preparation of fruit juices which are stable for prolonged periods and retain their original flavour and content of vitamins. Investigations carried out by the Department of Agriculture have related to mineral deficiencies of land types and the relation between soil, climate and cultivation of the principal crops in Ontario, while the Department of Pathology and Bacteriology has continued its studies of bovine mastitis and the parasites of sheep

The Carnegie Institution of Washington

THE Yearbook of the Carnegie Institution of Washington, July 1, 1936–June 30, 1937, contains the reports of the Executive Committee and of the president for the year ended October 31, 1937, together with reports on investigations received up to December 10 and a bibliography of publications issued during the year by the Institution or of the Institution's staff through all channels (Washington Carnegie Institution of Washington) The president's report again refers to the relations between science and social problems and to the importance in society not merely to appreciate the difficulties in interpretation of the influence of science but also to be aware of the interdependence among social elements in the same way that we are aware of the interrelations among elements involved in the unity of Nature The Geophysical Laboratory has continued researches to determine with all possible precision the underlying causes of geological and geophysical phenomena A major advance in the terrestrial magnetic research is reported by Dr J A Fleming, in the proof of the association of a special type of magnetic disturbance and sharp fade outs of high frequency radio wave reflections with bright eruptions in the solar chromosphere With this advance, the Mount Wilson Observatory was also associated, and the Observatory also expanded greatly the scope of solar investigations with the rapid increase in solar activity The Division of Plant Biology has continued to study the ecology of the Great Plains and its bearing on the agricultural and human population of that area The Division of Animal Biology has made several observations fundamental to the cancer problem, and the value of diverse approaches by different groups of workers is well illustrated in this work as in reports from the Divisions of Embryology, the Nutrition Laboratory and the Department of Genetics in the field of endocrinology

Technical Colleges of South Africa

THE Carnegie Corporation of New York has lately issued a critical study by Dr F H Spencer of the technical colleges of South Africa Dr Spencer has had experience of technical education in Great Britain, and this has enabled him to make some interesting comparisons The technical colleges provide (*a*) full time pre apprenticeship courses for pupils aged 14–17 or 18, (*b*) part time courses for apprentices and others already at work. The place accorded in the full time courses to general cultural work is, by British standards, inadequate, geography being dropped after the first year, while history, even from the economic point of view, does not enter the picture The part time courses, which are everywhere the largest part of the technical college work, are dominated by the Apprenticeship Law This enactment has conferred on South Africa some of the benefits which in Great Britain should have resulted from the clauses of the Fisher Act providing for daytime continuation education from 14 to 18 In South Africa, despite a certain amount of recalcitrance, the Apprentice Law is an undoubted success Apprentices attend ordinarily about eight hours a week of which half is taken from day time working hours The great merit of the system is that the compulsory attendance is almost universally followed up to an advanced stage by a not unsatisfactory proportion of the apprentices This advanced stage at least for the constructional trades, is comparable with university work, and those who pass through it to the national certificate stage will furnish the 'non commissioned' staff of industry who are as essential to success as the management

The Belgian Grid

IN *Electrical Industries* of July, W Fennell gives a review of the salient engineering features of the Belgian Grid, which began by the co operation in 1919 of isolated supply companies These companies, mostly in the southern and eastern provinces (Liège, etc), happened to be in close contact with heavy industries They realized the existence of by product power going to waste' at the large industrial works and saw that in some cases it would be economical to use this power rather than to build large power stations or extend small ones A power production combine was formed to further the interests of manufacturers who had blast furnace and coke oven gas and process steam available greatly in excess of their own power requirements In addition, they had engines used as stand by plant, much of which would not be necessary if the various works' plants were interconnected The electricity supply companies also had means of utilizing the waste power This combine has spread so that it includes practically the whole country under a grouping system All the undertakings and associated works are linked up into two networks, north and south, which are themselves interconnected The production of power, while remaining under local control, is directed by a national co ordinating company The tariff applied to plant owners is based on the principle that the amounts they pay or receive are equal to the reduction or increase of expenditure entailed in their installations by running in parallel, compared with independent working The success that Belgium has attained as a competitor in the steel and chemical industries indicates that this co operative experiment, now twenty years old, has been a substantial contributory cause

Conservation of Natural Resources

UNDER this title, the American Association for the Advancement of Science has issued a selected list of literature dealing with various aspects of the subject Almost too late, rather than too soon, the United States is becoming conscious of the significance of the vast subject of conservation The very word is itself indicative of a more sober outlook The falsely alluring concept of limitlessness which in the last century tempted Americans to embark on a policy of exploitation concurrently with expansion has gone, in certain spheres retreat has followed expansion and many rueful surveys are being made of what has been left, with sound suggestions as to how it may best be used for the future America wants to reverse the processes by which man has violated basic arrangements in a manner which Nature will not tolerate" The literature covers a wide range of subjects, including land use which in this continent is especially bound up with the subject of soil erosion forestry and afforestation, important not merely because 'almost every one of the forty eight states is headed towards forest bankruptcy in timber but also because deforestation has had a terrible sequel in floods, soil wastage and silted rivers Lists of books on Oil and Gas Conservation and Saving Our minerals indicate that the future shortage of these vital products has passed from the realm of prophecy to that of serious and calculable prediction The inclusion of a section on the conservation of wild life serves to show how important is this question both in and out of the national parks which are of increasing value to the States

Research at Port Erin, Isle of Man

THE report of 1937 (No 50) of the Marine Biological Station at Port Erin, Isle of Man drawn up by Dr R J Daniel, director, shows the largest number of students using the building in any one year and also the greatest number of visitors to the aquarium More plaice larvæ have been liberated than during any previous season and there has been the highest percentage survival of lobsterlings in the hatchery The new Fauna List is now published a most useful and complete volume—which will be of the greatest assistance to all students The main work of the Laboratory has been directed towards the breeding of oysters a research which has now been going on for more than three years The chief difficulty in obtaining proper spatfalls in the experimental pond is the varying temperature—a very low temperature ruining a promising beginning To combat such conditions, a number of oysters were kept at a raised temperature level in the culture house Some oysters were also kept in dishes in the hatchery and the spawn from these has provided the basis for the limited series of culture house experiments These are still going on, and work is maintained in the improvement of methods and feeding of the larvæ in specially adapted vessels

Announcements

SIR WILLIAM BRAGG has been elected a foreign associate of the Paris Academy of Sciences in succession to the late L Torres Quevedo

PROF MAJOR GREENWOOD, professor of epidemiology and vital statistics in the University of London, has been awarded the Bisset Hawkins Gold Medal of the Royal College of Physicians, for his researches in statistics

THE twelfth International Horticultural Congress will be held in Berlin on August 12–20 After a series of meetings in Berlin the delegates will visit certain horticultural experimental stations and the chief areas of horticultural production A visit on August 20 to a Horticultural Exhibition at Essen will bring the Congress to an end The following delegation has been chosen to represent the British Government at the Congress Mr H V Taylor, Mr David Akenhead Prof E E Cheeseman, Mr F Birkinshaw, Mr F J Chittenden Col I R Durham Dr R G Hatton Sir Arthur Hill Mr H J Holman, Sir Frank Stockdale Dr M A H Tincker and Dr C W Wardlaw

A General Discussion on Luminescence has been arranged by the Faraday Society and will be held in the Biochemical Laboratory University of Oxford on September 15 17 Among the topics to be discussed are various aspects of the luminescence of solids liquids and gases and chemiluminescence As usual in these discussions a number of distinguished foreign guests have been invited to take part

THE Council of the Harveian Society of London has chosen The Value of Periodic Medical Examination in the Detection of Disease in Middle Life" as the subject for the Buxton Browne Prize, which consists of a medal and a sum of £100 The prize is open to any member of the medical profession registered in the British Isles or Dominions, and is limited to candidates less than forty five years of age Essays must be sent to the Treasurer of the Society Mr Cecil Wakeley, 14 Devonshire Street W 1 before October 1 1939

MR ROBERT L SACKETT dean of the School of Engineering at Pennsylvania State College from 1915 until 1937 has been awarded the Lamme Medal of the Society for the Promotion of Engineering Education for achievement in this technical field Mr Sackett is the eleventh recipient of the medal provided for in a trust fund created by the late Benjamin Garver Lamme who was chief engineer of the Westinghouse Electric and Manufacturing Co for twenty one years prior to his death in 1924 Since his retirement as dean at Pennsylvania State College, Mr Sackett has devoted himself largely to the work of the Engineering Council for Professional Development He has served as president of the Society for the Promotion of Engineering Education and as vice president of the American Society of Mechanical Engineers

ERRATUM In the letter entitled 'Irregular Mitosis and Meiosis induced by Acenaphthene" by Prof Dontcho Kostoff, in NATURE of June 25, p 1144, the sentence beginning "The viable pollen grains are equal in size " should read "The viable pollen grains are unequal in size "

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 258.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Optical Observation of the Debye Heat Waves in Crystals

MANY years ago[1], it was pointed out by one of us that Debye's concept identifying the thermal energy of a solid with the energy of elastic vibrations within it having a wide range of frequencies has an important optical consequence, namely, that a beam of light traversing a transparent solid would be scattered to an extent depending upon the energy of thermal agitation This conclusion was also verified experimentally in a semi-quantitative fashion[2] The principal experimental difficulty in studying the subject was that of obtaining crystals sufficiently large and at the same time free from imperfections or inclusions, these conditions being necessary to prevent the feeble thermal opalescence being overpowered by parasitic diffuse light The same difficulty appears in attempting to investigate the thermal opalescence in crystals by spectroscopic methods. The elastic waves, longitudinal or transverse as the case may be, which scatter the light being progressive, they should give rise to Brillouin-Doppler shifts of optical frequency corresponding to their respective acoustic velocities. If parasitic light be present, the unmodified scattering and the hyperfine structure components usually accompanying the same would overpower the Brillouin-Doppler components to be expected.

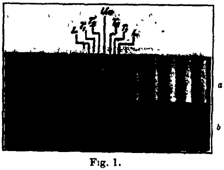

Fig. 1.

(a) DIRECT LIGHT, (b) SCATTERED LIGHT

It is significant, in view of the foregoing remarks, that E. Gross[3], who claimed, some years ago, to have obtained evidence of a Doppler shift due to the longitudinal waves in crystals, offered neither photographs nor measurements confirmatory of the claim. Even in a recent communication[4] in which the same author points out that with crystals there should be three components on either side in the scattered light corresponding to the three sheets of the acoustic wave-surface, no such convincing experimental evidence has been presented. Indeed, a perusal of the communications quoted leaves the impression that the results so far obtained by E. Gross suggest, rather than demonstrate, the existence of such Brillouin-Doppler shifts in the light scattered by crystals

The thermal scattering of light in crystals has been under investigation in this laboratory during the past few years, and we have at last succeeded in obtaining satisfactory photographs which show in an unmistakable way the physical reality of the Debye heat waves in crystals Fig 1 (*a*) shows the interference pattern taken with a Lummer Gehrcke plate of 4046 A radiation of a water cooled mercury lamp Fig. 1 (*b*) shows the pattern, under exactly the same conditions, of this radiation scattered transversely within a large crystal of gypsum The latter had been previously examined in a strong beam of sunlight, and a portion which showed a clear blue thermal opalescence and was free from inclusions was chosen for illumination. On a comparison of the two pictures which have been carefully set side by side to correspond, it will be seen that the two patterns are completely different Measurements show that the principal component of the incident radiation, which is very feebly present in the scattered light, gives rise to three components on either side displaced by 0·59, 0·36 and 0 2 cm $^{-1}$ of which the first is the most intense From the Brillouin formula, these three shifts correspond respectively to acoustic velocities 3,350, 2,050 and 1,100 metres per second. Of these, the first is presumably due to the longitudinal waves and the other two due to the transverse ones

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July 8

[1] Raman, C V, NATURE, 109, 42 (1922)

[2] Raman, C V, NATURE, 111, 13 (1923)

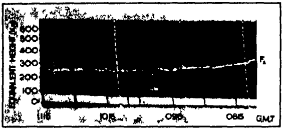
[3] Gross, E, NATURE, 126, 211 (1930), and *Z Phys*, 68, 685 (1932).

[4] Gross, E, *C R*, U R S S, 18, 93 (1938).

Bright Solar Eruptions and the Ionosphere

AN investigation of the ionospheric conditions during a bright solar eruption shows that at such times an increase of ionization can be produced within the normally reflecting regions of the ionosphere.

The accompanying photograph shows such an increase of ionization to have occurred quite suddenly at 0927 G.M.T. on October 1, 1937, at an equivalent height of 125 km., or slightly higher than the normal *E* region. A solar eruption of intensity 1 reported from the Royal Observatory, Greenwich, to have begun at 0928 G M T was, we suggest, the cause of this burst of ionization, which increased the normal amount in this region by more than 100 per cent The photograph shows a second reflection from this height of 125 km, indicating that no marked absorption in or below the normal *E* region was produced during the eruption These observations indicate that the quality of the ionosphere for the propagation of radio waves is sometimes improved as the result of a bright solar eruption



IONOSPHERIC DISTURBANCE BEGINNING AT 0927 G M T ON OCTOBER 1 1937

It is now well known[1] that there have been an increasing number of occasions during the last few years when during a bright solar eruption radio signals have disappeared completely At such times the condition of the ionosphere is similar to that described in 1933[2] as the no echo condition and is due to the production of ionization at abnormally low levels the consequent absorption thereby masking the normal reflecting regions

We deduce therefore that on a majority of occasions on which bright solar eruptions take place ionization is produced in the ionosphere, and that it depends primarily upon the *height* at which it is produced whether radio transmission conditions are better or worse It follows therefore that the initial comparisons of the worst radio transmission conditions and bright solar eruptions must be extended to include this more recent observation before the effects of a bright solar eruption on the ionosphere can be completely assessed

The work described above was carried out as part of the programme of the Radio Research Board and this note is published by permission of the Department of Scientific and Industrial Research

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July 7

[1] For bibliography see Newton and Barton *Mon Not Roy Ast Soc* 594 (June 1937)

[2] Appleton Naismith and Builder NATURE 132 341 (1933)

Crystal Structure Models

TABLE tennis balls have often been used in making models of crystal structures, and the purpose of this letter is to direct attention to two ways of using them which, so far as we are aware, are new

(1) Models of crystal structures of inorganic substances are clearest when the atomic centres are indicated by balls and these are joined by rods The following method may be used to connect table tennis balls by rods of celluloid, a convenient diameter for which has been found to be 3/16 in The end of the rod are dipped in acetone for about a minute when they swell and become gelatinous on the surface Meanwhile, the surfaces of the balls to be joined are rendered slightly gelatinous by moistening them with acetone The rod is now placed in position between the balls and if necessary held there for about 20 sec The rod and balls now adhere to one another sufficiently strongly for it to be possible to continue building the model Durofix may be used as the cement but the join is not so strong as that obtained with acetone Celluloid rods can be easily cut to any required length and this greatly facilitates the making of models with correct interatomic distances

(2) In studying the structures of organic substances, *it is often necessary to see how molecules* pack into the unit cell The distance between neighbouring carbon atoms in a molecule is about 1 5 A while the distance between carbon atoms in neighbouring molecules is not usually less than 3 4 A A model representing the space occupied by any one molecule can therefore be made by cutting off spherical caps from the table tennis balls and fitting the balls together so that the distance between their centres is ¾ in Such model molecules can then be packed into the unit cell with their surfaces touching To cut off the spherical caps the balls are held in a split brass tube of internal diameter slightly less than 1½ *in* mounted on a lathe and a razor blade is used as a cutting tool

The accompanying photographs show similarly orientated models of naphthalene $C_{10}H_{14}$ constructed according to both methods The model with rods is valuable in teaching and the packing model is more useful in research work when it is required to discover the geometrically possible molecular orientations

MODELS OF NAPHTHALENE BUILT UP FROM TABLE TENNIS BALLS AND CELLULOID RODS (LEFT), AND FROM TABLE TENNIS BALLS ALONE (RIGHT) ILLUSTRATING THE INTERATOMIC DISTANCES AND MOLECULAR PACKING RESPECTIVELY

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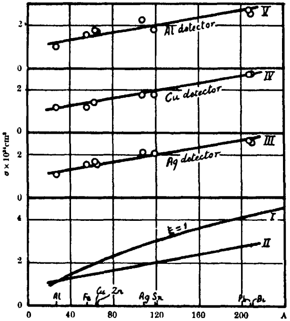
Interaction of Fast Neutrons with Atomic Nuclei

Neutrons may interact with nuclei in two different ways, namely (*a*) formation of a compound nucleus, in a quasi-stationary state, with a subsequent emission of a corpuscular or electromagnetic radiation; (*b*) elastic (possibly also inelastic) collisions without sticking to the nucleus.

The decrease of intensity of a fast neutron beam when passing through matter, measured with a detector which responds only to neutrons above a certain energy, will be due to inelastic collisions (mostly process *a*) and elastic scattering (mostly process *b*)

The aim of this work was the study of the interaction of fast neutrons with nuclei through the measurement of the neutron absorption in different substances



I produced the neutrons by deuteron bombardment of lithium (400 kv, about 100 μ amp), as a measure of their intensity I used the activities induced by reactions of the type ($n - 2n$) and ($n - p$), that is, such reactions as $^{107}\text{Ag}\text{-}n\text{-}2n\text{-}^{106}\text{Ag}$ (24·5 min.), $^{63}\text{Cu}\text{-}n\text{-}2n\text{-}^{62}\text{Cu}$ (10·5 min) and $^{27}\text{Al}\text{-}n\text{-}p\text{-}^{27}\text{Mg}$ (10·2 min.). The energy of the neutrons has in these conditions an upper limit of about 13·5 Mev.[1]. The detectors respond only to high-speed neutrons: silver and copper to neutrons of energies certainly above 8 Mev. and probably practically 12 Mev. (at least for copper[2]), aluminium above 4·5 Mev. Thus my measurements concern two energy regions of very different widths: 12–13·5 Mev. and 4·5–13·5 Mev

The absorbing substances and the detectors were placed in the immediate neighbourhood of the neutron source; thus a great part of the scattered neutrons were reaching the detector and therefore the extinction of the beam was mostly due to effects other than scattering. If we suppose that every neutron that sticks to a nucleus and forms with it a compound nucleus cannot produce any of the above-mentioned reactions in the detector, then, in these conditions, the effective cross-section of the absorbing nucleus, as calculated from the intensity measurements, should not be smaller than $\sigma = \pi R^2 \xi$ where ξ is the sticking probability (process *a*) and R the nuclear radius. Curve I gives the calculated values of σ for different atomic weights A, assuming $\xi = 1$ and $R = 2 \times 10^{-13} A^{1/3}$ cm.

Measured cross sections for silver, copper and aluminium detectors are plotted as Curves III, IV, V, and the average for all detectors as Curve II

The discrepancy for heavy nuclei between the experimental Curve II and the theoretical Curve I can be explained by assuming that for these nuclei, ξ is less than 1, that is, a fast neutron may fall on a nucleus without sticking to it and without changing its direction by a great amount.

Another possible explanation would be to suppose that ξ equals 1, but to assume that compound nuclei are able to emit neutrons still of sufficient energy to activate the detectors; in this case we should be dealing either with elastic scattering or with scattering in which the neutron suffers quite a small loss of energy However, due to the difference in the width of the sensitivity regions of the detectors, it is to be noted that this assumption would lead to a greater cross-section as detected with silver and copper than with aluminium This is not the case and, on the other hand, an emission of very fast neutrons by compound nuclei, though highly excited, is very improbable, if we assume the liquid drop model

The former assumption (ξ less than 1) seems to fit experimental data and theoretical expectations better. It is interesting to note that the experiments of Dunning, Pegram, Fink and Mitchell[3] in which, contrary to my experimental conditions, the authors measured the absorption including all processes mentioned above (*a* and *b*) the curve $\sigma(A)$ has a shape corresponding rather to the assumption that ξ equals 1

After this work was completed, Grahame and Seaborg[4] published a paper on a similar subject. My results, though concerning neutrons of somewhat different energy regions, are in excellent agreement with theirs.

A detailed description of the apparatus and the experimental arrangement used will be published elsewhere.

I wish to express my thanks to Prof. S Pieńkowski for many stimulating discussions.

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[1] Stephens, W E, *Phys Rev*, **53**, 223 (1938)

[2] Sagane, R, *Phys Rev*, **53**, 212 (1938).

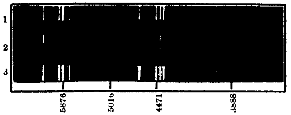
[3] Dunning, J R, Pegram, G B, Fink, G A, and Mitchell, D. P, *Phys Rev*, **48**, 265 (1935)

[4] Grahame, D C, and Seaborg, G T, *Phys Rev*, **53**, 795 (1938).

Band Spectrum of Helium

In the course of some investigations on the electrical properties of helium at fairly high pressures (about 25 mm. mercury), it was found that, if the gas was excited in such a way as to produce the line spectrum and the band spectrum of helium in comparable intensity, the rate of decrease in intensity of the band spectrum was much smaller than that of the line spectrum after the excitation was removed.

The accompanying reproduction shows three spectra of a discharge in helium at 27·5 mm. pressure taken under different conditions with a Bellingham and Stanley No. 2 glass spectrograph. Spectrum 1 was taken when the discharge was running continuously. Spectrum 2 was taken of a discharge in which the excitation was interrupted periodically and in which the light from the discharge could fall on the spectrograph about 1/600 sec after the excitation was interrupted. Spectrum 3 was taken with an interrupted discharge in which the light from the discharge was able to fall on the spectrograph just before the excitation was interrupted.



BAND SPECTRUM OF HELIUM (2·75 MM MERCURY)

It will be seen that, for comparable intensities of these band spectra the intensity of the lines in spectrum 2 is negligible compared with that of the lines in the spectra 1 and 3. As the energy of the electrons in the discharge is insufficient 1/600 sec after the discharge has been interrupted, to excite the atoms of helium, it seems necessary to suppose either that the helium molecule is formed after interruption of the discharge by the collision of a metastable atom with a neutral atom or that the helium molecules formed in the discharge have a life of the order of 1/600 sec. As the rate of decrease in intensity of the band spectrum is of the same order as the rate of decrease in number of metastable atoms the former explanation seems the more probable.

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May 19.

Reflecting Power of Crystals with an Ideal Mosaic

WE have studied photographically the connexion between the magnitude of the mosaic structure of crystals, $\Delta\sigma$, and the intensity of X-ray reflection, R_s, in a symmetrical arrangement, in which the radiation by the mosaic crystals is focused[1].

As has been shown by Feifer and Jahoda by means of a double crystal spectrometer with photographic recording[2], there are two kinds of mosaic, namely, a normal regular 'ideal mosaic' ($\Delta\sigma_{min}$) and a coarse, less regular, the latter occurring in imperfect and especially in metallic crystals. This irregular mosaic causes sometimes a considerable increase of the value of $\Delta\sigma_{min}$.

The experiments have shown that the reflecting power of X-rays varies with the magnitude of the mosaic $\Delta\sigma_{min}$, and that in the case of crystals with a large ideal mosaic, its influence on the intensity of reflection R_s predominates over the other factors (distribution of electrons, absorption in the lattice and so on). The following relation has been found to hold:

$$\frac{f(\Delta\sigma_{min})}{R_s} = \text{constant}$$

When investigating the reflecting planes of crystals by Baćkovský's method, it is found that separate parts of the crystal are considerably imperfect, whereas some parts do not reflect at all. Thus an exact relationship can only be obtained by the use of especially selected crystals. As an example of our measurements with different crystals—quartz, gypsum, rock salt and sphalerite—we have discussed measurements in which the coefficient of reflection is characterized by the exposure $T_s \sim 1/R_s$ (in a symmetrical arrangement for the copper K lines) under identical conditions.

Crystal	$\Delta\sigma_{min}$. 10 (rad.)	T_s. 10 (sec.)	$\Delta\sigma_{min}$. T_s. $10^4 \sim \frac{\Delta\sigma_{min}}{R}$
SiO₂ ⊥ axis	(4·8)	{36·0 0·0}	{1·7 3·3}
CaSO₄	10·4	2·4	2·3
NaCl	8·8	0	2·0
ZnS	56·2	3·6	2·0

From the third column of the table it is evident that the product of the exposure and the magnitude of the ideal mosaic is constant, that is,

$$T_s \cdot \Delta\sigma_{min} = \text{constant}$$

Only in the case of quartz, where the mosaic is insignificant, do the results fluctuate. The coarse mosaic of the imperfect crystals of metallic type does not contribute to the intensity of reflection.

We wish to mention that under the influence of a direct electric field (of about 10,000 volts/cm.) we obtained for ZnS a diminution of the mosaic $\Delta\sigma_{min}$ from 110″ to 80″. This change became after a longer application of tension permanent (plastic). The diminution of the mosaic was accompanied by the diminution of the intensity of reflection. Since in the case of rock salt no analogous case was observed, the rectification of the mosaic of sphalerite is probably due to the piezo electric forces.

The changes in the mosaic exhibited by grinding depend mainly on the kind of grinding.

The large intensity of reflection of crystals with an ideal mosaic justifies their utilization in all symmetrical methods.

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Charles University,
Prague.
July 1.

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[1] Baćkovský, J. M., NATURE, 141, 852 (1938).

[2] Feifer, J., and Jahoda, M., C. R. Acad. Sci., in the press.

Films on Freshly Abraded Copper Surfaces

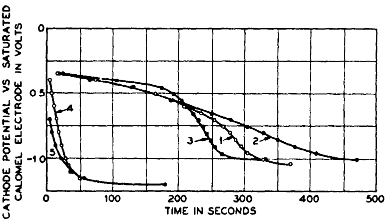
WE have been interested in the nature and amount of films formed on metals during and immediately after cleaning by abrasion, and have made measurements of the thickness of such films using a modification of the electrolytic method of Evans and Miley[1]. We find that films of substantially the same thickness, giving similar cathode potential time curves at constant current, are present on freshly abraded copper whether the abrasion is carried out in air or under benzene. A somewhat thinner film was found when an abrasive wet with water was used. The results are summarized in the accompanying table, the figures in the third and fourth columns representing the means of at least three determinations for experiments 1–3 and of two determinations for experiments 4 and 5 Typical curves are given in the accompanying figure

THICKNESS OF FILMS ON FRESHLY ABRADED COPPER SURFACES

Experiment No	Treatment of surface	Milli equivalents of film reduced* per sq cm 1)	Thickness of film as Cu_2O*(A
1	Abraded 000 emery paper under benzene	3 2	41
2	Abraded 000 emery paper in air	3 9	4
3	Abraded 000 emery powder under water	2 8	33
4	Abraded 000 emery paper reduced in hydrogen	No detectable film	
5	Abraded 000 emery paper reduced in hydrogen immersed in benzene 20 mins	0 16	2

* Area of surface calculated from measured dimensions

The edges and both faces of the specimens which were milled to 2 cm × 2 cm × 0 2 cm from oxygen free high conductivity copper were abraded Abrasion under benzene was carried out in a very similar manner to that described by Dobinski[2] The benzene was a high quality thiophene free grade which had been twice redistilled over activated copper The specimens were placed wet in the electrolytic cell and were dried in a stream of purified nitrogen The cathode potential measurements were made in an oxygen free solution over which nitrogen was passed



CATHODE REDUCTION OF FILMS ON FRESHLY ABRADED COPPER

Current density 0 01 ma /sq cm area of surface 9 6 sq cm Arrows indicate inflection point Numbers refer to accompanying table

Recently Dobinski[2] has shown that the electron diffraction pattern obtained for a metal polished under benzene is different from that for a metal polished in air and has inferred that the pattern is characteristic of an unoxidized surface The experiments reported here show that abrasion of copper surfaces under benzene by a very similar technique produces a surface film probably oxide which is comparable in thickness to that produced by abrasion in air Submersion of copper in benzene without abrasion produces a considerably thinner film Dobinski assumes that polishing under benzene means polishing in the absence of air Actually the solubility of oxygen in benzene is appreciable[4] He also believes that polishing with a moist abrasive in air produces a thicker film than polishing with a dry abrasive Our experiments indicate that this is not the case when copper is abraded with emery

Our results may be explained on the assumption that combination of the copper takes place with oxygen dissolved in the benzene or the water at the high local transient temperatures developed on the surface during abrasion[3] More detailed results and experimental technique will be published shortly

Bell Telephone Laboratories W E CAMPBELL
463 West Street U B THOMAS
New York June 14

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[1] Evans and Miley NATURE 139 283 (1937) Miley Carnegie Scholarship Memoirs 25 197 (1936) *J Amer Chem Soc* 59 2626 (1937)

[2] Dobinski NATURE 138 31 (1936) *Phil Mag* Ser 7 23 397 (1937

[3] Bowden and Ridler *Proc Roy Soc* A 104, 640 (1936) Bowden and Hughes NATURE 139 152 (1937) *Proc Roy Soc* A 160 575 (1937)

[4] Inter Crit Tables 3 pp 263 255 The Bunsen absorption coefficients for oxygen in benzene and water are 0 163 and 0 031 respectively

Electron-Inertia Effects in Thermionic Tubes

I WAS extremely interested in the communication by Messrs Ratcliffe and Kownacki[1] on the investigation of electron inertia effects in thermionic tubes As these writers state the difficulty in the experimental determination of inertia effects in ordinary valves is that they occur at such high frequencies that accurate measurement is practically impossible In order to increase the inter-electrode transit time and so decrease the frequency at which the inertia effects become appreciable Messrs Ratcliffe and Kownacki propose using a thermionic tube in which the electrons are replaced by relatively slowly moving ions

I have described[2] an alternative way by which the inertia effects may be made to occur at sufficiently low frequencies for accurate measurement The inter electrode transit time of electrons in a cylindrical diode can be increased many times if a magnetic field of suitable magnitude is applied to the valve in the direction of the electrode axis I have investigated experimentally the effect of these long transit times and have determined the equivalent electrical circuit of any thermionic tube in which the inter electrode transit time of electrons is predominant I have shown that the long transit times possible in magnetrons are responsible for the production in these valves of relatively low frequency oscillations similar in character to the high frequency Barkhausen Kurz oscillations generated in positive grid triodes It would be interesting to know whether Messrs Ratcliffe and Kownacki obtain the same results for inertia effect with their novel type of triode as I have with the magnetron

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June 24

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[1] NATURE 141 1009 (1938)

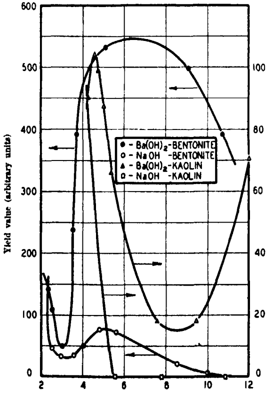
[2] *J Inst Elect Eng* 80 84-97 (1937)

Viscosity of Clay Suspensions

Considerable attention has been given recently to the thixotropy and viscosity characteristics of clays. During the course of a research programme now in progress, certain results of general interest have been obtained

Fract No	Average equivalent spherical diameter	Mobility 25° C	(cp ¹ 50° C)	Yield Value (dynes/cm ²)		r (25° C)
				25° C	50° C	
1	0 135 μ	0 580	—	34 5	—	1 93
2	0 28	0 625	1 64	22 6	32 0	1 79
3	0 45	0 862	—	0		1 30
4	1 05	0 950	—	0		1 18
5	0 55	0 950	—	0		1 18
6	2 2	0 991	2 94	0	0	1 13
7	8 5	0 991	-	0	—	1 13
2 (in 40 2 wt % ethyl alcohol	0 28	0 276	2 14	69 5	48	1 52

Viscosity measurements, using a capillary viscosimeter (radius 0 0415 cm , length 9·33 cm) were made upon seven samples of kaolinite of varying particle size, kindly supplied by Dr H Whittaker from fractionation of Kentucky ball clay (fractions 1-4) and Georgia kaolin (fractions 5-7). X-ray analysis indicated all to be essentially kaolinite, except fraction 4, which contained about 30 per cent silica The results for suspensions of 10 weight per cent are shown in the accompanying table, pH being approximately constant at 6 5



Deviation from normal behaviour, as indicated by yield value and relative viscosity at infinite shear, increases with decreasing particle size and was found to parallel plasticity. Rise in temperature caused an increase of yield value for aqueous suspensions, in contradiction of predictions[1] made on the basis of the attraction-repulsive force theory of Hamaker[2] Alcoholic dispersions, however, showed a diminution in yield value with temperature, as did glass spheres suspended in an organic liquid and measured by a technique previously described[3].

The accompanying graph shows results obtained, using a MacMichael viscosimeter, when varying amounts of caustic soda and barium hydroxide were added to electro-dialysed kaolin and bentonite suspensions The suspensions containing caustic soda showed little or no thixotropy, but it was very pronounced for barium hydroxide - bentonite suspensions from about pH 4 upwards. The results indicate the importance of the nature of the metallic ions associated with a clay and suggest that the presence of certain ions may be essential for thixotropy.

Complete data will be published elsewhere.

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Cambridge, Mass
June 21

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[1] Houwink 'Elasticity, Plasticity, and Structure of Matter', 351 (Cambridge, 1937)

[2] Hamaker, *Rec Trav Chim* **56**, 1 (1937), and other papers

[3] Broughton and Windebank, *Ind Eng Chem* , **30**, 407 (1938)

Estimating Numbers Without Counting

In ecological work it is often necessary to have comparative estimates of the numbers of organisms in a large number of samples An exact valuation may not be required, but an approximate numerical estimate is always preferable to statements in such terms as few, many, very many, etc The following method was devised to furnish estimates rapidly and without counting of the numbers of a few of the more important species of the marine plankton where only one or two such species formed the bulk of the samples and *where an estimation within ± 15 per cent of the actual numbers would be sufficient.* Actually the plankton is as a rule so mixed that the method can only be applied to special series of samples and not to normal survey work. It is thought, however, that the method, which is believed to be new, may be of value to workers in other fields · perhaps for estimating the seed production of a large number of plants or samples of small insects all of one species.

The method is akin to the colorimetric method and the name proposed for it is the *plethometric method* (πλῆθος: an aggregation or multitude), kindly suggested by my colleague, Prof. T. E Jessop.

A scale of dots is made as in Fig 1 The dots are so arranged that when a mask with a circular opening is placed over the scale, the number visible will increase by a definite amount as the mask is slid from left to right. At *A* the number visible is 110, at *B* it is 230 and at *C* it is 270. From such a scale others can be made having, instead of dots, life-size photographic images of the objects to be estimated. A strip of glass coated with glycerine jelly is laid upon the original scale and one of the objects dropped into position over each dot, and then the whole is photographed and enlarged to natural size. Scales for common plankton animals such as *Calanus*, *Sagitta* and *Limacina* were very skilfully made for me by Mr J H Fraser when a member of my staff Such scales are mounted in a frame to wind off one roller on to another below a circular opening as in Fig 2, the rollers being turned at X and Y Along side is placed the sample in a circular dish of the same size as the said opening and the sample is spread as evenly as possible by a needle or brush The scale is turned to right or left until its number of images appears to equal that of the objects in the sample, with practice this may be done very quickly and usually to within ± 10 per cent The number is read off through the opening *n* which may be kept screened by the slide *s* until the judgment is made When once such a scale is made hundreds of samples can be dealt with in a very short time Even without a photographic scale a scale of dots roughly the size of the objects in the sample will serve for providing an approximate estimation

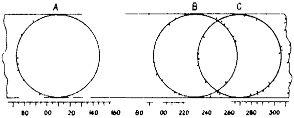

Fig 1

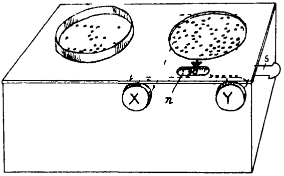

Fig 2

My friend, Dr E O Halliwell, has suggested that it might be applied to the rapid estimation of blood corpuscles in place of the usual counts A double microscope with a single but divided eyepiece would enable one to compare a blood sample with a photographic scale or a slide of increasing numbers of actual corpuscles prepared as a permanent mount Experiments we have made using two microscopes and a comparator eyepiece indicate that it should be as accurate as the use of the ruled counting slide, and very much quicker

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June 21

Assignment of the Fundamental Frequencies and Computation of the Potential Function of Tetrachlorethylene

The vibration spectrum of tetrachlorethylene has been discussed by me[1] and later by Linnett and Thompson[2] It is of particular interest in that the value for the C—C force constant ($6\ 25 \times 10^5$ dynes/cm) seemed abnormally low for a double bond This was taken to indicate resonance between other possible structures in which the carbon atoms were linked by a single bond

In both the above investigations a simplified type of potential function was employed in which many interaction terms were ignored The importance of those terms has since been demonstrated by the work of Manneback[3] and others[4] on the spectrum of C_2D_4 I have therefore undertaken a re investigation of the spectrum of C_2Cl_4 using a potential function of the type employed by Manneback and Verleysen[3]

Assuming for the nine planar frequencies of the molecule the values (in Manneback s notation) S_1 (1569 445 383) A_1 (913 400*) A_2 (802 346*) S_2 (512 341) a thirteen constant potential function is necessary to obtain real solutions in the four groups I have attempted to approach as much as possible the valency deformation system nevertheless the values of interaction constants are very important (20 per cent of the principal terms) so demonstrating the great influence of Cl atoms

The detailed result cannot be quoted here, but it is sufficient to remark that the value for the C—C force constant is now 8×10^5 dynes/cm instead of $6\ 25 \times 10^5$ It would therefore appear that the earlier conclusions regarding the existence of resonance in this molecule may be premature since it is possible to correlate the frequencies with a force field in which the C—C constant has its normal double bond value

The other important point to which I would direct attention concerns the assignment of the fundamentals where it will be noticed that the value for the lowest of the S_1 group is taken as 383 cm $^{-1}$ instead of 236 cm $^{-1}$ which represents a motion out of the plane This is based on the polarization measurements of Heidenreich[5] The above set of fundamentals allows of easy interpretation of the remaining observed frequencies as simple addition bands

Detailed calculations and discussion will appear shortly elsewhere

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June 2

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* 400 and 346 frequencies have been computed from the relations between the forces and the known frequencies.

[1] Duchesne Nature 139 288 (1936) 139 634 (1937)

[2] Linnett and Thompson Nature 139 509 (1937)

[3] Manneback and Verleysen *Ann Soc Sci Brux* 56 349 (1936) 57 31 (1937)

[4] de Hemptinne Jungers and Delfosse Nature, 140 323 (1937) Sutherland and Conn Nature 140 644 (1937)

[5] Heidenreich *Z Phys* 97 277 (1935)

Distribution of Fluorescence Excitation of Bivalent Europium in Calcium Fluoride and of Bivalent Samarium in Calcium Sulphate

In the course of the investigation of the fluorescence of fluorite conducted in the Institut für Radiumforschung, Vienna[1], it seemed desirable to determine the distribution of excitation in fluorite for the blue Eu^{++} band

A series of limited portions of the ultra violet spectrum of an iron arc was successively allowed to fall on the powdered sample in a flattened quartz test tube The blue fluorescence thus excited was photographed on different parts of a Kodak Panatomic film behind a filter to keep out the ultra violet light The transparency of the developed film was measured with a barrier layer photo cell Taking into account the energy distribution in the spectrum of the iron arc, maxima of the blue fluorescence were found for the following wave lengths of the exciting light for synthetic calcium fluoride with 10^{-3} or 10^{-4} europium and in sodium chloride with 10^{-4} europium, all after treatment with radium rays from 230 to 240 mμ 260 280 350 and 385 mμ, for natural fluorite from Weardale (purple) practically the same wave lengths, only, instead of the last mentioned maximum one at 400 mμ[2] For longer wave lengths the method is not applicable because of the overlapping of exciting and emitted wave lengths

Calcium sulphate with 10^{-3} samarium gives after radium treatment for the red Sm^{++} fluorescence maxima of excitation at 240 350 370 and 400 mμ Treatment of calcium sulphate with 10^{-3} samarium with light of wave length 240 mμ has the same effect as that with radium rays the untreated preparation shows, when illuminated with filtered ultra violet light, only the well known lines of trivalent samarium, but after prolonged treatment with wave length 240 mμ, the red and infra red bands 630 and from 689 mμ to 734 mμ appear on illumination with filtered ultra violet In calcium fluoride with europium also the wave length 240 mμ seems to produce the same effect as radium rays

Presumably the excitation maxima of shorter wave length are connected with the *formation* of excited bivalent rare earth centres (reduction of the trivalent rare earth ions), those of longer wave length with the excitation of such centres already formed

H PH **ECKSTEIN**

Vienna July 4

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[1] See the report by K Przibram in *Z Phys* **102** 331 (1936) **107** 709 (1937) and also NATURE **141** 970 (1938)

[2] Groot W de *Arch Neerland* IIIa **7** 207 (1924) had already found two regions of excitation in fluorite below 230 mμ and between 340 and 380 mμ

Crystal Structure of Thianthren and Selenanthren

IN a recent paper by Cullinane and Plummer[1] on the isomorphous relationships of some analogous organic derivatives of oxygen, sulphur and selenium, we gave the results of some preliminary crystallographic measurements on thianthren and selenanthren (diphenylene disulphide and diphenylene diselenide) The crystallographic measurements have now been completed and an X ray determination made of the sizes of the unit cells The results are here given and refer to a different c axis from that quoted in the paper by Cullinane and Plummer

The crystallographic measurements show that thianthren and selenanthren, which crystallize in the monoclinic system, are isomorphous This result is in agreement with the conclusions of Cullinane and Plummer Our observations also show that the unit cell for thianthren chosen by Prasad, Shanker and Peermohamed[2] is face centred in the basal plane and is therefore not primitive This agrees with the remark to that effect made by Cox[3] Our photographs confirm the assignment of the space group C_{2h}^5 to thianthren made by Prasad, Shanker and Peermohamed and show that selenanthren also belongs to the same space group

Full details of the work will be published elsewhere

Thianthren	*a* *b* *c* 2·37 1 1·95	*β* 110·0	
	a 14·3 A	*b* 6·09 A	*c* 11·8 A
Selenanthren	*a* *b* *c* 2·36 1 1·97	*β* 110·20	
	a 14·5 A	*b* 6·21 A	*c* 12·1 A

J EDGAR CRACKSTON
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[1] Cullinane and Plummer *J Chem Soc* 63 (1938)

[2] Prasad Shanker and Peermohamed *J Ind Chem Soc* **14** 177 (193)

[3] Cox *Chem Soc Annual Reports* **34** 189 (1937)

Colchicine and Acenaphthene as Polyploidizing Agents

KOSTOFF[1] has recently directed attention to the similarity in action of colchicine and acenaphthene and recommended the latter substance for purposes of chromosome doubling Preliminary tests with acenaphthene used in saturated solutions of liquid media[2] adapted to the observation of mitosis in stamen hairs of *Tradescantia* gave no indication that acenaphthene is at all comparable to colchicine as a polyploidizing agent After 2 and 4½ hours counts of nuclear stages showed the following percentages

	Prophases	Prometa-anaphases	Telophases	
Acenaphthene	9	3	-	2 hours 200 cells
Check	11 8	4	9	
Acenaphthene	9 4	1 9		4½ hours 100 cells
Check	9	1 6	9 6	

Not a single polyploid cell was formed in this experiment nor were any nuclei observed showing chromosomes in metaphasic condition typical of colchicine Young plants of marigold tops of which were immersed for 1 48 hours in culture solution[2] saturated with acenaphthene showed during the successive week effects distinct from those of colchicine

Kostoff[3] has meanwhile changed his method of application of acenaphthene Instead of using saturated solution he now brings crystal into contact with the plant material Certain phases of the acenaphthene reaction apparently resemble that of colchicine More work is required before the effects can be compared Any reversible reaction of the type described by Kostoff, if easily applied widens the possibilities of inducing somatic changes in clonally reproducible plants

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July 12

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[1] Kostoff D *C R* U R S S **19** 197 199 (1938)

[2] Nebel B R and Ruttle M L *J Heredity* **29** 1 9 (1938)

[3] Kostoff NATURE **141** 1144 1145 (1938)

Effects of Floods in East Norfolk

A RECENT visit to the part of East Norfolk flooded by the sea in February and April of this year was made memorable by a succession of south westerly gales towards the end of June The best point from which to see the flood damage was found to be at Horsey Staithe Looking north eastwards an astonishing spectacle met the eye To the left there was a summer scene of woods and cottages clustered round Horsey Hall and Horsey Church, where a slight elevation of the ground had left an island during the advance of the sea In front the sea's retreat had left a red desert towards which the gale raced during the forenoon and early afternoon when the local land breeze reinforced it, a region later to be haunted by the melancholy piping of redshanks and the anxious cries of a cloud of lesser terns and ringed plover, when there came the calm of the evening before the setting in of the prevailing south east breeze This red desert, so recently part of the North Sea, ended in an imposing greyish yellow barrier where the sand dunes were being rebuilt with the aid of a crane fed by a hastily constructed light railway

During the worst of the gales, that of June 20, smoke was seen, rising apparently from one end of the barrier itself What could be burning up there on that barren sand ? In a few moments the mystery was solved, a steamer appeared, its funnel visible almost down to deck level This was no mirage, but evidence that it was high tide and that if the gale were to veer to north west the scouring undertow would soon resume its work of destruction But the people of the village showed no signs of fear even during the height of the gale, for they retain unspoiled, many of them, the hardy spirit of the men who used to set out from Denmark in mid winter for Iceland or Greenland in open boats and often arrived at their destination To the Londoner or foreigner as he is termed by the Broadsmen, Horsey Staithe did not seem to be a place in which to linger on that June morning

Leaving the ruined bird sanctuary on the southern side of Horsey Mere to one s left and taking a path which leads past sledge covered shallows, where the bittern can still be found to Waxham Cut, the scene began to change An arm of the red desert on the right presented a more than wintry landscape, the nearer trees were rust red and more gaunt than trees in their winter sleep, but on the banks of the Cut bright green sedge was springing up On the calmer days earlier in the month, reed buntings were to be seen as usual, and many swallow tail butter flies

The old farm house by the bridge, where so many bird lovers have gathered during the past five years, luckily escaped the flood with a few scars only Some of the trees had sucked up the brackish water and assumed the rust red of the neighbouring plain, but others were in their summer green From this point to Waxham village and Palling the countryside had its usual summer appearance apart from the effects of the drought of the previous four months Only the presence of workmen strengthening and renewing the dunes at Palling gave a hint as to where the next assault of the sea might be expected, while the large and now rarely used parish church at Waxham was a reminder that the sea s advance has in the course of centuries swallowed up miles of once prosperous countryside

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Points from Foregoing Letters

PHOTOGRAPHS showing the interference pattern of light scattered by thermal agitation (elastic weights) in a clear crystal of gypsum are submitted by Sir C V Raman and C S Venkateswaran The displacement of the three components into which the incidental radiation is split indicates, according to Brillouin s formula, acoustic wave velocities of 3 350, 2,050 and 1,100 m per sec

A hundredfold increase in the ionization at an equivalent height of 125 km, slightly higher than the normal *E* region, which occurred on October 1, 1937, at 0927 G M T is ascribed by R Naismith and W J G Beynon to a bright solar eruption the appearance of which was reported by the Greenwich Observatory at practically the same time

Dr A Soltan has measured the effective cross section for collisions of fast neutrons with atomic nuclei The sticking probability appears to be less than unity, at least for heavy nuclei

From the persistence and rate of decrease in intensity of the band spectrum of helium gas (at 25 mm mercury pressure) Dr S P McCallum and M S Wills infer that either the helium molecules formed in the electric discharge have a life of the order of 1/600 sec or, more probably, they are formed after interruption of the discharge by the collision of a metastable atom with a neutral atom

A photographic study of the relations between the magnitude of the mosaic structure of crystals and the intensity of X ray reflection shows, according to Prof V Dolejšek, M Jahoda, J Ježek and M Rozsival, that the case of specially selected crystals of calcium sulphate, sodium chloride and zinc sulphide, the product of the exposure and the magnitude of the ideal mosaic is constant

Using an electrolytic reduction technique W E Campbell and U B Thomas show that films 30–60 A thick as oxide, are formed on copper during abrasion by French emery, whether carried out in air, under benzene or under water

Commenting on Ratcliffe and Kownacki's suggestion to utilize slowly moving ions in place of electrons in a thermionic tube, in order to decrease the frequency at which inertia effects become appreciable, Dr J S McPetrie refers to an alternative method in which a magnetic field of suitable magnitude is applied to the valve in the direction of the electrode axis

A table giving the mobility and other properties of kaolin clays of known particle size, and graphs showing the effect of *p*H and valency of cations upon the yield value of aqueous suspensions of such clays, are submitted by G Broughton and R S Hand

A method of rapidly estimating within about fifteen per cent the number of small organisms, seeds, etc, in samples, by comparison with a photographic scale of equal size dots or objects, of known density, is described by Prof A C Hardy

A reinvestigation of the spectrum of tetrachlorethylene, C_2Cl_4, using a potential function of the type employed by Manneback and Verleysen, leads J Duchesne to a value of 8×10^5 for the C—C force constant instead of $6 25 \times 10^5$, so that the frequencies can be correlated with a force field in which the C—C constant has its normal double bond value

Research Items

Property among the Ciga of Uganda

THE Ciga of Uganda and Ruanda, whose system of property holding has been studied by Miss May Mandelbaum Edel (*Africa*, 11, 3, 1938), unlike most people of this area, were not ruled by Hamitic overlords and when British dominion was established over them were independent. The basis of their livelihood is horticulture, the fields covering the hillsides beside their houses, which are grouped in rambling hamlets. The staple food is eleusine, eked out by peas, beans, corn and wild greens. They also keep cows, goats and sheep, but the cows are not surrounded by an aura of sanctity, nor are the traditional taboos of their pastoral neighbours observed. Herding does not set the *tempo* of life. Industrially they have knowledge of all the techniques practised among the serfs of their neighbours, including iron smelting, but some pursuits are the work of specialists. The important social group is the household. Ownership is essentially individualistic. Clothing and ornaments, utensils, furniture, animals, food and land—to all these individuals, particularly adult male family heads, have exclusive claims. This claim is acquired through manufacture, gift, certain forms of seizure, purchase or inheritance, and the owner may dispose of his property in many different ways. The word *nyina*, used to designate ownership, has an important extension in reference to a compound, where it includes command over the persons of the household. In his economic transactions, the master of a household need submit to no higher authority than his own. He may lend, give away, sell or destroy any of his possessions. The one kind of control which does not occur among the Ciga is testamentary. A man cannot legislate about the disposal of his possessions after his death. The individual character of property is sharply brought out by the marriage arrangements, the father alone receives the bride price. The individual kraal head is also his own master with regard to agricultural land. When once a man has acquired title by marking off its boundaries with a hoe, it remains his indefinitely and passes to his heirs. Except indirectly, women cannot own property.

Jew's Harps from Hainan Island

A GAP in the study of the distribution of the jew's harp is filled by Mr Chungshee H Liu in an account of three such instruments recently discovered in the course of anthropological investigations among the Li people of Hainan Island (*K'o Hsüch* [*Science*], 22, 1–2; 1938, Shanghai. In Chinese with English abstract). The existence of the jew's harp has been traced by many investigators among various tribes in south and east Asia and in the islands of the Pacific. Chinese scholars of ancient and modern times have recorded its use by the tribesmen along the south-western borderland of China. The original home of the instrument is said to be southern Asia, somewhere along the border-line between Burma and Yunnan. It has a wide distribution in India, Nepal, Tibet, Assam, Burma, Siam, Indo China, Malaya, Formosa, Japan (Hokkaido), and from Borneo to the Philippines, Fiji and Samoa. Of the three examples discovered in Hainan in 1934, two are of bamboo and one is of brass. Although small in size, they have a pleasing tone. Judged by their structure, they are genealogically related to those harps which are used by the Lissu of Yunnan, the Chin of Burma, the Naga of Assam and the Fan of Formosa, as well as allied with those of the Chiang of Chinghai or the Lolo of Szechuan. The discovery of the jew's harp as a cultural trait among the Li people of an Indonesian culture area fills, therefore, a lacuna in its geographical distribution and provides evidence long desiderated by students of ethnology.

Leaf Extension in *Cladium*

MISS VERONA M. CONWAY has carried out extensive observations on the rate of extension of the inner leaves of the shoot of *Cladium Mariscus*, in Wicken Fen and under various experimental conditions (*New Phyt*, 37, 3, June 28, 1938). Dr Godwin had noted the great uniformity with which these leaves extend so that if they are all cut off close to the ground, months later, after considerable extension, their cut ends will all be found within a millimetre distance of one another in length. Very suitable material is thus provided for observations upon the effect of various conditions upon leaf growth and thus conclusions may be drawn as to the habitat conditions that are optimal for the species. Miss Conway's observations have led her to the conclusion that the extension rate is closely correlated with temperature and therefore shows a strong seasonal periodicity. It is also inhibited by strong light and therefore takes place mainly at night, the rate does not vary greatly in the course of any one night, when its magnitude seems largely determined by the temperatures of the preceding day. If the plant is growing in soil which is not saturated with water, it shows a lower extension rate, and Miss Conway concludes that optimal conditions for the growth of *Cladium* include a completely water logged soil.

Economic Aspects of Potato Viruses

Two papers which lead towards a fuller understanding of the economic production of potato stocks free from virus diseases have recently been published. J. B. Loughnane and Paul A. Murphy show (*Sci Proc Roy Dub Soc*, 22, 1, May 1938) that two potato viruses, namely *X* and *F* (*Solanum* viruses 1 and 8 respectively) are transmitted from plant to plant by contact of the foliage. This happened in the still air of an insect free greenhouse, but was accentuated when the foliage was agitated by wind. Miss Phyllis Clinch, J. B. Loughnane and Paul A. Murphy further demonstrate (*Sci Proc. Roy Dub Soc* 22, 2, June, 1938) that *Solanum* virus 1 spreads considerably under field conditions, even in stocks of potatoes selected for their freedom from virus diseases. The combined results are important, for anyone who has been concerned with the production of clean stocks of potatoes can relate annoying occurrences of virus *X* It is now clear that greater attention must be paid to the initial elimination of this disease from nursery stocks, whilst a further practice of wide planting to avoid contact of the foliage, at least in the early stages of isolation should also minimize still further any chance of infection

The Hypocreales

LITERATURE upon the classification of the Ascomycetes and particularly the Pyrenomycetae, is comparatively unavailable to the general student of mycology There is in fact no collected account of later date than Cooke s Handbook of British Fungi , published in 1871 A critical study of the Hypocreales, a section of the Pyrenomycetae, by T Petch, is therefore most welcome (British Hypocreales ', *Trans Brit Mycol Soc* 21 Pts 3 and 4 243 , June 1938) The family Hypocreales includes several fungi of extensive pathogenicity notably *Dialonectria galligena* the cause of apple canker and *Claviceps purpurea*, or ergot of rye Citation of the genera *Nectria, Epichloë, Melanospora Claviceps* and *Cordyceps* should commend the importance of this family even to the amateur mycologist whilst the specialist finds a highly critical monograph of the forty one modern genera now comprised in the Hypocreales Mr Petch has described two new species in the course of his investigations namely *Calonectria tessellata* and *Gliocladium strictum* Thirty nine text figures illuminate general structure and spore form

Bacterial Rotting of Begonias

Messrs W J Dowson, W C Moore and L Ogilvie have recently described (*J Roy Hort Soc* 63 6 , June 1938) a bacterial disease of begonias, which appears to be already distributed somewhat widely in England Leaves are at first spotted with glassy areas, and later turn brown whilst the rot spreads to the petioles and stems, causing death of the plant The pathogen is a yellow bacterium which is provisionally diagnosed as *Pseudomonas begoniae* and its disease producing effect has been established by isolation and re inoculation Control lies in the destruction of infected plants followed by such garden hygiene as the propagation of disease free cuttings in sterilized soil

The Fluorine Molecule

THE internuclear distance in the fluorine molecule has been calculated as 1 45 A by L O Brockway (*J Amer Chem Soc* , 60, 1348 , 1938) from electron diffraction measurements in the gas Half this value is 0 73 A , whereas the covalent radius for the fluorine atom obtained by extrapolation of the carbon, nitrogen and oxygen radii and also obtained from the observed distance in methyl fluoride is 0 64 A , so that the distance in the fluorine molecule is about 14 per cent greater than the value expected for a normal covalent single bond The author points out that the accuracy attained was, on account of experimental difficulties, less than that of other electron diffraction determinations, but considers that the result is not in error by more than about 0 05 A

Hydration and Denaturation of Proteins

ON the cyclol theory, proteins have cage like molecules Water can be associated with these molecules in three ways first, by direct co ordination with the fabric, secondly, inside the hollow shell of the molecule, thirdly, in the protein crystal, in the inter molecular spaces within the crystal cell (D M Wrinch, *Phil Mag* 25, 705 , 1938) It seems likely from the open lattice structure of the protein molecule, that many protein crystals will contain not only water molecules but also foreign ions The crystallizability of the native proteins indicates that their molecules must have a more or less rigid structure All the amino acid residues of the native protein are present in the denatured protein yet the latter has never been obtained crystalline Wu concludes that there must be some linking of the residues in the native protein which has been loosened in the denatured protein allowing the molecule to become flexible Northrop points out the entropy of native protein is very much less than that of denatured protein suggesting that the former has a fixed configuration and the latter a number of possible configurations The cyclol cage has regions of greater and lesser stability and any factor increasing the instability of a particular region could lead to a tearing open of the cage molecule The migration of protein molecules to an aqueous surface could form such a factor since the passing of the hydrophobic R groups out of the water at the surface would lead to a general disturbance of the water relations of the protein molecule Protein molecules are denatured when they form films and lose water of hydration The thickness of the film may be as small as the thickness of a single amino acid residue, suggesting a complete tearing open of the cage like molecule On the other hand, it may be greater suggesting partial opening or the folding over of a flat fabric

New Application of Photo-electric Cells

THE practical applications of photo electric cells are continually expanding According to a report issued by Science Service of Washington, D C , C W La Pierre and A P Mansfield, of the General Electric Company of America, have described a machine to the American Institute of Electrical Engineers which determines the skew of the cloth and controls the apparatus which straightens it When cloth leaves the loom, warp and weft—the lengthwise and crosswise threads—are perpendicular to each other, but after the cloth has been bleached, washed, starched and dried the weft may be appreciably out of position This skew is important, because any designs printed on the cloth will be distorted after the cloth is cut into small pieces The cloth is straightened by passing it through a device called a 'tenter , which contains fingers for gripping the edge of the cloth and stretching it while still wet so as to eliminate the skew Formerly the controls were hand operated, the operator gauging the amount of stretch by the simple expedient of watching the cloth carefully , but this procedure is subject to human limitations and is only satisfactory for relatively coarse weaves and low cloth speeds The authors state that by means of their electrical device the work can be done much faster and more accurately

Carbohydrates of Well-Defined Molecular Weight in Plant Juices

By Prof. The Svedberg and Nils Gralen, Institute of Physical Chemistry, University of Uppsala

THE attempt to bring the solid carbohydrates of plants and animals, for example, cellulose, starch, glycogen and their derivatives into solution has so far resulted in polydisperse systems not possessing well defined molecular weights[1] This fact may be taken as an indication that the question is wrongly put, that such structures as cellulose and starch do not spontaneously form particles of definite mass (molecules) and therefore cannot be broken down to real molecular dispersion without profound chemical change

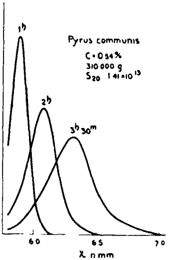

Fig 1

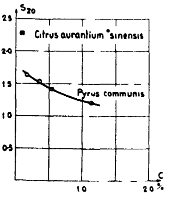

Fig 2

In another class of high molecular compounds, the proteins, we meet with a similar phenomenon Keratin, fibroin, myosin and other proteins which occur in a semi-solid state do not as a rule give solutions of well-defined molecular weight On the other hand, all the proteins of the body liquids are characterized by their well defined molecular weights.

From these statements it would seem reasonable to conclude by analogy that there is a fair possibility of finding carbohydrates of well defined molecular weight in plant juices This would mean that when Nature produces a substance which occurs as a solute in a natural liquid, this substance may form well defined molecules We do not know much about the final stages in the building up of cellulose and starch It is generally believed that the synthesis takes place from the simple sugars through intermediate compounds similar to those observed in the enzymatic breakdown processes studied *in vitro*, but nothing definite is known with regard to those hypothetical stages It is possible that these substances exist in solution in plants as high molecular carbohydrates of well defined molecular weight From this point of view, an examination of plant juices with appropriate modern methods such as ultracentrifugal sedimentation, diffusion and electrophoresis should be of considerable interest

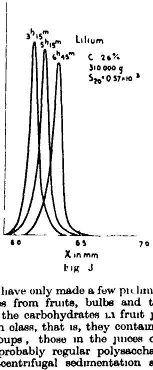

Fig 3

So far we have only made a few preliminary studies of the juices from fruits, bulbs and tubers The majority of the carbohydrates in fruit juices belong to the pectin class, that is, they contain methylated carboxyl groups, those in the juices of bulbs and tubers are probably regular polysaccharides

The ultracentrifugal sedimentation and the diffusion of pectin from apples, pears, plums and oranges was determined directly in the juice and on material precipitated with alcohol These substances are not monodisperse but better defined than starch or cellulose solutions The pectins from apples, pears and plums have approximately the same molecular weight (25,000–35,000), while that from oranges is definitely higher (40,000–50,000) As an example, the sedimentation and the relation between sedimentation constant and concentration for the pectin in pear juice is shown in Fig 1 and 2 A value for the sedimentation constant of orange pectin is also inserted in Fig 2 The increase of sedimentation with decreasing concentration indicates interaction of the molecules due to dissymmetrical shape or hydration

The carbohydrates in the juice of bulbs and tubers have proved more nearly monodisperse in sedimentation and diffusion Fig 3 shows the sedimentation of the carbohydrate from a *Lilium* bulb The molecular weight was 16 000

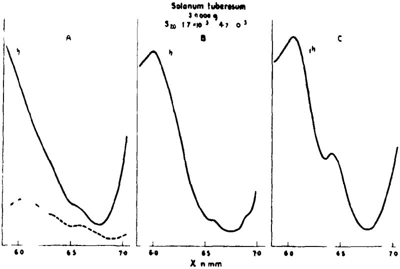

Fig 4

There is a noticeable change in the sedimentation picture with the development of the plant When a bulb or a tuber begins to sprout high molecular carbohydrates appear in the juice in higher concentration than before As a rule, two well defined components can be distinguished This may be taken as an indication that the breaking down of the reserve carbohydrate (starch or inulin) passes through two steps before the low molecular stage is reached As examples, in Fig 4 the sedimentation diagram from the juice of a dormant potato tuber (*A*), from one just beginning to sprout (*B*) and from one in the midst of sprouting (*C*) is given With increased activity the two high molecular components become more and more noticeable The dotted curve in (*A*) represents the sedimentation of the juice after removing the low molecular material by dialysis This shows that the two maxima are present even in the juice of the dormant tuber although in very low concentration Similar curves have been obtained with the juice from the tubers of *Helianthus tuberosus* and *Ranunculus ficaria*, and from hyacinth bulbs

By ultracentrifugal analysis we have also found traces of obviously monodisperse high molecular compounds probably carbohydrates in the juice from hyacinth leaves and in the sap from birch trees

It is hoped that investigations along these lines will help to throw some light on the processes of carbohydrate metabolism in growing plants

Kraemer E O and Lansing W D *J Phys Chem* 39 153 (1935) for cellulose Lamm Ole *Kolloid Z* 69 44 (1934) for starch Record Basil R (unpublished) for glycogen

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Physical Chemistry of Surfaces

Annual Meeting of the Bunsen-Gesellschaft

THE forty first annual assembly of the Bunsen Gesellschaft was held in Breslau on June 2 3 the principal theme of discussion being The Physical Chemistry of Surfaces The symposia of the Bunsen Gesellschaft are organized somewhat differently from those of its younger sister the Faraday Society All papers are delivered in full, only abstracts being available beforehand Papers delivered fall under three heads (*a*) summary reports invited from various experts, intended between them to cover the whole field of discussion (*b*) shorter contributions bearing on the main theme, (*c*) miscellaneous physico chemical contributions (*b*) and (*c*) were delivered in parallel sittings This produced a very full two day programme with little time for discussion—in fact there was no time whatever for public discussion on section (*a*) This disadvantage is appreciated, and the society has recently adopted a policy of holding smaller extra *Tagungen*, more after the model of the Faraday Society, in which discussion can be a principal feature

Prof P A Thiessen made some general introductory remarks and took the chair R Brill discussed surface films on water, a method of investigation which has been somewhat neglected in Germany since the time when Fraulein Pockels its originator had to arouse Rayleigh s interest to secure publication of her work He discussed in great detail the two dimensional equation of state and finally the work of Blodgett and Langmuir on built up multilayers Of all recent developments mentioned in the symposium, the latter undoubtedly shows the most promise of great expansion and exciting progress In a single lecture of such detail it was naturally impossible to deal with everything, but it is unfortunate that such well established novelties as measurement of film potentials and the investigation of chemical reactions in monolayers were never brought before the meeting

An interesting paper by K Neumann concerned molecular motion in surfaces He dealt first with the streaming set up at liquid surfaces by capillary forces, which often plays a large part in the rapid dissolution of surface active substances, and, secondly, with surface diffusion on solids—a field of research first opened up by the work of Volmer and Estermann on the growth of mercury crystals Both experiment and simple theoretical considerations show that the activation energy for change of position of a molecule on a crystal surface is roughly one fifth of the heat of evaporation, whence it follows that a molecule after condensation will usually change its place some thousands of times before evaporating again. This enables the regular growth of crystals, which is otherwise difficult to reconcile with the existence of condensation coefficients of the order of magnitude 1. The activation energy for the motion of single ions on the surface of an ionic crystal is not much less than the heat of evaporation, but adsorbed pairs of oppositely charged ions can readily move around one another. This accounts for the surface diffusion of sodium chloride, for which experimental evidence was presented.

O. Hahn reported on the investigation of surface processes by radioactive methods. Of particular interest is his 'emanation method' of investigating the 'inner surface' of a solid. This is a development from the older adsorption method used by Paneth. Hahn makes solid preparations containing minute quantities of radium, and determines the nature of the surface by the readiness with which the material gives up emanation. By this means, changes in the surface of a material (for example, iron oxide hydroxide gel or a catalytic thorium oxide) with time or heating can be followed with great sensitiveness. Later in the meeting, K. E. Zimens reported on theoretical work of S. Flugge which shows that the method can also be used to investigate diffusion constants in solids, in principle quite easily for values as small as 10^{-25} cm ^{2}/day. (The smallest *measured* diffusion constant in a solid is 10^{-17} found by Cremer in solid hydrogen from the rate of disappearance of isolated *ortho* hydrogen molecules, which are only destroyed by magnetic reaction with one another.) A very remarkable result obtained by the older methods is that found by K. Starke, that mixtures of $ZnO-Fe_2O_3$ or $ZnO-Cr_2O_3$ in equimolecular (spinel) proportions develop a very much increased adsorptive power for lead above that of the components, even at room temperature.

Th. Schoon dealt with electron diffraction as a means of investigating surfaces. He discussed the evidence for the Lennard-Jones effect (predicted contraction of the surface layers of ionic crystals, and a corresponding expansion in molecular crystals), which remains doubtful, owing to uncertainties about the refractive index for electrons of the possible presence of adsorbed gas layers. Among other points dealt with were the depth of penetration of electrons, by which is meant the depth to which an electron at grazing incidence (3°) can pass in and out of the crystal, being scattered only once. From the fact that with 25 kv., cetyl palmitate and stearic acid crystals, grown from hydrocarbon solvents, give the same diagram, but differ at 40 kv., it is concluded that electrons at these voltages have respectively shallower and deeper penetrations than 20 A.

P. Harteck dealt with the various types of adsorption (Van der Waals adsorption, capillary condensation, and reversible and irreversible activated adsorption). R. Suhrmann reported on electron emission phenomena. C. Wagner gave a masterly survey of reactions at phase boundaries, classified according to the nature of the velocity determining stage. This was so closely packed as to be incompressible, and it is recommended that the original paper be referred to when it appears in the *Zeitschrift für Elektrochemie*. K. Fishbeck made much the same attempt with narrower limitations. Finally, G. M. Schwab surveyed surface catalysis. This paper also, unfortunately, lends itself to compression as little as the subject lent itself to compression into a single lecture of 35 minutes.

An arbitrary selection must suffice for the miscellaneous papers. L. Bergmann demonstrated a number of interesting experiments with supersonics. Th. Förster showed how it is that the strength of a C–H bond is influenced by the state of binding of the carbon (single, double or triple bond, or strained ring). The mutual influence arises from the fact that the sum of the mixture ratios of *2s* and *2p* states in the four bonds must remain constant and equal to 1 : 3. Reduction of the angle below the tetrahedral angle reduces the ratio below 1 : 3, and hence increases it in the other bonds. The maximum binding is reached with a ratio of about 1 : 1 (C–H bond in acetylene). With nitrogen, the bonding of which is not a mixture of electron states, but purely *2p* in the first approximation, there is no mutual influence, as the Raman spectra have shown. Schmid and Larsen showed that the increase of conductivity at high frequencies (λ 12 m. and 20 m.) is very large in solutions of soaps, etc., containing ionic micelles. This indicates that the reduced conductivity and activity in such solutions is a Debye-Huckel electrostatic effect (theory of Hartley and others) rather than reduced dissociation as supposed by McBain. H. J. Antweiler and M. v. Stackelberg reported further experiments on the peculiar currents of liquid with speeds up to 8 cm./sec. which are set up in the electrolyte at liquid metal cathode surfaces under certain conditions. This can now be satisfactorily interpreted as a cataphoretic effect. K. Clusius and K. Weigand have measured the pressure dependence in the transformation II (isotropic) ⇄ III (anisotropic), in solid hydrogen sulphide and heavy hydrogen sulphide. The hysteresis in this change is still something of a mystery, but the authors suppose it means that many molecules must become rearranged simultaneously. X-rays indicate that the *S* atoms scarcely move in the transition. F. C. Frank presented a descriptive theory of the phase change liquid to liquid crystal, showing the way in which the quasi-crystalline structure of the former can develop semi-continuously into the latter. This was intended to be a contribution to the general theory of phase changes from the point of view that this is one of the simplest of all crystal–non-crystal transitions.

On the whole, in spite of the high quality of individual contributions, the meeting produced nothing of great novelty. This applies particularly to the main theme. Partly this reflects a certain lack of enterprise in German physical chemistry, which is at the moment mainly distinguished by painstaking covering of well-trodden ground; partly it indicates that the time was well chosen for a summarizing symposium designed to report progress, rather than to make it.

There were as usual a number of social events in a programme which scarcely left a minute unprovided for. Of these the most memorable was a concert in the *Schloss*, with music by Mozart and Frederick the Great—the latter appropriately as the one who gave the *Schloss* its present inner form. At the final dinner, we learnt that this was the fortieth *Bunsentagung* which Prof. Bodenstein had attended, without interruption. Finally, many members took part in a visit to the Waldenburger Bergland and Salzbrunn, and some continued home *via* the ridge way of the Riesengebirge.

F. C. FRANK.

Guy's Hospital Medical School

New Institute of Pathology

THE new Pathology Building at Guy's Hospital Medical School, which was opened on June 23 by the Chancellor of the University, the Earl of Athlone, completes the rehousing of the School and Hospital laboratory departments. It makes a valuable addition to the facilities available for carrying on medical research in London by providing suitable modern accommodation in close association with one of the largest hospitals.

In welcoming the Chancellor, the Dean of the Medical School pointed out that a comparatively small number of hospitals, such as Guy's Hospital, which had originally been founded for the care and cure of a small neighbouring population, had developed into the training ground for the medical services of the nation. To-day, however, the solvency of these hospitals is in imminent danger, and the whole clinical training of the medical student is not only handicapped but is also seriously threatened by the desperate financial straits in which these essential hospitals find themselves. "It is one of the queerest anomalies," he said, "of this British civilization that the training for the most important and most devoted of its public services should be hampered at every stage by being committed to an existence of perpetual mendicancy."

The Chancellor, in replying, stated that the University viewed with great satisfaction every effort made by its constituent schools to provide themselves with accommodation and equipment worthy of institutions of university status, and he congratulated the Medical School of Guy's Hospital on the fulfilment of its wise policy of concentrating all the departments of the School on one site. He also said that the University recognizes with appreciation that the present building has been largely paid for out of the ordinary funds of the School, without public appeal, though with some financial assistance from the Court of the University. "The reputation of the hospital," he said, "depends on its school, and the reputation of the school depends on the financial stability and efficiency of the hospital."

The opening of a large modern medical school building designed to afford extensive accommodation for research, provides an opportunity of directing general attention to the seriousness of the position in which those responsible for medical education in this country are now finding themselves placed. The prescribed course of education for a medical qualification is at present divided into two parts of roughly equal length. In London the earlier half is carried out in well equipped departments, like that now opened at Guy's Hospital, belonging to institutions which are carefully controlled and inspected by the University authorities and liberally supported by University funds. The provisions for teaching in the second half, however, present a striking contrast with those in the first. They depend almost entirely upon materials and facilities provided by more or less independent institutions—the teaching voluntary hospitals—many of which are very much older than the University itself. For some years these essential hospitals have been in straitened circumstances, and the teachers of clinical subjects in their wards and out-patient departments have been faced with increasing handicaps upon their activities. Though these obstacles have been greatly lessened by the loyal support given by the teaching staffs, as well as by the ingenuity of the administration in making resources stretch as far as they will go, it should now be generally realized that medical students are no longer receiving the best training which the medical advances of the past fifty years have made possible. Nor is there any assurance that even the present hospital facilities will be continued in the future on the same level as in the past. In their endeavour to maintain their former predominant position many of the voluntary hospitals, in recent years, have seriously overstrained their resources, and are adding yearly to accumulating deficits. They are faced, therefore, with the very serious alternatives of either curtailing the facilities they place at the disposal of the University for medical education or of extending in some direction the basis of their financial support. What direction such extension should take will require careful consideration, especially in view of the double duty that these institutions undertake: they provide hospital beds for the population of London on the one hand and medical practitioners for the country as a whole on the other. To meet these two distinct claims it would seem that both local and national support must be forthcoming.

University Events

Belfast.—Arrangements have been made for co-operation between the University and Armagh Observatory, and Dr. E. M. Lindsay, astronomer at Armagh, has been appointed part-time lecturer in astronomy in the University. Dr. Lindsay will continue to hold his post of astronomer at Armagh.

Mr. O. G. Edholm has been appointed to the newly created lectureship in physiology. Mr. Edholm is at present assistant lecturer in physiology at King's College, London.

Cambridge.—The electors to the John Humphrey Plummer professorship of mathematical physics have elected Prof. R. H. Fowler, fellow of Trinity College, from October 1. Prof. Fowler resigned from the chair on his acceptance of the directorship of the National Physical Laboratory on the resignation of Prof. W. L. Bragg (see NATURE, June 4, p. 1002); but has been advised to withdraw his acceptance of this post for reasons of health, and signified willingness to be re-elected as professor of mathematical physics.

D. J. Bauer, of Trinity College, has been re-elected to the Michael Foster studentship in physiology for 1938–39. Mr. Bauer, who was educated at King's College School, Wimbledon, graduated with a first class in both parts of the Natural Sciences Tripos. The annual value of the studentship is £105.

Oxford.—In Convocation on July 30 the honorary degree of D.Sc. was conferred on Prof. C. G. Jung, professor of psychology in the University of Zürich and president of the Tenth International Medical Congress for Psychotherapy meeting in Oxford.

Southampton.—Dr. P. Ford, lecturer in charge of the Department of Economics, has been elected to the chair of economics and head of the Department of Economics and Geography in University College, Southampton.

Miss F. C. Miller has been appointed senior lecturer in geography.

Science News a Century Ago

The Horticultural Society

A MEETING of the Horticultural Society was held on August 7, 1838, H M Dyer, vice president, being in the chair "The specimens" said *The Times*, "exhibited some interesting varieties One of the most valuable was the vanilla plant, cultivated by Professor Motreu, of Liège, who gave it the same attention as is employed in the cultivation of melons and cucumbers In the first year of its growth it produced 50, and in the second year upwards of 160 fruits, and the success of its cultivation led to the belief that it might be introduced into Europe as an article of profit From the gardens of the Society was a Trinidad pineapple weighing 5 lb 12 oz This is one of those extraordinary fruits that grow on that island, near a pitch lake, and are there met with of a weight of 28 lb , which they might attain in this country, were the soil and cultivation properly known The cultivation of the vanilla plant was dealt with a week or two later by Prof Motreu in a paper to the British Association in Newcastle

The *Athenæum* and School Buildings

In its issue of August 11, 1838 the *Athenæum* dealt at length with a Report of the Secretary of the Board of Education on the Subject of School Houses published at Boston, U S A Always a persistent advocate of national education, the *Athenæum* remarked that, ' Habituated as we are to opposition to all national education that is directed to a higher object than a polemic triumph, we were almost startled at the plain good sense of the men of Boston, who have brought their time and attention to bear upon the philosophy of school accommodation Planning, ventilation, windows, lighting, heating, location, desks and seats, and play grounds were all the subject of discussion in the report, which said that ' when it is considered that more than five sixths of all the children in the State spend a considerable portion of the most impressionable period of their lives in the school house, the general condition of those buildings, and their influence upon the young stand forth at once as topics of prominence and magnitude All those readers who had the improvement of our domestic education at heart were enjoined to procure reprints of the report for cheap or gratuitous circulation

Honours to Men of Science

UNDER the above heading, the *Mechanics Magazine* of August 11, 1838, said ' Sir John Herschel is, we believe, the first Englishman who has ever received a baronetcy purely on account of his scientific acquirements His father was only a Hanoverian knight, which was also the honour enjoyed by himself previous to the late coronation Sir Edward Lytton Bulwer is only the second *literary* baronet, having been preceded by Sir Walter Scott No great inventor has ever received a similar honour , Sir Richard Arkwright was indeed knighted, but that was not on account of his mechanical merits, but in the usual routine, as the bearer of an address of congratulation on His Majesty s escape from the knife of Peg Nicholson, or some equally important occasion " In connexion with this, it may be remarked that Lord Liverpool, when Prime Minister, offered a baronetcy to Watt, who, however, declined it,

Societies and Academies

Dublin

Royal Dublin Society, June 21

REPORT OF THE RADIUM COMMITTEE FOR 1937

10 110 millicuries of radon were issued during the year and reports received from hospitals and the larger private users record the treatment of 502 cases of malignant and 97 of non malignant diseases Of all cases of malignant disease treated by any method in these institutions, more than fifty per cent received radium treatment Out of a large number of malignant cases of which detailed results are recorded, some sixty per cent were apparently cured, or at least were free from symptoms at the end of a year Records are also included showing the number of cases treated in former years which are known to be still alive One large user comments on the imperative need for taking all possible steps to ensure that patients come forward for treatment before the disease has advanced so far as to render the results hopeless

W R G ATKINS A modified use of the hæmocytometer for counting sparse fields By suitable focusing, it is possible to arrange that the entire circular microscope field just encloses the square millimetre of the hæmocytometer, and thus the entire field being of a known area can be used for counting purposes In this way a number of sample counts can be effected on a single slide

Paris

Academy of Sciences, June 13 (*C R* , 206 1769-1839

LÉON LECORNU The pressures experienced by the envelope of an ellipsoidal balloon

ROBERT LESPIEAU The synthesis of adonite

JEAN TILHO and CAMILLE ARAMBOURG The discovery by Stephane Desombre, of a fossil elephant in the centre of the Sahara

JEAN DELSARTE Certain functional transformations relating to linear partial differential equations of a second order

NICOLAS CIORANESCU A generalization of the first formula of the mean and the polynomials of Tchebichef

KWOK PING LEE The multiple values and the directions of Borel of meromorph functions

ALBERT PFLUGER The variation of the argument and the distribution of the zeros of a certain class of analytical functions

JEAN LUNEAU The influence of the pressure on the resistance to movement in air for very low values of the Reynolds number

GEORGES DEDEBANT and PHILIPPE WEHRLE The equations to the probable values of a turbulent fluid

LUCIEN REINGOLD The calculation of the temperatures and instantaneous maximum pressures in explosion motors

FERNAND CHARRON The distribution of heat between two bodies rubbing together

RAYMOND JOUAST, MARCEL PICARD and RENÉ HÉROU The determination of the ratio of the international ohm to the absolute ohm The method is based on a standard inductance (of known geometrical dimensions) and the frequency of an alternating current, and gives a ratio of the international ohm to the absolute ohm of 1·00052 This is compared with earlier values, 1·00045 (United States National Bureau of Standards) 1·00050 (National Physical Laboratory), and 1 00048 (Physikalisch-Technische Reichsanstalt, Germany).

PIERRE GRIVET · A new phenomenon in the working of the photo-electric cell at high frequency.

VICTOR SINN · Researches on the reactions at the positive electrode of the lead accumulator. Determination of the amount of sulphuric acid used by the positive plate of a lead accumulator during discharge, when opposed to the hydrogen electrode, gave figures agreeing with the theory of Gladstone and Hibbert within 1 per cent

JACQUES DE LASSUS SAINT-GENIES: The conditions of correct projection of crimped films

PAUL GESTEAU: A method for the quantitative analysis of substances in solution by their absorption spectrum in the field of the ultra-violet

GEORGES ALBERT BOUTRY and **JEAN GILLOD**. The properties of a new type of photo-emissive cell Studies of a cell in which the cathode was formed by a thin layer of caesium deposited on silver.

MARCEL MATRICON The application of the method of the self-consistent field to atomic nuclei

PAUL LAFFITTE: The projection of flame in gaseous mixtures and on the phenomenon of shock in explosion motors

GEORGES CARPÉNI · The preparation, electrometry and spectrography in the ultra-violet of *d*-araboascorbic acid.

LOUIS HACKSPILL and **LAMBERT A VAN ALTNEA** The action of caesium on carbon monoxide Caesium combines at the ordinary temperature with carbon monoxide, even under low pressure, giving a stable exothermic compound $(COCs)_n$, probably $(COCs)_6$, reacting with dilute acids giving glyoxal

ANDRÉ ADRIEN SANFOURCHE: The preparation and properties of the neutral lithium phosphate Neutral lithium phosphate, free from LiOH, can only be obtained by neutralizing phosphoric acid with the exact proportion of lithium hydroxide. Its composition is $Li_3PO_4 . 9{\cdot}5 H_2O$.

MME YVONNE KHOUVINE, GEORGES ARRAGON and **YOSHINORI TOMODA** The oxidation of tetramethyl-α-*d*-methyltagatoside with nitric acid.

MLLE DINAH BIQUARD: The Raman spectra of indanone

CHARLES EMILE BRAZIER and **LÉONIDE GÉNAUX**: The earthquake of June 11, 1938 Results shown by the seismographs at the Parc Saint-Mawr Observatory

MENGLI ENIKEFF. Researches on the subterranean waters of the interior delta of the Niger.

HENRI BRANDSTETTER and **JEAN LAGRULA**: Values of the magnetic inclination in the Sahara and the Sudan

RENÉ SOUÈGES: The embryogeny of the Nyctaginaceæ The development of the embryo in *Oxybaphus viscosus*.

MARC SIMONET and **PIERRE DANSEREAU**: Several tetraploid mutations of *Petunia* appearing after treatment with colchicine.

WALTER RIESE: The structure and function of the brain of the newly born bear.

FERNAND LE CHUITON, CHARLES MISTRAL and **JEAN DUBREUIL**: Attempts at the vaccination of the pig with the virus of swine fever after passage through the guinea pig. Rapid loss of virulence for the pig and also of the antigenic power against the original virus.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

ASSOCIATE PROFESSOR OF ENTOMOLOGY in the Punjab Agricultural Service—The High Commissioner for India, General Department, India House, Aldwych, London, W C 2 (August 15).

LECTURER IN ELECTRICAL ENGINEERING in the County Technical College, Worksop—The Principal (August 15)

PRINCIPAL of the Hendon Technical Institute—The Secretary to the Education Committee, Education Offices, 10 Great George Street, Westminster, S W 1 (August 27)

LECTURER IN METALLURGY in the University of Leeds—The Registrar (September 1)

PRINCIPAL of the Bridgwater Art and Technical Institute—The Chief Education Officer, County Hall, Taunton (September 3)

LECTURER IN PHYSIOLOGY in the Portsmouth Municipal College—The Registrar

Reports and other Publications

(not included in the monthly Books Supplement)

Other Countries

Spisy vydávané Přírodovědeckou Fakultou, Masarykovy University Čís 248 O difusních potenciálech, VI (On the Diffusion Potential, VI) Napsal V Čupr Pp 15 Čís 249 · Trois notes sur les espaces abstraits (Tři poznámky o abstraktních prostorech) Par Bedřich Pospíšil Pp 9 Čís 250 Morfologický vývoj těšínského podbeskydí (Morphologische Entwicklung des Teschener Hügellandes) Napsal Fr Vitásek Pp 18 Čís 251 Processus lemurinicus Von Dr Karl Kahn Pp 23 Čís 252 Akustická měření katodovým oscilografem (Akustische Messungen mit dem Kathodenoszillographen) Napsal J Zahradníček Pp 10 Čís 253 O pasivitě chromu a ferrochromu v kyselých roztocích (Passivity of Chromium and Ferrochromium in Acid Solutions) Napsali V Čupr a O Lasák Pp 16 Čís 254 O přemístění rovnostranného trojúhelníka v prostoru a speciální ploše osmého stupně vytvořené tímto pohybem (Sur le déplacement d'un triangle équilatéral dans l espace et sur une surface spéciale d'ordre huitième) Napsal Miloslav Pelíšek Pp 28 Čís 255 Vliv přípravy kysličníku zinečnatého na jeho redukci vodíkem (On the Influence of Preparation of Zinc Oxide on its Reduction by Hydrogen) Napsal F Schacherl Pp 13 Čís 256 Sur les caractères des points dans les espaces topologiques (O charakterech bodů v topologických prostorech) Par Bedřich Pospíšil Pp 23 Čís 257 Pohlavní dvojtvárnost larev a kukel pakomárů (Geschlechtsdimorphismus der chironomidenlarven und -Puppen) Napsal Jan Zavřel Pp 23 Čís 258. i Sur les espaces compacts (O kompaktních prostorech), ii Sur les caractères des points dans les espaces £ (O charakterech bodů v £-prostorech). Par Eduard Čech et Bedřich Pospíšil Pp 14 (Brno A Píša) [197

U S Department of Agriculture Circular No 478 The American Dog Tick, Eastern Carrier of Rocky Mountain Spotted Fever By F C Bishopp and Carroll N Smith. Pp 26 5 cents Farmers' Bulletin No 1798 Control of Common White Grubs in Cereal and Forage Crops By Philip Luginbill Pp 20 5 cents Technical Bulletin No 590 Biology of the Pea Weevil in the Pacific Northwest with Suggestions for its Control on Seed Peas By A O Larson, T A. Brindley and F G Hinman Pp. 48 10 cents (Washington, D C Government Printing Office) [207

Mexico's Resources for Livelihood a Study of the Influence of Foreign Ownership By Alejandra Carrillo Pp 34 25 cents. Gold and Poverty in South Africa · a Study of Economic Organization and Standards of Living By Max Yergan. Pp 24 15 cents. (The Hague and New York · International Industrial Relations Institute) [217

Briefe Franz Xaver Freiherrn von Zach und seines Nachfolgers Bernhards von Lindenau von 1791–1816 an P Martin Alois David. Herausgegeben von Otto Seydl (Publikace Pražské Státní Hvězdárny, Č. 11) Pp 206 (Praha Státní Hvězdárna Republiky Československé) [246

Lucknow University Studies. No 10 The General Field Theory of Schouten and Van Dantzig By Prof N. G Shabde Pp. iv+58 (Lucknow Lucknow University) [17

Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen Afdeeling Natuurkunde, Sectie 1, Deel 16, No 4. Second Report on Viscosity and Plasticity Prepared by the Committee for the Study of Viscosity of the Academy of Sciences at Amsterdam Pp viii+287+2 plates. (Amsterdam: N V Noord-Hollandsche Uitgeversmaatschappij) [17

Festschrift zum 60 Geburtstage von Prof Dr Embrik Strand. enthaltend dem Jubilar gewidmete Arbeiten ausländischer Zoologen und Paläontologen Vol 1 Pp ii+644+14 plates. Vol. 2. Pp. ii+652+37 plates Vol 3. Pp. ii+608+20 plates. Vol 4. Pp. ii+784+16 plates (Riga Sistematiskas Zoologijas Instituts.) [17

U S Department of Agriculture Circular No 474. Muskrat Investigations in Dorchester County, Md., 1930–34 By Frank R. Smith Pp 24 10 cents. Leaflet No. 161. The Eastern Tent Caterpillar By F M Wadley Pp 4 5 cents Technical Bulletin No. 601 Selenium Occurrence in Certain Soils in the United States with a Discussion of Related Topics; Third Report. By Horace G Byers, John T Miller and K. T Williams, and H. W Lakin. Pp. 75. 15 cents Technical Bulletin No. 607. Occurrence of the Beet Leafhopper and Associated Insects on Secondary Plant Successions in Southern Idaho. By D E Fox. Pp. 44. 10 cents. (Washington, D.C. Government Printing Office.) [267

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Inland Water Problems

IT is inevitable that in a country of the population and extent of the United States of America, the administration of the various public services should be framed on a scale of greater magnitude and amplitude than is practicable or desirable in smaller countries. Yet even if this be admitted, there is no reason why in any two countries, kindred objects of public concern should not be pursued with equal intensity of effort and corresponding breadth of outlook Where a service is essential for the general welfare, an equivalent degree of enterprise and energy may not unreasonably be expected in both cases

This reflection presents itself in considering a comparison of the respective attitudes of the British and American Governments in regard to the question of the national administration of water, one of the most essential services of a civilized community Until recently, in Great Britain there had been no attempt at the effective co-ordination of water resources of the country on a national and systematic basis, and little control over their exploitation beyond the slight and general supervision of Parliament over Bills relating to powers for local supplies. It was left in rather a vague, haphazard way to the Ministry of Health to take action, if and when necessary, with the result that matters in general were allowed to shape their own course, the Ministry only dealing with specific problems as they arose, a characteristically British method, commonly known as 'muddling through'. As for any definite public statement or programme of policy to be adopted for the most efficient and beneficial use of water supplies in regard to the nation as a whole, serious consideration was rarely given to such matters in official or political circles Indeed, until forced into action by the pressure brought to bear upon Parliament in consequence of the drought of the years 1933 and 1934, and the joint representation of the British Association and the Institution of Civil Engineers, no attempt at a systematic investigation of the water resources of Great Britain was ever contemplated Only with some degree of ministerial reluctance, after an unsuccessful attempt to describe it as superfluous and unnecessary, was an Inland Water Survey Committee instituted in 1935 under the Ministry of Health Since then, there has been appointed, also under the Ministry of Health, a Central Advisory Water Committee, which has been engaged in reviewing the work of nine independent Regional Advisory Committees in various parts of the country. The first report of this Central Committee has just been issued, and it affords an indication of the lack of co-ordination which prevails between these bodies and external interests related to water supply.

In the United States, the subject of inland water control has exercised a far greater degree of Governmental consideration and the matter has been dealt with on broad national lines. There is, in the first place, a National Resources Committee dealing with all the national assets of the country, and an important section of this is the Water Resources Committee, including representatives of the War, Interior, and Agricultural Departments, Public Health Service and Federal Power Commission. Through the activities of this body, a co-ordinated plan and policy for each drainage basin in the country has been laid down, and the individual plans have been reviewed and co-related in respect of national needs and budgetary limitations. This has been accomplished with the aid of forty-five drainage basin committees, constituted on a democratic basis, with popular representation

It is pointed out that a unified system of water control, as opposed to a medley of unrelated projects, is essential in the best interests of the nation, and that an integrated federal policy is required in order to deal satisfactorily with various types of water problems having interdependent relationships The main principles underlying the determination of the adopted programme have been described as a "concern for the promotion of public safety, public health, public convenience and comfort and public economic welfare" so as to secure "the establishment or maintenance of a high standard of living".

Elsewhere in this issue (p 280) will be found particulars of a six-year programme which has been recommended to Congress, involving in the total an estimated expenditure of 891 million dollars, or a "weighted average" per annum of 200 million dollars—say 40 million pounds Expenditure on this huge scale indicates profound appreciation of the necessity for a far-reaching development of national resources which, in the case of America, are themselves of enormous magnitude

The water resources of Great Britain are of much more modest extent, but, none the less, they call for careful conservation and development, and the point may well be raised again, as on a previous occasion (see NATURE, August 4, 1934), whether identification of the Inland Water Survey with the restricted outlook of the Ministry of Health is in the best interests of the country Water is not the special preserve of any particular Government Department: it is a national asset We have advocated—and still believe the scheme to be best—the establishment of an entirely untrammelled investigation under the Department of Scientific and Industrial Research, the impartiality and independence of which would secure to the nation at large an unbiased outlook on this matter of national concern. The Ministry of Health has its own problems to face, and is not in any way concerned with industrial or commercial requirements, or with the needs of agriculture, fisheries and navigation. It cannot then be claimed that these interests are adequately represented as they should be in a matter of this kind.

The fact of the existence of the Central Advisory Water Committee does not invalidate our contention in the least It, too, is a purely departmental Committee and although its functions (*inter alia*) are "to advise the Government Departments on questions relating to the conservation and allocation of water supplies", yet, being under the ægis of the Ministry of Health, it cannot, in our view, have that independence of attitude and breadth of outlook which should characterize a committee of this kind It is true that it includes among its members, individuals associated with a variety of water interests, but none the less it has to supplement its sources of information with the assistance from other departments of "assessors". one from the Board of Trade, two from the Ministry of Agriculture and Fisheries, one from the Ministry of Transport and one from the Department of Scientific and Industrial Research. If the representations of these assessors are to carry their full weight, the assessors themselves should have the prestige and standing of members of the Committee The matters with which they deal are not side issues, but questions of serious importance

We have no intention of making any reflection whatever on the composition of the Inland Water Survey Committee and the Central Advisory Water Committee, or on the particular steps taken by the Ministry of Health to establish them The cause of criticism lies in the fact that the matter is of such far-reaching importance to all classes of the community that, as in the case of the United States, it calls for the existence of a comprehensive and strictly independent Water Resources Committee on which there would be direct representation of all the varied interests in inland water administration, private as well as corporate This would naturally include certain Government departments, some of which are remote from the sphere of public health, and relate to the wider aspects of national economy in regard to commerce, transport and industrial development

A national programme of development drawn up by such an impartial committee would command far greater confidence and support when submitted to Parliament than the unavoidably biased recommendations emanating from a single Ministry. Without such a programme and policy Great Britain must inevitably continue to drift in an aimless way, subject to visitations of drought and flood, and through lack of vision and forethought, reprehensibly neglecting the systematic development of one of the most important natural assets of the country.

Scholiasts and Science

Ancients and Moderns:
a Study of the Background of the "Battle of the Books" By Prof. Richard Foster Jones. (Washington University Studies, New Series Language and Literature, No 6) Pp xi + 358 (St Louis, Mo Washington University, 1936) 3 dollars

> "Then, *Aristotle*, observing *Bacon* advance with a furious Mien, drew his Bow to the Head, and let fly his Arrow, which mist the valiant *Modern* and went hizzing over his Head, but *Des Cartes* it hit, the Steel Point quickly found a *Defect* in his *Headpiece*, it pierced the Leather and Pastboard, and went in at his Right Eye The Torture of the Pain whirled the valiant *Bow man* round, till Death, like a Star of superior Influence, drew him into his own *Vortex*"

THUS Jonathan Swift, in his satire "The Battle of the Books", written in 1697 to ridicule those of his contemporaries who contended that the performances of their times exceeded those of the ancients The above passage, and one in which Harvey, Paracelsus and Galen are concerned, are about all that refer to the particular revolt against the ancients that culminated in the foundation of the Royal Society, but nevertheless Prof Jones gives the subtitle "A Study of the Background of the Battle of the Books" to his book, which is a heavily documented account of the wordy warfare that accompanied the rise of the experimental method in England It is essentially a history of polemic, and might well itself have appeared under Swift's title, but with Swift's book it has little to do The title-page may mislead the student of literature

Prof. Jones is a whole-hearted champion and admirer of Francis Bacon, and attributes the triumph of the experimental philosophy to him alone—"the achievement of this desideratum was the destiny of one man—Sir Francis Bacon" This, and a contention that the Puritans did much to make Bacon's work popular, in connexion with schemes for educational reform, especially the putting down of the teaching of divinity, are his constant theme, in support of which he adduces a large number of authors of various degrees of distinction, or of obscurity, Hakewill, Hartlib, Durie, Starkey, Webster and the like.

Prof. Jones certainly succeeds in proving that between 1640 and 1660 Bacon was often cited as a champion by such men, in their writings against the abuse of classical authority and in favour of educational reform and the utilitarian cultivation of the sciences None of these men, however, cuts much of a figure as a practical experimenter, or, indeed, as an original investigator of any kind Prof Jones is, accordingly, often driven to the type of unsupported assumption that characterizes so many of Francis Bacon's most ardent supporters He tells us, on the strength of the fact that Wilkins refers to him once or twice, that "Bacon was certainly the chief source of Wilkins' ideas", although Wilkins, in the book in question, set out to expound and defend the Copernican theory, which Bacon ridiculed Wilkins further adduces Galileo and Kepler, whom Bacon was so far from appreciating that he never refers to either of them Prof Jones tells us that "one who has been plausibly identified as Robert Hooke" published a continuation of Bacon's "New Atlantis" he adduces no support of this identification, except that the book is by R H Esquire It is most improbable that it was by Hooke It was published in 1660, and Aubrey, who was Hooke's great friend, and stayed with him in his lodgings so frequently, tells us that the first thing he published was the known "An Attempt for the Explication of the Phenomena observable in an Experiment published by the Hon R Boyle .", a little tract which came out under his full name in 1660. Hooke was at the time Robert Boyle's assistant, busily engaged in his beloved experimenting, and it seems unlikely in the highest degree that he should have had the inclination or leisure to publish such a book in the same year, that he should use his initials after having already used his full name, and that he should call himself Esquire—which he was not In any case, it seems to some of us that the book is completely out of Hooke's character

As an example of how far Prof Jones will go, he says, "Though he does not mention Bacon, Worcester is an outstanding example of the hold which the inventive spirit, fostered by Verulam, was fixing on men". There is nothing to show that Bacon had any influence whatever on Worcester—catalogues of inventions, usually illustrated and supplied with detail, were current long before Bacon's influence can possibly have been felt, for example, Ramelli and Zonca, of which traces are to be found in Worcester's booklet—while anyone who has read Worcester's "Century of Inventions" will be hard put to it to find any trace of real inventive achievement in this mere catalogue of projects and devices, many of them clearly impossible and others as clearly never tried, let alone perfected as the author claims for all of them One example may suffice How to make an artificial bird to fly which way and as long as one pleases by or against wind sometimes chirping other times hovering still tending the way it is designed for No directions are given as to how any of the inventions are to be constructed The contention that Worcester invented a practicable steam engine is scarcely taken seriously to day (see *Trans Newcomen Soc* 13 75)

There is one man of science who frequently cites Bacon in terms of warm admiration namely Robert Boyle but even here Prof Jones gives way to exaggeration After quoting a large number of citations of Bacon by Boyle he says the above are not a tithe of the citations which might be produced I shall be astonished if Prof Jones can make this good—at any rate the folio edition of Boyle s work 1772 has a very good index and Prof Jones has cited nearly all the references to Bacon to be there found Putting aside this hyperbole however there is no doubt of Boyle s veneration for Bacon and a further proof of the respect in which Bacon was held is that his picture appears in the Hollar frontispiece to Sprat s History as *Artium Instaurator* Prof Jones finds this natural but then he nowhere considers seriously Bacon s actual achievement or in particular the criticisms of Lasson and Duhring or of Liebig Draper and Sir Oliver Lodge men of science who have carefully considered Bacon s writings

In spite of his boast that he brought a new method and of his attacks on Aristotle Bacon s outlook and terminology were Aristotelian rather than modern The experimental method which he described namely the gathering of vast bodies of observations by journeymen which were then to be mechanically raked over by a philosophical machine (cf Prof Jones s remark This democratic spirit is further revealed in his elaboration of Bacon s idea that the [scientific] method requires of its devotees neither learning nor genius) was incapable of being turned to any practicable use and further he not only had no conception of purposeful experiment or of the working hypothesis but definitely failed to recognize the scientific work of prime importance that was going on around him He was a contemporary of Kepler Galileo Gilbert and Harvey—Harvey was in fact at one time his physitian according to Aubrey —but he has nothing to say of their work except for a casual condemnation of Gilbert Harvey s derisive he writes philosophy like a Lord Chancellor was justified

What then is the reason that Bacon was so constantly cited by the enlightened amateurs who fought for the experimental method but except for Boyle scarcely at all by the great pioneers who founded modern science Perhaps it is to be sought in the fact that Bacon with his great position furnished that authority for their arguments which was needed by those who had cut themselves loose from Aristotle s authority A man of Bacon s high office and high reputation was a most valuable symbol of the importance the respectability of the new experimental learning He advocated the study of Nature the devotion of funds to experimental learning and the building of a great foundation for experimental investigation Those who were working for these things could cite his great name as patron and protector so that for the controversialists he was a man of the greatest significance The methods which he advocated however and his whole outlook on experimental research which was purely utilitarian constituted a retrograde movement rather than an advance and confronted with the fact that Galileo and Gilbert had founded modern science and that Kepler had revolutionized astronomy before Bacon s works were known it is hard to argue that Newton Huygens and their great contemporaries would have been one whit the worse or the advance of science one moment retarded if Bacon had never lived For the history of education and opinion Bacon is of great significance on the history of science as such he exercised we believe no influence Prof Jones makes no distinction

Prof Jones s book is deserving of high praise in that it contains a large amount of valuable material not hitherto brought together especially that bearing on the hundred years before 1650 He points out that there was a widespread belief during that period that the world was actually in decay that learning was in its dotage and that the ancients had laid down limits beyond which we could not hope to progress and he quotes from various lesser known authors passages that clearly express that point of view and describes the campaign which was conducted against it He also gives a good account of the controversy that attended the birth of the Royal Society laying stress on the writings of Casaubon the most enlightened of the defenders of antiquity and duly describing the writings of Sprat and Glanvill Of the position of Stubbe who carried on so sustained and senseless an attack on Glanvill he does not however give a correct picture Stubbe s almost insane hatred of the Royal Society his fanatical spirit and his intemperate charges seem to puzzle the author It has been shown by Dr Harcourt Brown that Stubbe was merely a hired pamphleteer a Man of as much Acrimony as Wit who drew his pen with great virulence and layd about him most furiously indeed and was well gratified by Dr Hamey for it Dr Hamey being an important figure in the College of Physicians, a body said to have been jealous of the new Society. "It is probable," says Harcourt Brown, "that we do not know more than a very small share of the real motives which involved the Royal Society in such a storm of criticism" the Stubbe incident is one that he happens to have cleared up

The book is clearly the fruit of long study, and is heavily documented concerning authors of whom little is elsewhere available It is all the more unfortunate that reference to its riches is made so difficult Not only is there no index, but also the management of the notes, of which there are some seventy pages at the end of the book, is not a convenient one Sometimes the title of a book is quoted in the text and reference has to be made to the notes for the author. sometimes the author's name is quoted, and reference has to be made for the book The numbering of the notes begins afresh for each chapter, so that unless the reader happens to remember the chapter which he is reading, he has to turn back to find it, before he can look up his note The present reader, at any rate, has found the system very troublesome He realizes the value of the book, but also realizes that if, in six months' time, he wants to find any particular passage about some remembered name, he may have to search the whole of the book to find it again A small fraction of the time that must have been spent in gathering the material would have sufficed to digest and order it in such a way as to double its value to the student

E N DA C A.

Migration of Man: Past, Present and Future

Environment, Race and Migration: Fundamentals of Human Distribution, with Special Sections on Racial Classification and Settlement in Canada and Australia By Dr Griffith Taylor Pp xv + 483 (Toronto University of Toronto Press, 1937 3 50 dollars London Oxford University Press 15s net)

EVER since the historic controversies of Darwin's days, the evolution of man has been at once the subject of popular appeal and, scientifically, a problem of peculiar difficulty The layman indulges his fancy in speculating about 'the missing link' and the 'cradle of the race', the anthropologist often becomes increasingly reticent the more he knows. Which means that anthropology is perhaps still in its 'formative' stage, and knowledge of man, both of prehistoric times and of the present day, is not yet sufficiently advanced for very definite conclusions as to the exact location of the earliest centres of human evolution or the mechanism of the distribution of races

Prof. Griffith Taylor holds a theory (which he has advocated for a number of years) that there was one 'cradle' of evolution, namely, in Central Asia, and thence spread successive waves of racial stocks—Neanderthal, Negrito, Negroid, Australoid, Mediterranean, Nordic and Alpine In Parts 1 and 2 of the present work, he elaborates this theory and attempts to survey at once the characteristics and distribution of the different races, the migration routes of primitive man, the climatic and geographic factors at the present day as well as the fluctuations in both these attendant upon Pleistocene glacial and interglacial stages. Truly the author has embarked upon a Herculean task Anthropologists will not concur in some of his conclusions, but of this he is well aware He declares in the preface that, since his views on Australia's empty spaces were only accepted after a period of some twenty years, he "hopes that by 1944 his views as to race evolution and the relative status of Nordics and Alpines will be generally accepted !" Points such as these were raised at the time of his earlier publication "Environment and Race" and need not be discussed here

One could wish that Prof Griffith Taylor had given space to more details and discussion of racial matters The book suffers throughout from compression of this material, while some other subjects could well have been omitted (for example, geological features of the world in pre-Tertiary times). The author illustrates his points with numerous maps and diagrams, some of which are most illuminating He uses the polar projection to indicate the routes of migration from Central Asia, but his description of this map (p 30) requires revision. It is scarcely correct to speak of a *polar* projection as showing ". . . the central Asiatic land-mass with the three great continental 'peninsulas', America to the south-east, Eur-Africa to the north-east and Australasia to the north-west".

Parts 3 and 4 deal with conditions of settlement in Canada and Australia and with the influence of environment upon potential white settlement. The author is at his best in these sections of the book. Here also, however, the work is too condensed. The part dealing with Canada could well be expanded into a complete geography of the country. Prof. Griffith Taylor discusses the future of settlement in Canada and estimates that the Dominion could support another ten million settlers. This conclusion is misleading, however for it is based on figures from the Canada Year Book for 1934–35 for areas of occupied and potential agricultural lands which show a total of occupied land as 163 million acres with 198 million acres still available. It is known in Canada that these figures are a gross exaggeration. He makes a further calculation that the Dominion could conceivably support a population of somewhere about 100 millions. This total is based on population densities in Europe where he says Geographers are agreed that the population density is almost wholly controlled by crops and coal. He then asks How many people can Canada support using the same standards as those of Northern Europe including the use of coal to the same extent? The answer which he obtains namely 100 millions is admitted to be a mere approximation and subject to many other factors. Economists in Canada would no doubt have a good deal to say about this. Evidently Prof Griffith Taylor is ranging himself on the side of the optimists.

The book concludes with a chapter entitled Deductions and Suggestions, in which the author makes a well timed plea for the study of anthropology as a means of overcoming national and racial prejudice.

It is difficult to review a work such as this. It contains much that is interesting and stimulating but it is too rapid in its survey and yet is not free from repetition. Doubtless lack of integration is due in some measure to the incorporation of material previously published in the form of articles etc. The absence of a bibliography (except for a brief one on Australian settlement) is to be deplored. The serious student will require more detail while for the average reader there is too much although the author has lighter touches here and there such as the remark that of scenery— unlike the human subject the younger it is the more interesting'

S. W. ALTY

Evolution of the Printed Herbal

Herbals:
Their Origin and Evolution a Chapter in the History of Botany 1470–1670. By Dr Agnes Arber. A new edition, rewritten and enlarged. Pp xxiv + 326 + 27 plates. (Cambridge: At the University Press, 1938.) 21s net.

THE first edition of Dr Agnes Arber's delightful book on herbals has long been out of print and the appearance of a new and enlarged edition is therefore doubly welcome. It gives a clear account of the evolution of the printed herbal in Europe between the years 1470 and 1670, primarily from a botanical and secondarily from an artistic point of view. The first chapter deals with the early history of botany, touching on the philosophical treatises of Theophrastus (b 370 B C) and Albertus Magnus (d A D 1280), and the materia medica of Dioscorides, which for sixteen centuries was regarded as the most authoritative work on the subject.

The earliest printed herbals (fifteenth century) form the subject of the second chapter, some of them being in reality far more ancient than their dates of publication would suggest. They include the "Encyclopædia" of Bartholomæus Anglicus, the "Book of Nature" of Konrad von Megenberg, the "Herbarium" of Apuleius Barbarus, the "Latin Herbarius", the "German Herbarius" and the Ortus Sanitatis. The early history of the herbal in England is discussed in the third chapter which covers, besides English manuscripts of Apuleius Barbarus Banckes Herball" and the Grete Herball"

The botanical renaissance of the sixteenth and seventeenth centuries is described in Chapter iv (pp 52–145), which contains also sections on the 'Origin of Herbaria", and the 'Revival of Aristotelian Botany". Among the herbals dealt with are those of the German fathers of botany, namely, Brunfels, Bock, Fuchs and Valerius Cordus. No mention is made of the 'Botanologicon" of Euricius Cordus (1534) which though not strictly a herbal yet affords a vivid picture of the state of botany and pharmacy in Germany in the early sixteenth century, and should be taken into account in any history of the subject. Other sixteenth century botanists whose careers and herbals are reviewed are Dodoens, Clusius and Lobel (Low Countries), Mattioli and Colonna (Italy), Garcia de Orta and Monardes (Spain and Portugal), Gesner and the brothers Bauhin (Switzerland), Turner and Gerard (England).

An all too brief account of the evolution of the art of plant description is given in Chapter v. Here much research remains to be done, especially on the history of botanical morphology and terminology. The sixth chapter outlines the evolution of plant classification The evolution of the art of botanical illustration (Chapter vii pp 185–246) is treated much more exhaustively and to the general reader will perhaps be the most attractive portion of the book It is evidently based on many years of study

The doctrine of signatures and astrological botany are discussed in Chapter viii The chief exponents of the doctrine were Paracelsus (1493 1541) Porta (fl 1588) and William Cole (fl 1657) but it had its origins in remote antiquity a fact scarcely brought out by the author In Dioscorides we find for example that the seed of Εχιον (*Echium vulgare*) resembled a snake s head and that the root was an antidote for snake bites

Dr Arber points out in conclusion (Chapter ix) the incalculable debt which botany owes to medicine and a further debt to the arts of printing and wood engraving through which the traditional lore recorded in the manuscript herbals was embodied in the printed herbals which succeeded them In these the finest period as regards illustration was between 1530 and 1614 while classification nomenclature and description reached their zenith in Gaspard Bauhin s Prodromos (1620) and Pinax (1623)

There are three appendixes the first consisting of a chronological list of herbals between 1470 and 1670 the second being a list of historical and critical works consulted and the third forming a subject index to the second

Considering the book as a whole one cannot fail to be impressed by the versatility exhibited by Dr Arber in dealing with the varied aspects—morphological taxonomic historical bibliographical and æsthetic—of the evolution of the printed herbal There is only one criticism that may be made that some account should have been given of the works of the Arab physicians for example, Serapion the younger Mesuë and Avicenna who are so frequently cited in the Ortus Sanitatis and of certain other pharmaceutical works which were much consulted during the fifteenth and early sixteenth centuries such as the Luminare maius of Manlius de Bosco

The new edition is even more fully illustrated than the first containing 131 text figures 26 plates and a frontispiece showing a physician using a herbal after a picture by Adrian van Ostade (1665) The printing reflects credit on the Cambridge University Press and both text and figures show up better on the whiter paper employed in this edition The only misprint noticed is Isodorus (pp 301 305) for Isidorus T A S

Chemical Thermodynamics

Physical Chemistry
By Prof J N Brönsted Translated from the Danish edition (1936) by R P Bell Pp xv + 390 (London William Heinemann Ltd 1937) Price 12*s* 6*d*

IN Prof Bronsted s book which has been very well translated and is attractively printed the bias is towards thermodynamics Kinetic theory is also treated adequately and is used throughout the book to supplement the thermodynamics The rather abstract mathematical form of most of the book will tend to make it hard reading for many students There does not seem to be a single description of an experiment or a piece of apparatus in the book The thermodynamics is rather unusual, reminding one of Ostwald s energetics with its intensity and capacity factors and the suggestion that the second law can be deduced from the first This makes the derivation of the fundamental results longer than usual Once they have been achieved, the thermodynamic laws are applied by Gibbs s method which the author considers to be the easiest way of attaining simplicity and rigour

As might be expected the sections on electrolytes and the general theory of acids and bases are particularly full and interesting Although activity coefficients are used throughout the simple Debye Huckel equation is merely stated without derivation and its limitations are not emphasized A rather full treatment is given of the Bohr atom model but there is no mention of modern quantum theory or even of quantum numbers Reaction kinetics receive brief but clear treatment including the author s theory of the intermediate complex and there is a short account of reaction kinetics in gases from the point of view of critical energy The section on photochemistry is very brief A derivation of the phase rule is given with some very simple examples of its application A section on surface and colloid chemistry is written mainly from the thermodynamic point of view

The book will be found very interesting and stimulating by advanced students and by teachers For honours courses it will require considerable supplementing, and general students will mostly find it rather difficult

Lectures and Conferences on Mathematical Statistics

Delivered by J Neyman Revised and Supplemented by the Author with the editorial assistance of W Edwards Deming Pp ix + 160 (Washington Graduate School of the U S Department of Agriculture, 1938) 1 25 dollars

IN April 1937, Dr J Neyman, of the Department of Statistics, University College, London, delivered three lectures and was the leading speaker at six conferences, all held at the Graduate School of the United States Department of Agriculture, Washington The lectures were on the theory of probability, on probability and experimentation, and on the testing of statistical hypotheses The conferences dealt with randomized and systematic arrangements of field experiments, plant breeding, sampling in social problems analysis of time series, statistical estimation, and confidence intervals

The conferences were particularly valuable, as those present, many of whom were themselves eminent experts, put searching questions concerning difficult points In the verbatim reports of these questions and Dr Neyman s answers, the student will find a discussion of the relative values of alternative methods and of the relationship between alternative theories, which is almost unobtainable elsewhere The theory of statistical inference seems to be still in a very unsettled state, and the procedure recommended by one authority for conducting, for example, an agricultural experiment, is disapproved of by another authority Perhaps the differences are not always as serious as they at first appear Thus Dr Neyman s theory of confidence intervals cannot it is insisted, be reconciled with Prof R A Fisher s theory of fiducial probability, but so far the numerical results obtained have been the same, and it is possible that this will always be the case H T H P

Diesel Engine Design

By H F P Purday Fourth edition Pp xix + 520 + 4 plates (London Constable and Co , Ltd , 1937) 24s net

THIS is the fourth edition of a work which first appeared in 1920, and that the fourth edition is called for so soon indicates the value of this book

A comparison of the new edition with the last gives a very good idea of the progress made in Diesel engine design since 1928, as the author now finds it necessary to include new chapters dealing respectively with supercharging, torsional vibration, structural vibration, lubrication and noise all these subjects have come into the foreground in that interval

The title of the book is accurate, since the contents deal more with the art of design than with the sciences of the subject, although this is not to say that the latter are not taken fully into account , each chapter concludes with references to original papers which a reader may consult for a fuller treatment The reviewer concludes by repeating a remark made in reference to the third edition "Altogether any criticisms of the book relate only to details, and the author is to be congratulated on having written one of the best books of its kind" S J D

Strahlen um Uns

Von Heinz Tschelnitz Pp ii + 80 (Brunn, Prag, Leipzig, Wien Rudolf M Rohrer, 1938) 20 Kč

THIS little book is a survey of the chief questions of what is termed radiobiology Though it contains a certain amount of controversial matter and not a few speculations, it will interest both physicists and biologists by directing the attention of each to recent researches of the other connected with radioactive and electromagnetic radiations Evidence is adduced that all living creatures are continually subjected to the influence of such radiations For example, animals breathe ordinary air which contains radium emanation , their food and drinking water contain a small but definite amount of radioactive salts and cosmic rays play on them from above The organs of animals contain minute quantities of radioactive substances

The author supports the view of Stoklasa that a certain concentration of radioactive elements is natural and proper in any healthy living organism, but that any concentration in excess of this has a pathological effect He thinks that the relations of radioactivity to life are only just beginning to be understood, and he sees in the further study of the biological action of radiations the likeliest direction of progress in the understanding of life itself Though the reader may not agree with the author s views concerning the mitogenetic rays of Gurwitsch (cf NATURE 119 556 , 1927) the dependence of water divining and cancer on the emission of rays by the earth and other topics he will find the speculations entertaining if not always convincing

A Course of Pure Mathematics

By Prof G H Hardy Seventh edition Pp xii + 498, (Cambridge At the University Press, 1938) 12s 6d net

THE seventh edition of this famous text book first published in 1908, has now appeared It has been revised and reset The Cambridge Press mathematical printing is better than ever, the spacing and general lay out of the formulæ being excellent A large number of new examples from the Mathematical Tripos have been included The sections on the elementary properties of differential coefficients have been revised following the treatment in de la Vallée Poussin s ' Cours d Analyse" Apart from this, the general scheme of the book is unchanged The author says that the book was written at a time when analysis was neglected in Cambridge, and that if he were to rewrite it now it would be less like "a missionary talking to cannibals" and more like the usual ' Traité d'Analyse ' No one will regret that he has not made the change If we all live now on a decent mathematical diet it is due in no small part to the influence of this book They say that analysis has passed the peak of its popularity , but studies of this kind can never be out of date We believe that our successors will continue to derive the same inspiration from this book that it has given to us in the past thirty years E C T.

Geological and Archæological Aspects of South-Eastern Asia

By Dr H de Terra, P Teilhard de Chardin and Dr Hallam L Movius

MEASURING the age of man in terms of cyclic geological processes has always been a subject fascinating to the student of the Ice Age Unfortunately too little is known of such processes outside the glaciated regions to work out a stratigraphic scheme which might be applied to wider regions and yet this would be the solution to many important problems concerning the Quaternary and the prehistory of man In Asia for example mammalian fossils enable us to distinguish roughly between three Quaternary divisions but the fossil localities are scattered far and wide and the Quaternary formations traditionally passed over by governmental surveys are very imperfectly known

The wish to put our knowledge of the Ice Age in southern Asia on a geological basis led three years ago to the joint Yale Cambridge Expedition to Kashmir and India the results of which are now in process of publication by the Carnegie Institution of Washington From these results the Quaternary of India was seen to have been determined by diastrophic and climatic events of a very distinct nature permitting a detailed subdivision of the Ice Age Its periodic character was expected to make this stratigraphic scheme applicable to neighbouring regions or to supplement it by additional information In this way it was also hoped that the Cenozoic geology of India might become more clearly integrated with that of China which in turn would aid in the study of Early Man In discussing this plan with Father Teilhard de Chardin at the occasion of the symposium held in March 1937 in Philadelphia we planned to study the late Cenozoic geology and archæology of Burma Burma being favourably situated geographically between India and China held out considerable promise especially since Palæolithic tools had been found there recently by Mr T O Morris in association with terraces A few salient features of the Quaternary of Burma will be briefly outlined below Father Teilhard de Chardin co operated with the expedition during the four months of field work and the third author carried out the archæological work in close association with the geological party

The expedition was undertaken under the joint auspices of the Academy of Natural Sciences of Philadelphia and the Peabody Museum of Harvard University Following the field season in Burma, all members of the expedition proceeded to Java There during the month of April we had the opportunity of visiting under the expert guidance of Dr von Koenigswald the sites at which fossil man and Palæolithic implements had been discovered in recent years

TERRACE SYSTEM OF THE IRRAWADDY VALLEY

In the Irrawaddy Valley our investigations were carried out chiefly between Magwe and Nyaungoo near Pagan but various excursions were made also along tributary streams leading westward to the Arakan Yoma Mountains The most characteristic features of the Irrawaddy terraces are as follows

(1) They are superimposed on the Irrawaddy Series a folded and peneplained river formation the upper part of which contains a mammal fauna analogous to that of the Upper Siwaliks of India

(2) Occupying an old valley the terraces are mainly composed of coarse boulder bearing gravels in which three distinct stages of aggradation could be differentiated

The highest terrace gravel is preserved in a group of hills situated in the oilfield of Chauk and some 350 ft above the stream The size of its pebbles depicts an ancestral Irrawaddy much more powerful than the present river An oldest lateritic soil mantle in the adjoining hills appears to be connected with this stage which clearly was a period of greater rainfall (At present this region belongs to the dry belt of Burma with 60–70 inches of annual rainfall which falls almost entirely between the months of June and September No lateritic soils are formed here at present) At one place the highest terrace was found to contain some flaked pebbles of fossil wood and silicified tuff This terrace is strongly tilted

The second and third terraces lie some 180 ft and 100 ft respectively above river level and are associated with a thick series of red gravel and sand In this was found near Mingun opposite Mandalay a Middle Pleistocene type of fauna (with *Elephas namadicus*) and farther downstream an Early Palæolithic industry (see under Archæology) A long interval of erosion and of aridity preceded the deposition of this second river drift, and then a valley was formed with ferruginous soil caps containing the earliest prehistoric industry The second river gravel buried the valley but prehistoric settlements continued as indicated by the wealth of rolled Palæolithic tools in the basal gravels Again this was a period of increased weathering and water supply during which the adjoining highlands released thick fans of red earth on to the second terrace

The fourth terrace is made of the third type of gravel which is generally less coarse and more sandy A somewhat advanced type of Palæolithic was found in this The fifth terrace (25 ft) approaches in composition the recent river deposit and may be post Pleistocene in age

(3) The terraces are associated with soils corresponding to periods of greater and lesser rainfall The first and second type of gravels are connected with lateritic soils found on the adjoining land surface From here red earth was washed into the valley especially during formation of the second terrace in which fine grained red sand merges laterally into lateritic slope wash deposits Increasing aridity is indicated by the presence of loessic soils on the fourth terrace This soil is of yellow or pinkish colour mostly structureless and was drifted in the manner of true loess on top of the third terrace the erosional surface of which was thus again buried The composition of this fourth terrace however proves that this must have been a major and prolonged fill stage

(4) The Irrawaddy terrace system is of regional extent for it was found also in the adjoining Shan Plateau in the reaches of the Namtu and Salween Rivers

The interpretation of these features leads to conclusions which are of importance to both geologist and archæologist It is interesting to note the great resemblance of this terrace system with that found in North West India both in respect to the number and the nature of the physiographic cycles In both regions the terrace formation began in the Middle Pleistocene because of the then established relative stability in the Himalayan foredeeps in which the Early Pleistocene beds are generally strongly folded In India three major fill stages could be correlated with the three last Himalayan glaciations and terraces were ascertained some 150 miles distant from the limits of glaciation In Burma the distance from the glaciated tracts is more than double that amount but here the soil records indicate the impact of corresponding climatic cycles in the nature of Pluvial and Interpluvial stages which were apparently superimposed on cyclic diastrophic processes It is probable that in the upper Irrawaddy Series are hidden two Early Pleistocene sub stages which as yet do not readily permit of the same detailed analysis These earlier beds have yielded certain palæontological data which are likely to throw new light on their stratigraphic position

PALÆONTOLOGICAL ASPECTS OF THE PLEISTOCENE IN BURMA

The Upper Irrawaddy fauna has been known for some time especially through studies by Noetling and Pilgrim and lately Colbert has analysed it anew with the collection of Dr B Brown The vertebrate fossils collected by us can only confirm the view that an Upper Siwalik type of fauna is represented in these beds In our material forms such as *Leptobos Bubalus Stegodon* primitive elephant and horse are most prominent together with other types of lesser stratigraphic significance

It is important to note that these beds have for the first time yielded both freshwater molluscs and plant remains Their state of fossilization as well as the type of freshwater fauna represented clearly indicate an Early Pleistocene age for most of the Upper Irrawaddy series Moreover the overlying terrace gravels contain a Middle Pleistocene type of fauna (*E namadicus Bos* cf *namadicus Hippopotamus*) reminiscent of the Narbada Pleistocene of peninsular India Such a succession would be difficult to comprehend if the underlying beds were to represent the late Pliocene

Of special interest was the discovery of fossiliferous fissure deposits in the Shan Plateau near Mogok Except for a skull of *Ailoropus* nothing was known of this fauna which is likely to throw new light on former faunistic relationships of the Indian with the Chinese mammal world The presence of *Stegodon Flephas namadicus Bos Rhinoceros Cervus Hystrix* links this fauna with that typical for the limestone fissures found in the neighbouring provinces of China

CORRELATIONS WITH SOUTH CHINA

The conclusions arrived at by Teilhard de Chardin in regard to existing analogies between the late Cenozoic of Burma and China can only be mentioned very briefly in this report Such analogies are striking mainly (*a*) in the late Pliocene lake deposits of the Shan Plateau (*b*) in the Early and Middle Pleistocene gravel formations (*c*) in the fissure deposits All three are practically continuous between Eastern Burma and the Yangtse basin They must therefore be contemporary and express the same series of diastrophic and climatic changes over the same geological unit Hence the terraces of the Yangtse may be linked to those found in India and Burma and the possibilities of covering under a single stratigraphic and physiographic scheme the late Cenozoic history of the whole south and central Asiatic Mass becomes an assured possibility'

ARCHÆOLOGY OF BURMA

By Hallam L. Movius

At several localities in Upper Burma fairly extensive sites yielding Lower Palæolithic tools were discovered In all cases the implements are rolled and are associated with the main terrace (*T*–3) gravels of the Irrawaddy Valley This horizon may be assigned on palæontological grounds to the Middle Pleistocene The principal sites are at Yenangyaung Chauk and Nyaungoo (near Pagan), although further collecting was also done at Pakokku and at Pauk in the Yaw Valley The implement types, which include chopping tools, crude scrapers, a few flake implements and cores, are made either of silicified tuff or fossil wood Hand axes are completely absent, a fact which seems to indicate a more definite association with an Eastern Asiatic focus than with an Indian one Typologically the closest analogies to the Lower Palæolithic of Burma are found at Patjitan in Java, but Dr von Koenigswald's extensive collection from this latter region includes hand axes, in addition to an abundance of Burmese forms Thus at present the cultural affinities of the Burmese Palæolithic are not altogether clear, although the Java connexion cannot be denied Perhaps both are derived from a common source somewhere in South China, or perhaps in Malaya

Since an entirely new Lower Palæolithic complex is presented by the Burmese material, it has been named the 'Anyathian' after the coloquial Burmese for an Upper Burman (ăn ya thă) The early Anyathian is represented by two phases—phase 1 from the basal cemented gravels of *T*–3, and phase 2, which is derived from the overlying uncemented material Only crude chopping tools, made of roughly tabular blocks of silicified wood, worked on the upper surface of one end, are found in the earliest phase The implements are all heavily patinated and rolled In phase 2, however, the forms are more varied several types of chopping tools, crude flake implements, and nuclei occur The former include finely made core implements with alternately flaked cutting edges while the latter are extremely coarse and are devoid of Levalloisean or Clactonian influences In Burma, therefore, the chopper rather than the hand axe is the type Lower Palæolithic implement

The Late Anyathian is found unrolled on the surface of *T*–3 and slightly rolled in the Upper Pleistocene gravels of *T*–4 It seems to be essentially a development from the Early Anyathian, although the implement types are small and on the whole more specialized They include many new forms — disk shaped end scrapers, side-scrapers, blades, and even steep scrapers of Upper Palæolithic type Chopping tools of the Early Anyathian are also present, which makes it difficult to determine whether this culture represents an innovation or an indigenous development brought under influence from an Upper Palæolithic centre outside the region

No Mesolithic has yet been found in Burma although the cave region of the Southern Shan States was extensively explored However, abundant Neolithic material was collected everywhere on the surface of the higher terraces, as well as *in situ* associated with polished stone axes, at Minbu and Kyaukpadaung Pottery from the latter locality confirms the Neolithic dating of this complex, originally described by Noetling as 'Eolithic'', and more recently by Morris as Upper Palæolithic '

Thus a chronological basis for the Burmese Stone Age has been established, and as Dr de Terra points out, this archæological sequence is substantiated by stratigraphy Burma has, therefore, added another link in our chain of knowledge concerning the development of early man in south east Asia One salient fact however, which emerges from a preliminary study of the Anyathian, is the absence of influence from southern India This is significant in the light of Dr von Koenigswald's discoveries in Java, for if the culture of Patjitan is connected with India, traces of this connexion must inevitably exist in Burma However, with the exception of the Javanese hand axes, the Patjitanian and the Anyathian are almost identical These facts, therefore, suggest that we are dealing with a new centre of Lower Palæolithic development in the Far East to which the orthodox European classification cannot be applied

EXCURSION TO JAVA

Our field season in Burma closed at the end of March, when all members of the expedition proceeded to Java Here we visited, under the guidance of Dr von Koenigswald, the most important places where either fossil man or Old Stone Age cultures had in recent years been discovered It is impossible to do full justice here to the truly remarkable wealth of information which Java holds in regard to Quaternary geology and early man

Especially interesting to us was the Solo Valley with its terraces containing Palæolithic industries and the skulls of *Homo neanderthalensis solœnsis* Oppenoorth One cannot help but feel that a physiographic survey of this region will furnish a key to a more detailed stratigraphy which so far has been founded mainly on palæontological data Here it became evident that the Quaternary of Java differs in many respects from that found in continental Asia , for one thing, volcanism has here introduced processes of sedimentation the periodic character of which is not readily recognized Also, the climatic records of the humid tropics differ altogether from those found in more arid latitudes, and the effect upon fauna and sediments is such as to make direct correlations with the Quaternary of the Asiatic mainland less readily available than was at first anticipated

The new site of the *Pithecanthropus* skull and mandible near Sangiran north of Solo assures beyond doubt the Middle Pleistocene age of this fossil Its stratigraphic location was in the lower portion of the Trinil beds', which are here overlain by some 150 ft of Middle and Upper Pleistocene fossiliferous strata, all of which are clearly exposed in one section Especially clear is the position of the infant skull of *Homo modjokertensis* v Koenigswald, near Modjokerto in eastern Java Despite the relatively shallow depth at which the skull was discovered (3 ft), it was evident that in the absence of soils and terraces, nothing could have obscured the true location and stratigraphy of this fossil Its age, according to von Koenigswald, is Lower Pleistocene because of its association with certain mammals such as *Hippopotamus antiquus* and *Cervus zwaani*, as appear to be ancestral to others found in the Trinil fauna

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In concluding this report, I wish to express our sincerest appreciation for the financial support which the American Philosophical Society, Harvard University and the Carnegie Institution gave to this undertaking We also wish to thank the Director of the Geological Survey of India, and the members of the Geological Department of Burma and our colleagues in Java for the friendly co operation extended to us

International Committee on Social Relations of Science

THE Committee on Science and its Social Relations (C S S R) instituted by the International Council of Scientific Unions, in May of last year, held its second meeting in Paris this year, when a number of organizational questions connected with the work undertaken were discussed From a report prepared by the secretary the following points may be mentioned

As stated already (NATURE, 140, 983 , 1937 141 723 , 1938), the main work of the C S S R for the present is to collect materials for the preparation of a report and of bibliographies on the social relations of science, to be presented at the next meeting of the International Council in 1940, and thereafter it is hoped, to be printed for wide circulation For the execution of this plan the C S S R has applied to the national academies, or other nationally representative bodies of various countries, and to a number of international scientific organizations, with the request to assist it in its task by supplying information, and by appointing correspondents who may gather around themselves other men of science interested in the work of the C S S R , so as to form local or special groups co operating with the latter The Royal Society of London has nominated Prof F E Weiss as its correspondent, and a subcommittee, with members for physics, chemistry, engineering and, if possible, also for medicine and for some other branches of science, is being formed

To guide correspondents in furnishing their communications to the C S S R , it was proposed to draw up questionnaires, indicating the points which should be judged to come within the scope of the inquiry The preparation of these questionnaires was a kind of experiment as in a way they should form a programme for analysing the manifold influences that science and human society exert upon each other Various points of view presented themselves according to which topics might be classified , on one hand attention should be given to the influence on social relations emanating from the application of a number of definite recent scientific discoveries , on the other the influence of science on the outlook of men and women should be considered The relation between certain subjects and the life of human society further could be investigated according to national points of view, or from that of the various domains of science themselves

It was decided, therefore, in the first place to draw up a general questionnaire', intended as a guide for the use of correspondents of the nationally representative scientific organizations of the various countries The subjects listed in this questionnaire have been grouped under three headings, as follows (1) the meaning of scientific research for the development of our world picture—to be understood not only in the philosophical sense, but also in the sense of the set of ideas with which the public (in its various forms of appearance) is operating , (2) the influence of the applications of scientific work upon human society, the transformations that are induced by them and the adaptations which are required in consequence , (3) reactions of human society upon scientific work

In connexion with the experimental character of the work, it may very well appear that other subjects besides those listed will have to be introduced, or that various questions should be framed differently It must be remarked also that owing to the structure of the International Council in which the medical and engineering sciences agriculture sociology and economics have no representation problems referring to the latter subjects provisionally have been left aside the more so as these subjects require a different treatment and should not be attacked before some experience and contact with the organizations specially created for them might have been obtained Only a few borderland problems have been touched upon here and there

In asking the national correspondents to give attention to the general questionnaire it is not expected that they should treat all the subjects listed in full The extent to which information can be supplied will depend upon the measure in which attention is given to science in the various countries and thus may largely differ from one country to another It is possible also that certain questions may not be directly applicable to the conditions found in some countries It has been suggested that correspondents leave aside questions which appear to them to bear no relevance to the situation in their countries and either restrict themselves to the other questions or give information in a more independent form

It should be emphasized however that the C S S R hopes to receive information concerning the many points of view which may be developing in various countries Along with the list of questions for national correspondents a series of questionnaires has been drawn up in which the subjects are considered from the points of view of the particular branches of science These questionnaires are not intended for consideration by the national correspondents but are forwarded to correspondents of international scientific organizations In part they contain some of the same topics as had been brought together in the general questionnaire but for a number of subjects more detailed problems have been noted These questionnaires thus far have been devised for mathematics astronomy mechanics physics chemistry biology geophysical sciences geography

The C S S R has also requested correspondents to supply a bibliography or a list concerning summarizing and reviewing or abstracting work that is being done with respect to scientific publications either in their country (in the case of national correspondents) or in the branch of science represented by them (in the case of correspondents from scientific organizations) Such lists should give the names of progress reports collections of abstracts of scientific literature names of abstracting and reviewing organizations science press service where this is present etc

The C S S R hopes that along with the help given by correspondents and their sub committees co operation may be obtained and organized with other bodies occupied with similar problems

At the present moment there seems to be a possibility of coming into contact with the British Association for the Advancement of Science—at the forthcoming Cambridge meeting the Council of the British Association will present a scheme for the establishment of a special Division for the social and international relations of science (see NATURE July 30 p 195) and with the American Association for the Advancement of Science

Attempts are being made to secure the foundation of an organization for the study of the social relations of science also in Holland Such organizations which should be formally wholly independent of the C S S R can perform much useful work by promoting special investigations on problems of importance for the country where they are working for which purpose—assuming that the necessary financial means can be found—research students for example might be appointed At the same time they could assist the correspondent of the C S S R in his work of collecting information according to the general questionnaire while on the other hand the C S S R can help in establishing international contacts and in correlating results brought forward from different countries Moreover such organizations may find the possibility of considering sociological and economic problems which fall outside the scope of the I C S U and the C S S R

It is expected finally that assistance also may be obtained from individual scientific investigators who take an interest in the work of the C S S R Apart from the help that may be asked from them with reference to particular scientific topics there are the following points concerning which views or information often can be given better by individual persons than by official organizations

(*a*) The part played by scientific thought in the outlook of various social groups

(*b*) The forms in which scientific workers and their work are involved in the various struggles and conflicts of human society

(*c*) The forms in which the consciousness of a social responsibility of science and of scientific workers is taking shape

Scientific workers who desire to give information or to express views on points coming under the scope of the Committee s work are requested to communicate with the correspondent for their country or their branch of science or directly with the secretary of the C S S R (Prof J M Burgers van Houtenstraat 1 Delft) The secretary of the C S S R also will be glad upon application to forward copies of the report or of the questionnaires to persons interested

Water Development Schemes in the United States*

THE National Resources Committee of the United States Government, the membership of which includes the Secretaries for the Interior for War for Agriculture for Commerce and for Labour has issued an important document on Drainage Basin Problems and Programs (1937 Revision) which has been prepared by the Water Resources Committee with the co operation of local, State, regional and federated organizations It is a comprehensive review of suggestions emanating from forty five Drainage Basin Committees, themselves nominated by 'Governors and State Planning Boards, including field men from interested Federal bureaus It will thus be seen that the recommendations are based on a wide spread representation of national interests

The report was commissioned by the President and constitutes a revision of the report to Congress on February 3 1937, rendered necessary by recent developments, including fresh problems and new standards of treatment An amended programme, accordingly, has been prepared covering a series of specific projects to be undertaken within a 2–6 year period, at an estimated cost, amounting in the total to 891 091,000 dollars, with a "weighted average" per year of 200 624,000 dollars This weighted annual average compares with more than 180,000,000 dollars recommended in the President's 1939 Budget for the same classes of work During the last six years the Federal Government has expended more than 1,300,000,000 dollars on works of a similar character

Foremost in the report comes the subject of flood control, which in the United States is a matter of the most serious public concern One has only to recall the devastation and loss of life caused during the floods of recent years in the Mississippi and Ohio river valleys to realize how vital this matter is to a vast mass of the population Unfortunately, the problems involved are so complex that, as yet, they are inadequately explored, and it is felt that it would be most unwise to authorize any additional general flood control plan until more trustworthy information is obtained An early inauguration of surveys and investigational studies of a comprehensive character is urged and budgeted for at a cost exceeding 260 million dollars

The reclamation for agricultural purposes of extensive regions of arid and semi arid country requires continued attention Works are already authorized and in hand to the extent of upwards of 600,000 000 dollars but further surveys are needed for future planning and development West of the 100th meridian, there is a vast domain of no fewer than 700 million acres where agriculture can make no progress without artificial irrigation The outlay required is put at nearly 300 million dollars Problems of flood control policy naturally involve a consideration of the allocation of cost among the various scattered communities in low lying regions subject to inundation in fair proportion to the incidence of benefit and of ability to pay and this is a matter which can only be settled by prolonged negotiation

Water power is an important consideration in the United States, where there are very considerable reserves ready for exploitation The energy produced is utilized in many directions for power, heating and lighting Water power has within the past half century furnished 3–4 per cent of the total energy derived alike from mineral fuel and water and the report states that "despite the fact that the nation now depends and in future must depend largely on its fuel resources, its water power is of great value and presents great opportunities in the co ordinated development of water resources" Some of the more important undertakings in hand, as the Boulder Dam on the Colorado River, the Bonneville and Grand Coulee Dams on the Columbia River, and the series of developments in the Tennessee Valley have already been described in NATURE (139, 738, 823, 986, 1937)

The other subjects dealt with in the report, which runs to more than 150 pages, are so many and so varied that it is not practicable to touch upon them all within restricted limits of space A mere enumeration shows that they include navigation, soil conservation, beach erosion control, projects for agriculture and grazing, pollution, recreation and wild life, hydrological data and investigations and multiple purpose projects

The report concludes with an expression of the conviction of its members that "a National Planning Agency should have as one of its chief duties the continuous development of broad plans for full use of our water resources in relation to human needs and social objectives" This clear and explicit declaration of policy might with advantage be adopted in other countries, and every credit is due to the United States for setting so conspicuous an example of enterprise in the exploitation of its own supplies

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*Drainage Basin Problems and Programs 1937 Revision (National Resources Committee Washington D C) Pp x+154+4 plates (Washington Gov Printing Office 1938) 65 cents

Obituary Notices

Dr. J. W. Mellor, C.B.E., F.R.S.

On May 24, science suffered a great loss by the death of Joseph William Mellor, a man of remarkable attainments and outstanding achievement.

Born at Huddersfield in 1869, Mellor was taken by his parents to New Zealand when ten years old. During his youth he worked in a boot factory and took classes in the evenings at the Dunedin Technical College. At the age of twenty-five years he was awarded a scholarship at the University of Otago. After graduating and serving as a science lecturer at an agricultural college he was awarded an 1851 Exhibition, which took him to the University of Manchester in 1899. Under H. B. Dixon, for whom he had the highest regard, he completed a number of researches, perhaps the most important being investigations into the combination of hydrogen and chlorine.

On leaving Manchester, Mellor went to North Staffordshire, and, after a short period as science master at the Newcastle (Staffs.) High School, began his long association with the ceramic industries on his appointment as lecturer in pottery manufacture in Stoke-on-Trent.

At the commencement of his career in ceramics, Mellor worked under some difficulties, and it was due, in no small measure, to his initiative that the present North Staffordshire Technical College was built in 1914. He was appointed the first principal of the Pottery Department. As a teacher he was very popular with his students, and, in this capacity alone, he rendered great service to the local pottery industry. There can be no doubt that his early struggles gave him a deep insight into the difficulties of his evening students. Shortly before his death he said, "I think that I spent some of the happiest years of my life with those early students".

Mellor's great friendship with Bernard Moore, the eminent potter, played a conspicuous part in the progress of clay technology in Great Britain. He was associated with the work of the Ceramic Society about three years after its formation, becoming honorary secretary in 1905, a position he held until his death. He raised the status of the Society from a purely local association to that of an international institution. He extended its field to include refractory materials and clay building materials, as well as pottery. The Society's present eminence is a lasting testimony to his high endeavour.

Mellor wrote more than a hundred papers on ceramics, the first in 1904 and the last he completed two months before his death. Covering a very wide field, his researches into the constitution of the clay molecule and the properties of glazes are, perhaps, the most important. His papers on "The Crazing and Peeling of Glazes" and "The Durability of Pottery Frits, Glazes, Glasses and Enamels in Service" appeared in 1935 and gained world-wide appreciation. He was quick to realise the importance of refractory materials to the well-being of an industrial nation. He made contact with the manufacturers and users of these products, and, in 1909, was closely associated with the formation of the Refractories Committee of the Institution of Gas Engineers, which has been responsible, in Great Britain, for pioneer work into the properties of refractory materials. This association developed, and, in 1919, Mellor was largely instrumental in establishing the British Refractories Research Association under the ægis of the Department of Scientific and Industrial Research. As its first director of research, a position he held until 1937, he enlisted and retained the support of manufacturers and users of refractory materials, added great distinction to the work of the Association, and founded "The Mellor Laboratories", the present headquarters.

To his great scientific attainments, Mellor added a singular literary ability. 1937 saw the completion of his monumental work, "A Comprehensive Treatise on Theoretical and Inorganic Chemistry" in sixteen volumes. He received, during his lifetime, unstinted praise for this remarkable effort. To his few intimate associates, the completion of these volumes is almost beyond comprehension. They know that he wrote every word and every reference.

As a student, Mellor found it impossible to follow the many developments in chemistry without a good working knowledge of higher mathematics. His habit of making full notes of all his difficulties led him to consider writing a book on the application of higher mathematics to chemistry. Putting the suggestion to H. B. Dixon, he was advised to convert his ideas into words, and thus, in 1902, his first book, "Higher Mathematics for Students of Chemistry and Physics", appeared. Shortly afterwards he set to work on his "Chemical Statics and Dynamics", which was published in 1904, and later he confessed that the writing of this book had given him very great pleasure. His "Modern Inorganic Chemistry", a book of distinct individuality, had a remarkable vogue in the whole of the English-speaking world and rightly so. As a result of his early work in ceramics, in 1912 he completed "A Treatise on Quantitative Inorganic Analysis", which remains a standard work on silicate analysis.

In his youth, Mellor had considerable physical strength, and was a powerful swimmer. He was an enthusiastic and highly accomplished chess player. His sense of humour delighted all who knew him, and he combined with this considerable ability as a cartoonist. His book of cartoons, "Uncle Joe's Nonsense", revealed his ever-youthful spirit.

Mellor was a man of indomitable courage, profound wisdom and experience. He had remarkable astuteness. Of his pertinacity and capacity for sustained exertion there is abundant evidence. He could pursue a preconceived course of action with a tenacity of purpose rarely achieved. He had a vivid appreciation of loyalty and friendship To those who knew him, his supreme loyalty was, indeed, his greatest attribute. He was respected by all and much more than respected by those who were privileged to know him intimately A T. G

Dr. W. C. Willoughby

WE regret to record the death of the Rev. Dr W C Willoughby, an authority on the Bantu of South Africa, who died at Birmingham on June 19 at the age of eighty one years.

William Charles Willoughby was born on March 16, 1857. He was the son of Richard Willoughby of Redruth, Cornwall, and was educated at Tiverton and Springhill College, Birmingham In 1882, having been ordained a Congregational minister, he joined the Central African Mission of the London Missionary Society, but was compelled to return home after twelve months service owing to ill-health. His interest in Africa, however, continued unabated, and in 1893 he was appointed by the London Missionary Society to deal with difficulties which had arisen at Phalapye, the headquarters of Khama, paramount chief of the Bechuana After the Matabele War he was chosen by Khama and the two chiefs, Bathoen and Sebele, to act as their adviser in their appeal to the British Government in relation to the proposal to hand over the Bechuanaland Protectorate to the Chartered Company Largely owing to his efforts their appeal, presented by them in person in London, was successful

Willoughby remained in Bechuanaland for eight years and was then selected to act as first principal of the Tiger Kloof Educational Institution, which he had founded near Vryburg, Bechuanaland Here he instituted a very successful scheme of training in industry, craftsmanship and teaching for young African men and women Willoughby retired from Tiger Kloof in 1917, and two years later was appointed professor of African missions in the Kennedy School of Missions, Hartford, Connecticut He held this chair until 1931, when he retired, receiving the honour of D D. Dr Willoughby was widely recognized as an authority on Bantu anthropology He was a member of the African Races Committee from 1900 until 1908, and had been a local correspondent of the Royal Anthropological Institute since 1905 He was the author of "Native Life on the Transvaal Border" (1900), "The Soul of the Bantu" (1928), and "Race Problems in the New Africa" (1923). In these he showed a sympathetic insight into the mental qualities of the South African native, and though fully alive to the desirability of developing native culture, recognized the danger of attempting to impose Western civilization on native tradition.

Dr. L. Lilienfeld

LEON LILIENFELD, whose death occurred quite unexpectedly at Milan on June 6 through pneumonia contracted whilst engaged on the industrial application of his latest inventions, commenced his professional career as a medical man. A growing interest in cellulose led him to abandon medicine and devote himself to research work on this material. In 1912 he produced new derivatives of cellulose, namely, various cellulose ethers having very widely different properties and capable of diverse applications The Great War interrupted these activities and Lilienfeld was engaged on X-ray work in the Austrian army. He wrote a book embodying all his experiences which even to-day is regarded as a standard work in this branch of medical research

After the War, Lilienfeld returned to his work on cellulose and evolved a process by which viscose can be spun into a thread having a tenacity far greater than that of any rayon thread known at that time Naturally, this work brought Lilienfeld into prominence not only with the rayon world but also far beyond Afterwards he returned to the field of cellulose ethers, which he perfected in their application to rayon, films, etc. In this connexion it is interesting to note that Lilienfeld showed that certain ethers when taken internally counteract the effects of alcohol

Much of the work of Lilienfeld is embodied in numerous patent specifications, which demonstrate with what extraordinary energy and thoroughness he pursued his investigations

Those who knew Lilienfeld will learn of his death with deep regret, and many have lost in him a friend of great charm and generosity

Rev. E. Burrows, S.J.

WE regret to record the death of the Rev Father Eric Burrows, Assyriologist and cuneiform scholar, who was killed in a motor accident near Oxford on June 23 Educated at Felstead and Keble College, Oxford, Eric Burrows joined the Order of Jesuits in 1915 He studied Assyriology under the late Prof. S P Langdon, specializing in cuneiform epigraphy, and had already established a reputation as an authority upon the early religious and legendary literature of Mesopotamia, when in 1926 he became attached to the staff of Sir Leonard Woolley as epigraphist in the excavations at Ur. He worked with the Ur expedition in the field in each successive season until 1930. Much of his work is still unpublished, but his contributions to the official volumes on "The Royal Tombs" dealing with the documents of the early dynastic period of Ur, and his "Archaic Texts" are accepted as the standards of reference on archaic palæography and the beginnings of cuneiform.

WE regret to announce the following deaths:

Prof. G. W. Cavanaugh, emeritus professor of chemistry in Cornell University, on July 2, aged sixty-eight years.

Capt. F. S Barnwell, O B.E., chief designer of the Bristol Aeroplane Company, a pioneer in British aviation, on August 2, aged fifty-eight years.

Prof. L. Frobenius, who led numerous expeditions to different parts of Africa, and was a great authority on African culture, aged sixty-five years.

News and Views

Geology and Archæology in South-Eastern Asia

IN another column of this issue of NATURE (see p. 275) there appears a communication from Dr H. de Terra, Dr. H L Movius and Father Teilhard de Chardin of far-reaching significance for the study of early man in Eastern Asia. The investigations of the joint Yale-Cambridge expedition to northern India, of which Dr de Terra was leader, having established by the examination of the quaternary deposits a detailed subdivision of the Ice Age in that region, it was hoped that a like investigation of the quaternary gravels of the Irrawaddy Valley, in view of their central situation, might afford evidence for the integration of the cenozoic geology of southern China with that of India. Inferentially, it is obvious, such an integration would be of crucial value in establishing the chronological relation of the evidences of early man in the two regions In 1937 an expedition under the joint auspices of the Academy of Sciences of Philadelphia and the Peabody Museum of Harvard University, with Dr de Terra again as leader, entered upon the investigation of the quaternary deposits of the Irrawaddy Not only was the expedition successful in establishing the resemblance of the Irrawaddy terrace system with that found in north-west India, while the soil records indicate the impact of corresponding climatic cycles, apparently superimposed on cyclic diastrophic processes, but it was also able, thanks to the co operation of P Teilhard de Chardin, the distinguished authority on the quaternary geology of China, to demonstrate as sufficiently assured the possibility that the late cenozoic history of the whole of the south central Asiatic mass will be covered ultimately by a single stratigraphic and physiographic scheme At the same time the subsequent visit of the expedition to Java made evident that the quaternary of that area differs in many respects from that of the mainland and that direct correlation will be less readily available there than was anticipated.

THE palæontological evidence is of special interest in relation to the development of recent theory in the Chinese field. The most significant feature is the discovery of a previously unknown fauna in the fissure deposits of the Shan plateau, which, it is said, may prove to throw light on former faunistic relationships of the Indian with the Chinese mammal world This fauna of the Shan plateau is linked with that typical of the limestone fissures of the neighbouring provinces of China, which figures prominently in P. Teilhard de Chardin's recent researches. The archæological evidence, as Dr. Movius shows, is no less important. It presents an entirely new lower palæolithic cultural complex, for which the name "Anyathan" is proposed. In this culture the type lower palæolithic implement is the chopper, rather than the hand-axe. It persists into late Anyathan side by side with many new and more specialized forms, making it difficult to decide whether this culture is to be regarded as an innovation, or an indigenous development under outside influence It is especially to be noted, however, that although a chronological basis for the Burmese stone age has been established, substantiated by stratigraphy, and Burma thus affords another link in our chain of knowledge concerning early man in south-east Asia, the really striking fact which emerges is the absence of influence from southern India. There is, however, except in one respect, close resemblance with the recently discovered Patjitanian of Java. These facts, Dr. Movius concludes, are such as to suggest that we are dealing with a new centre of development in the Far East, to which the orthodox European classification cannot be applied

Composite Aircraft Development

THE seaplane upper part of the Short-Mayo composite aircraft has flown the return journey across the Atlantic It was able to get off the water from the American side under its own power, owing to the much smaller load of fuel required for the west to east journey with its constant following winds Now that the success of the idea is established, plans are in hand for a new design on similar principles incorporating all the modern developments in aerodynamics, such as constant speed airscrews, retractable undercarriage, slots and flaps as aids to lift and control, etc The body will probably be arranged principally for mails, with a few passengers

ANOTHER composite aircraft of somewhat different principles is proposed by Mr. A Plesman, of the K L M, Royal Dutch Air Lines The lower component in this case is practically a flying undercarriage that can make contact as well as detach itself while the upper main machine is in the air. Thus in normal flying the aircraft will have no undercarriage, saving the consequent weight and drag. This proposal is essentially different to the Short-Mayo design, in that it does not add the extra wing area and engine power for the take-off when the machine is heavily loaded with fuel and oil at the commencement of a long flight. Launching by catapult, or some such form of acceleration, is proposed to deal with this difficulty The scheme presupposes no necessity for any unexpected forced landing en route, a not unfair assumption with modern engine reliability, and the use of multiple-engined machines. In any event, a successful landing on the sea, in the case of a trans-ocean flight, would be of little value, as an average aircraft would be too fragile to remain afloat long under any but the most ideal of conditions.

New Cooling System for Aero-Engines

Messrs Rolls Royce have introduced a new system of water cooling under pressure on their Merlin IV engine This is similar to the usual atmospheric one, but is closed and provided with loaded valves, so that the boiling point of the water under pressure is raised The many recent developments in metallurgy and lubricating oils have made it possible for the internal combustion engine to function at higher temperatures and thus to increase thermal efficiency in addition to the obvious advantage of using smaller radiators with both less drag and weight The more general method up to the present of maintaining the engine at the higher temperature permissible has been to use liquids with higher boiling points Ethylene glycol is the most generally used in Great Britain, but this has objections in its corrosive effect upon parts of the cooling system, especially the inevitable joints if a substance such as a rubber or leather compound is used Extra cost, and the necessity of carrying a supply of the special liquid are also points against such preparations The new radiator and cooling system fittings may need to be somewhat more robust for dealing with pressure, but this is not altogether a disadvantage in that the more solid construction will add to its reliability Weakness due to flimsy construction has often been typical of the older water cooling systems It is reported that these engines with their new cooling will be fitted to the Armstrong Whitworth Whitley the new R A F bomber now coming into production

British Speleological Association

At the third annual conference of the British Speleological Association which opened at Giggleswick School, Yorks, on July 30, Dr R R Marett, rector of Exeter College, Oxford was elected president in succession to Sir Arthur Keith, who has held that office since the foundation of the Association As an anthropologist Dr Marett is perhaps best known for his studies of the religion and psychology of primitive peoples, but his connexion with the archæological exploration of caves is of long standing In 1911 he described before Section H of the British Association the excavations in the cave in St Brelade's Bay, Jersey, carried out by himself and other members of the Société Jersiaise, which resulted in the important discovery of a tooth of Neanderthal man in association with Mousterian implements

The conference of the Speleological Association was declared open in an original and appropriate ceremonial by Mr J A Slingsby chairman of the Governors of Giggleswick School At a business meeting of the Association it was reported that the survey of underground waters in Yorkshire, Derbyshire and Somersetshire is being continued, and that considerable progress had been made in listing the caves of Britain in which archæological material had been found in the past In addition to papers presented for discussion at sectional meetings, the proceedings included visits to a number of museums in Settle and neighbourhood containing material illustrating and recording the results of cave exploration, and visits to the caves themselves, including the Victoria and Jubilee caves, long well known for their archæological importance and Gaping Ghyll on Ingleborough, with its 340 ft shaft, miles of passages and huge main chamber On the evening of August 1, Sir Arthur Smith Woodward addressed the Association on Wild Animals Living with Early Man in Britain The Association will meet next year at Swansea

Roman Site in Wiltshire

An impressive indication of the general diffusion of a high degree of refinement in mode of life in Roman Britain and also of the economic and social decadence which accompanied the decay of Roman rule is afforded by the remains of a villa recently discovered at Atworth in Wiltshire (*The Times*, August 6) It is indeed remarkable that traces of a building of such an extent as has been revealed in the excavations of 1937 38 should have evaded previous record Its existence was made known only through the discovery by a schoolboy in a cornfield of a coin afterwards identified as of Constantine I This led to an investigation which was begun in August 1937 and at once revealed courses of masonry, in some instances no more than six inches below the ploughed surface now known to have been part of an L shaped house of corridor type containing at least twenty four rooms or passages a suite of baths, four or possibly five hypocaust chambers, a flight of six stone steps and three rather inferior tesselated floors Evidence that either on this site, or in the immediate neighbourhood there had stood a building of considerable architectural pretensions was found in the form of fragments of stone used to support a floor in one of the hypocausts, which were well worked and showed good mouldings They had once formed part of a cornice or plinth of a building in classic style The house was roofed with purplish pointed tiles of sandstone from the neighbourhood of Bristol Many rooms show evidence of conflagration in the form of a black deposit, mostly charcoal, above the floor, in which are broken tiles and roof nails In places three occupation levels can be seen, and sometimes the highest immediately above the burnt deposit is a primitive floor of rough flat stone or irregularly fitted pieces of roof tile Series of bronze coins range from Gallienus (A D 253–268) to Valens (A D 364–378), while the pottery can be ascribed to the second, third and fourth centuries A D It is thought that the villa may have been partially destroyed by fire in the raids of Picts, Scots, Franks and Saxons in A D 367, when many villas in south and western Britain were abandoned, to be occupied later, when the raiders had been driven out, by lower class Romano Britons

Prehistory and the Sahara

A meeting of the International Commission for Study of the Prehistory of the Sahara, which was initiated by Prof P Rivet, and of which Sir Robert

Mond is president, was held in Paris on June 27–30. It was attended by a number of distinguished archæologists and others interested in the problems of the Sahara from France, Great Britain, Egypt, Italy, Tunis, Morocco and the Sudan Numerous important communications, illustrated by lantern slides and exhibits, were presented and discussed in the sessions of the Commission. For the first time it was possible for the quaternary problem in the Sahara to be discussed as a whole, without reference to irrelevant political boundaries. Special stress, it would appear from a brief report in the *Journal des Débats* of July 4, was laid on the geological and geographical unity of the Sahara as a whole from the Nile to the Atlantic, in which the conditions of development, of desiccation, and of life are subject to the same general laws, notwithstanding certain local divergences. Valuable comparisons of observations from west, centre and east were made, and various conclusions emerged Among these, that from the early palæolithic onward it was not possible to establish exact correspondence between Africa and Europe, and secondly that the succession of the large number of rock engravings and paintings in the Sahara continued down to modern times The Commission, it will be seen, has thus made a substantial beginning in the important work of synthesis in Saharan studies. The results will appear in a volume, of which the publication has been guaranteed by Sir Robert Mond, who also entertained the members at luncheon at the close of the proceedings. It has been decided that the Commission will meet every fourth year, the business of the Commission in the interval being conducted by Mr. Harper Kelley at the Musée de l'Homme, Paris.

The Czechoslovak Research Council

DURING the twenty years of the existence of the Czechoslovak Republic, the university authorities and scientific institutions of that country have not failed to realize the importance of research work in the natural sciences Among the organizations which have fostered academic investigations is the Czechoslovak National Research Council (Československá Národní Rada Badatelská). This body has just issued its fourteenth annual report, in which reference is made to the work recently published and still in progress. Practically all branches of science are represented, and some of the investigations have been commented upon already in NATURE. From the report, too, it is learnt that several prominent Czechoslovak men of science have been invited abroad to describe their special contributions to recent advances in the different sciences. On the other hand, students from various European and American countries have spent some time in the laboratories at Prague and Brno, studying technique in chemistry (polarographic methods), archæology (excavations in Moravia), biology and physics. During the year under review the Council, together with other bodies, arranged for the International Congress for the History of Science which coincided with celebrations of the hundred and fiftieth anniversary of the birth of J. E. Purkyně, the physiologist. The report also refers to the support the National Research Council has given to some fifty students (fourteen of whom were thus able to go abroad), which has permitted certain investigations to be undertaken or prolonged. These include special geological surveys, archæological excavations, a study of certain properties of heavy water, work on genetics, the ecology of certain lake flora, and biochemical examinations of fungal colonies in beech woods.

The Rhodes Scholarships

THE Rhodes Scholarships statement for 1936–37 shows a distribution of the 185 scholars (93 from the British Empire overseas, 86 from the United States and 6 from Germany), as follows . natural science 56, philosophy, politics and economics ('Modern Greats') 36, law 29, modern history 17, English 14, Litt. Hum 10, economics 8, mathematics 6, modern languages 3, geography, education and colonial service probationers 2 each. The particulars given of distinctions achieved by former Rhodes scholars are interesting for the light they throw on the question how far the founder's objects are being realized. Every one of the fourteen Americans is described as holding an important position (such as head of, or professor in, a university or college, or member of congress) in America, which accords well with the words in Rhodes's will: "without, I hope, withdrawing them or their sympathies from the land of their adoption or birth". As regards the British Empire (the retention of the unity of which was one of the declared objects of the scholarships) noteworthy appointments mentioned are those of governor of the Canadian Broadcasting Company, solicitor to the Treasury, Ottawa, chancellor of the University of Sydney, director of education, Victoria, director of the Institute of Pathology, Sydney, and Nuffield professor of surgery, Oxford. One of the Germans is professor of economics and political science, University of Heidelberg, and another president of the Academy of Sciences, Munich. "The object", says the will, of the German scholarships, "is that an understanding between the three Great Powers will render war impossible and educational relations make the strongest tie".

Canadian Research Scholarships

FORTY-NINE scholarships have been awarded for 1938–39 by the National Research Council of Canada. Graduates from fourteen Canadian universities have been given awards which will enable them to pursue post-graduate studies at the following universities: Dalhousie, Laval, McGill, Montreal, Queen's, Saskatchewan and Toronto. Four special scholarships will be tenable in the National Research Laboratories at Ottawa, where the holders, who have already gained post-graduate experience in research, will be given an opportunity to put their talents to work on some practical problem such as they may expect to meet when they enter commercial or industrial work For work in the universities, the scholarships granted include one fellowship, seventeen studentships and twenty seven bursaries Twenty eight of the awards are to be used in financing graduate students in chemistry, including fourteen in physical chemistry, six in cellulose research, four in organic chemistry, two in general chemistry, one in inorganic chemistry and one on a practical chemical problem in the National Research Laboratories Twelve candidates will work in physics, including three in the National Research Laboratories Other divisions of science represented in the awards are biochemistry, 2, biology, 2, botany, 1, entomology, 1, genetics, 2, and mathematics, 1

Rockefeller Travelling Fellowships in Medicine

THE following Rockefeller travelling fellowships in medicine have been awarded by the Medical Research Council for the academic year 1938–39 R R Bomford, assistant physician, London Hospital, T Colver, outpatient medical registrar, Hospital for Sick Children, Great Ormond Street, London, R M Heggie, assistant lecturer in pathology and bacteriology, Welsh National School of Medicine, Cardiff, Ian MacKenzie, assistant surgeon, St Giles's Hospital, London, Dr G G E Smyth, Dickinson research scholar, National Hospital, Queen Square, London, Ivor G Williams, senior assistant radiotherapist, Meyerstein Institute of Radiotherapy, Middlesex Hospital All these fellows propose to work at centres in the United States, with the exception of Dr Smyth, who intends to study in Paris Dr Williams will hold his fellowship for six months only In addition, the Rockefeller Foundation has awarded similar fellowships, on the recommendation of the Medical Research Council, to the following candidates in the special field of psychiatry, neurology and related subjects, all of whom are from the Maudsley Hospital, London T R C Fraser, W W Sargant, and M J F McArdle

The World Power Conference

WE have received from the Central Office of the World Power Conference, Kingsway, London, the annual report for 1937 Dr William F Durand is the president and Sir Harold Hartley is the chairman of the International Executive Council The first conference was held in London in 1924, the second in Berlin in 1930 and the third in Washington in 1936 In addition, six other special meetings have been held The next meeting of the council will take place in Vienna on August 29, 1938 The total number of National Committees of the World Power Conference is now 42, and in addition there are four member countries with representatives After the conference at Vienna this year there will be a study tour of about a week's duration The Central Office continues to circulate to the National Committees and representatives, reports on the work being carried on by the International Special Committee on Radio Interference, under the auspices of the International Electrotechnical Commission

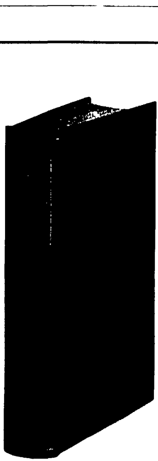
THE following appointments of official delegates to the sectional meeting of the World Power Conference to be held in Vienna on August 25–September 2, have been made to represent the Government of the United Kingdom, Sir Harold Hartley (chairman, International Executive Council and chairman, British National Committee of the World Power Conference, and Mr J M Kennedy, deputy chairman, Electricity Commission, appointed by the British National Committee of the World Power Conference, Sir Archibald Page, chairman, Central Electricity Board, and Dr F S Sinnatt, director of fuel research, Department of Scientific and Industrial Research The total attendance from the United Kingdom will exceed eighty, which is a record for any sectional meeting of the World Power Conference held abroad

International Management Congress

STRONG British support has been secured for the seventh International Management Congress which meets in Washington, D C, on September 19–24 More than ninety delegates fully representative of British industry, are attending to support Lord Leverhulme, who is the president of the International Committee An interesting unit of this party consists of nine young executives, one of whom is a lady, who are being assisted by bursaries paid out of the funds remaining from the sixth International Congress held in 1935 in London This party will travel together as a unit under the leadership of Dr E F Armstrong it is anticipated that each will profit from the collective experience of the whole Four tours by motor coach have been organized, enabling the delegates to visit a number of factories and cities Before the Congress, there is one tour of six days in New England and a second, taking five days, to the highly industrialized country between New York and Washington After the Congress, an eleven day tour goes through the mid-West to Chicago and back to New York via Buffalo and Niagara, and there is a final short tour to Boston It is proposed to give some form of written report of the visits, which will serve as a permanent record The tours are likely to be of exceptional educational value from the point of view of scientific management About 250 papers from some twenty countries have been accepted by the Congress The papers of each technical section have been summarized The chairman of the Congress Council is Mr Willis H Booth, vice president of the Guaranty Trust Company, that of the Co ordinating Committee is Mr William L Batt, president of S K F Industries, whilst the chairman of the Organizing Committee is Mr Harry A Hopf, well known as one of the most active protagonists of the management movement The delegates will be welcomed by Mr Cordell Hull, and there will be a formal reception at the White House

International Scientific Radio Union

THE sixth General Assembly of the International Scientific Radio Union (Union Radio Scientifique Internationale) will be held in Italy on September 4–14 The U R S I is one of the constituent bodies



NEW theories and the results of recent researches necessitated a thorough revision of this standard text. Every chapter has had a general revision, but the most extensive changes have been made in connexion with excitation, contraction, chemical transmission, structure of membranes, the permeability of cells, physiological oxidations, the chemistry of muscle, the vitamins, and the hormones. Entirely new sections have been added on the organizers or evocators, oxidation-reduction potentials, Liesegang phenomena, and the physiological study of temperature characteristics.

As in the earlier editions, the selection of material is based upon a desire to present those aspects of the subject which are most useful to the student who takes but one college course in physiology With this in mind, digestion is studied in man rather than in the amoeba : a considerable amount of mammalian physiology is included · and illustrations of general physiological principles are chosen, wherever possible, from mammalian work

Since the majority of undergraduates who study general physiology are not equipped in physical chemistry and biochemistry, the chapters dealing with these two subjects have been retained in the revision

Many new illustrations have been added to the third edition of TEXTBOOK OF GENERAL PHYSIOLOGY, and the bibliographies have been considerably enlarged.

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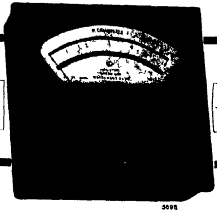

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of the International Council of Scientific Unions, with its secretariat in Brussels; and it is concerned with the various scientific aspects of radio communication and radio physics, in many branches of which international discussion and co-operation is beneficial in stimulating both theoretical and experimental research. At the previous general assembly of the U.R.S.I. held in London in 1934, Prof. E. V. Appleton was elected president, and he is also chairman of the British National Committee, of which Dr. E. H. Rayner is secretary. Other members of this committee who will be attending the forthcoming meeting in Italy include Prof. S. Chapman, Mr. T. E. Eckersley, Mr. E. B. Moullin, Mr. J. A. Ratcliffe, Dr. R. L. Smith-Rose and Mr. R. A. Watson Watt. It is anticipated that representatives of some twelve or more other nations will also be in attendance. The work of the General Assembly is divided among five commissions dealing respectively with radio measurements and standards, the propagation of waves, atmospherics, liaison and radio physics. The opening meeting will take place on September 4 at Venice, where most of the business of the Assembly will be carried out during the ensuing week. The formal closing meeting takes place in Rome, and various technical visits and other appropriate engagements of interest are included in the programme.

Imperial Veterinary Conference

An Imperial Veterinary Conference will be held at the Royal Veterinary College, Camden Town, London, N.W.1, on August 15–19. The subjects to be discussed will include the work of the Imperial Bureau of Animal Health, foot-and-mouth disease and certain other virus diseases, Johne's disease, bovine mastitis, caseous lymphadenitis of sheep, sheep blowflies, fowl paralysis and chronic bovine hæmaturia.

Announcements

The Jenner Medal of the Royal Society of Medicine, which is awarded for distinguished work in epidemiological research or for pre-eminence in the prevention and control of epidemic disease, was presented to Sir Arthur Newsholme on July 19.

The *Queen Mary* has established a new record for the east to west crossing of the Atlantic. She berthed at New York on August 8, after having covered the distance from the Bishop Rock to the Ambrose Channel lightship in 3 days 21 hours 48 minutes, at an average speed of 30·99 knots.

It is announced by the Berlin correspondent of *The Times* that a new height record for a glider was set up at Wasserkuppe by Capt. Walther Drechsel on August 5, when he ascended to 23,190 ft. The machine, a Minimoa glider, was towed to a height of about 3000 ft. and then released.

Through the generosity of the late Mr. Herbert Harlow of Bradford, the Bradford Technical College has been able to establish a Harlow fellowship of the value of £250 a year for research to be carried out at the Technical College, Bradford, in one of the branches of science relating to the textile industry or the dyeing industry. Mr. R. Williamson has been appointed to the first fellowship.

An Advisory Committee on Blindness, including its prevention and treatment, has recently been formed by the Minister of Health. The following have been appointed members of the Committee: Dr. P. M. Evans (chairman), H. R. Bickerton, J. D. Magor Cardell, Miss Grace Cracknall, James Ferguson, Percy Fleming, N. Bishop Harman, Dr. E. K. Macdonald, Miss Ida Mann, R. Foster Moore, G. F. Mowatt, Sir John Parsons and A. H. H. Sinclair. The Committee has been appointed for a period of three years. Mr. H. G. Benjamin, of the Ministry of Health, will be secretary, and Dr. A. E. Hallinan, of the Ministry of Health, will be medical secretary of the Committee.

The following awards for 1938–39 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company. Fellowships have been renewed in the case of Messrs. A. J. Shorter (to the University of Illinois), J. L. Tuck (at the University of Oxford) and to S. H. Wade (at Imperial College, London). Fellowships have been awarded to H. D. Anderson (University of Oxford), A. Cameron (Imperial College, London), H. S. Corran (University of Cambridge) and R. N. Haward (University of Cambridge). The Salters' Institute has also awarded fifty grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

The following appointments and promotion have been made in the Colonial Service: H. C. Thorpe to be plant breeder, Kenya; M. H. C. Glyn, to be veterinary officer, Northern Rhodesia; W. G. G. Pevie, to be veterinary officer, Tanganyika Territory; D. A. Frye, to be assistant analyst, Analyst's Department, Straits Settlements; J. R. E. Hindson (agricultural superintendent, Gold Coast), to be agricultural officer, Northern Rhodesia; R. M. Nattrass (plant pathologist, Cyprus), to be senior plant pathologist, Kenya; Gunn Lay Teik (assistant analyst), to be chemist, Department of Agriculture, Federated Malay States; W. Molegode (officer of Class I, Grade I, Agricultural Department), to be agricultural officer (Propaganda), Ceylon.

Dr. Wendell Meredith Stanley, of the Rockefeller Institute, Princeton, has been awarded the Rosenberger Medal of the University of Chicago in recognition of his isolation of crystalline forms of the filtrable viruses. The Rosenberger Medal for distinguished achievement in the advancement of learning or for notably great service in the promotion of human welfare has been awarded five times previously.

The first International Congress for Forensic and Social Medicine will be held at Bonn on September 22–24 under the presidency of Prof. Pietrusky, director of the Bonn Institute of Forensic Medicine. Further information can be obtained from Prof. Schrader, Franzosenweg 1, Halle a.d.S.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 296.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Fundamental Physical Concepts

THE flux-cutting equations, $H' = [VJ] = \varepsilon[VE]$ and $E' = -[VB] = -\mu[VH]$, enunciated in my article in NATURE of February 5, in conjunction with the ionic constitution of matter and the simple physical treatment of electric wave propagation, have suggested some novel physical concepts which may help towards at least a partial reconciliation between the classical and modern theories.

The classical theory was based on macroscopic experiments and hence dealt almost exclusively with average or resultant forces and fields; but if an attractive force or bond exists between every proton and electron, these straight bonds constitute the actual lines of force, and our familiar 'lines of force' are really only imaginary lines which indicate the direction of the resultant force and have no physical existence. An 'uncharged' body, that is, one containing equal numbers of protons and electrons, certainly produces no external resultant field, but on this view it has two similar systems of bonds radiating from its protons and electrons respectively, so that it should be regarded as being surrounded by two equal and opposite electric fields, and since an electric current consists of a procession or stream of electrons or protons or of both travelling in opposite senses, a linear current must be surrounded by two opposed radial electric fields moving translationally past each other. Since $H = [VJ] = jVJ \sin\theta$, and $J = e/r^2$ at a distance r from a charge e, $H = jev \sin\theta/r^2 = jids \sin\theta/r^2$, so that these moving electric fields are equivalent to a magnetic field and no vertical concept of a magnetic field appears to be called for.

The attractive force or tension in the bond between a proton and electron of charge $\pm e$ respectively is of course $T = e^2/\varepsilon r^2$, and the electrokinetic or 'magnetic' energy of a transversely moving electric field shows that the bond has an equivalent mass of $m = \mu e^2/r^2$ per unit length. But the velocity of propagation of transverse disturbances along a cord under a tension T and having a mass m per unit length is $V = \sqrt{\frac{T}{m}}$, so that for the above values of T and m, V should be $1/\sqrt{\varepsilon\mu}$. This indicates that transverse electric disturbances travel along the bonds exactly as if these bonds were material fibres or contractile tentacular projections from the protons and electrons, and enables the field distribution round a dipole oscillator to be determined with great simplicity. Incidentally, the total mass of the bonds surrounding a spherical charge e of radius r_0 works out to Sir Joseph Thomson's value of $2\mu e^2/3r_0$ for the electromagnetic mass associated with the charge.

In dielectric media the bonds between the molecules are loaded with ions which are also cross-coupled by the intra-molecular bonds, and the passage of an electric disturbance produces transverse displacements of the positive and negative ions in opposite senses, which are opposed by the inter- and intra-molecular bonds. This modifies the velocity of propagation and makes it dependent on the wavelength, in accordance with the Drude dispersion theory. If the medium moves, its internal bonds which correspond to Fresnel's 'bound ether' move with it, while the bonds which connect external charges and correspond to his 'free ether' do not, and this provides a simple explanation of the Fresnel drag coefficient.

Although this material bond hypothesis offers no explanation of the repulsion between like charges, except the pressure which must result from the attractive forces, it provides a very simple picture of the processes involved in electric wave propagation which is in complete agreement with the Maxwellian theory; and since the bonds appear to have mass they may be slightly curved or deflected by transverse gravitational as well as by electric fields, which may explain the deflection of light passing near the sun, and gives a simple physical interpretation of the relativistic 'curvature of space'. Moreover, although the bonds from a single orbital electron must oscillate and transmit radiation, those from a close assembly of such electrons will evidently interfere and transmit little or no radiation; while sporadic and more widely separated disturbances caused by changes of orbit would be transmitted with little interference. This conforms, at least qualitatively, with the Quantum theory; and if we assume that the violent ejection of electrons is accompanied by high frequency oscillations of their shape and bonds, the Heisenberg wave electron and electron diffraction phenomena become physically intelligible.

One other point of fundamental importance arises from the flux-cutting principle. The basic feature of wave propagation is that the displacing force due to acceleration balances the elastic controlling force. For a stretched cord transmitting a deformation of radius R, the displacing force is mV^2/R, which we can write down directly; but for electric waves we have to derive it by two stages $H' = j\varepsilon VE$ and $E' = -j\mu VH' = \varepsilon\mu V^2 E$, that is, by reciprocal electric and magnetic induction. But Ampère's experiments on the forces on current-carrying conductors gave us $f = \mu \frac{ids\, i'ds'}{r^2} \sin\theta$ for the transverse force on either of two parallel current elements ids and $i'ds'$ separated by a distance r and making an angle θ with r. Hence if we have two charges e and e' moving with velocity V transverse to r, $f = \mu ee'V^2/r^2 = \varepsilon\mu V^2 Ee'$, since $E = -e/\varepsilon r^2$, without any magnetic considerations. In conjunction with the above concept of a magnetic field as a translationally moving electric field, this suggests that 'magnetic force' should be regarded fundamentally as simply a symbol for $4\pi[VD] = [VJ]$, that magnetism may with advantage be eliminated from all fundamental physical discussions, and that it may be possible to express the forces associated with protons and electrons at rest and in uniform and accelerated motion by a single comprehensive formula, thus eliminating both the curl- and flux-cutting equations Such a change would be a great help towards clarifying fundamental problems, but it will take some time to formulate and assimilate, and in the meantime the flux-cutting equations and the simple physical concepts to which they lead should greatly facilitate the teaching and application of the Maxwellian theory.

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Radio Fadeouts, Auroras and Magnetic Storms

FROM observations made in the South Island of New Zealand we may add to the data already published in NATURE on the connexion between the radio fadeouts, auroras and magnetic storms of the two periods January 20–22 and January 24–26, 1937

As reported from Canberra[1], the first of these periods of activity began with solar activity and poor reflection of wireless waves from the ionosphere The wireless observations in New Zealand do not correspond exactly with those of Canberra On beginning observations of the reflection of waves from the F_2 region at 2100 G.M.T. on January 20 no reflected wave could be observed and this fadeout lasted until 2305 hours, after which time weak echoes were obtained

Magnetic conditions were moderately stormy during January 20 and 21 and an aurora was observed over New Zealand with its maximum phase at 0945 hours G.M.T., January 21. This faded out at 1100 hours. The magnetic storminess culminated in a major storm beginning at 0240 G.M T., January 22 and during the entire night an intense auroral display occurred in the southern hemisphere with its maximum phase at 1045 G.M T., January 22, when it was seen in Canberra

The interval from 2100 hours January 20, when the radio fadeout was first observed, until 0240 hours January 22, when the magnetic storm began, is about 30 hours.

The intense aurora which accompanied the storm probably began during daylight, since complex echoes from the ionosphere which accompany such activity were observed.

On January 24 the Christchurch observations of the radio fadeout corresponded exactly to those made at Canberra An interesting feature of the following period not already reported is that a good auroral display began in the southern hemisphere about the time of commencement of the magnetic storm at 1150 G.M.T., January 25. Through cloudiness it was not seen until 1315 G.M.T., but from the stage of development at that time it had probably started earlier.

This was in all probability the beginning of a period of world-wide auroral activity. The southern aurora mentioned above was followed by the intense aurora in the northern hemisphere[2] from 1800 G.M.T , January 25, until about 0230 G.M.T., January 26. This in turn was followed by another southern aurora observed in the evening from about 0900 h. G.M T., January 26 It seems reasonable to assume that an intense daylight aurora may have been in progress in the southern hemisphere at the same time as that observed in the northern hemisphere, for during the whole period of ionospheric observations in Christchurch from 2100 hours, January 25, until 0530 hours, January 26, no echoes could be received from the ionosphere. The magnetic storm was in progress during most of this period

The above auroral observations show that the estimated time interval of 39½ hours from the solar eruption (at 0250 G M T , January 24) to the commencement of the aurora is too large, but that this interval should be about the same as that to the commencement of the magnetic storm, i e., approximately 33 hours

Ionospheric conditions in Christchurch appear to be similar to those observed at Tromsø by Appleton[3] during a magnetic storm and auroral display. It is found, for example, that 'no echo' periods often occur in the morning following a night of magnetic and auroral activity The fadeout at 2100 G.M.T., January 20, may be of this type although no auroral or magnetic activity is known to have preceded it. Radio fadeouts coinciding in time with solar eruptions are observed as well as the periods of 'no echo' mentioned above It would appear, therefore, that in high latitudes a radio fadeout may be due to ultra-violet radiation emitted during an eruption or may also be due to ionization by the particle radiation causing the auroras

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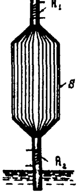
[1] NATURE, 141, 746 (1938)

[2] NATURE, 141, 232 (1938)

[3] *Phil Trans Roy Soc* , A, 236, 191 (1937)

Further Experiments on Liquid Helium II

IN a previous note[1], we reported our investigation of the formation of a thin film of liquid helium II on the walls of a tube which is in contact with it A very rough estimation of the thickness of the film was made from the amount of heat necessary for its destruction , it was found to be of the order 10^{-6} cm. The object of the further research was a direct determination of the thickness of the film



The apparatus for the measurements is shown in the accompanying diagram Here S is a cylinder of a great area, on the upper and lower part of which are soldered two tubes 4 mm. in diameter. A resistance thermometer R_1 of phosphor bronze wire 0 051 mm. thick is wound on the upper tube ; a heating coil R_2 of constantan wire 0·1 mm. thick is wound on the lower tube. The lower part of the apparatus is immersed in liquid helium so that the heating coil is above the level of the liquid. In the presence of a film of liquid helium II on the surface S, the thermometer R_1 indicates the temperature of the liquid helium II in the lower part of the apparatus On switching on in the heating coil a current above the critical value[1], the film disrupts and the thermometer registers a rise of temperature in the upper part of the apparatus This rise of temperature amounted to about 1° No temperature rise occurred at currents below the critical value

The procedure is as follows The presence of the film is ascertained from the readings of the thermometer R_1 The current in the heating coil is then switched on whereupon the film is disrupted With current on the dropping of the level of helium caused by evaporation is observed by means of a cathetometer After a while the current is switched off and, consequently, the film is allowed to form again

The curve of the dropping of the level as a function of time is taken throughout the experiment This curve exhibits a break and a jump at the moment the current is switched off From the magnitude of this jump, the surface of helium in the Dewar vessel and the surface S one easily finds the thickness of the film

Three experiments were carried out with different areas of S namely $700\ \mathrm{cm}^2$, $2\ 800\ \mathrm{cm}^2$ and $10\ \mathrm{cm}^2$ In the first two cases the jumps were $1\ 5 \times 10^{3}$, and $3\ 5 \times 10^{3}$ cm respectively as was expected no jump occurred in the third case Taking into account the quantity of helium evaporating during the cooling of the apparatus heated by 1° by the heating coil, we find from this data the thickness of the film to be 2 to 3×10^{-6} cm It should be noted that the film is easily destroyed even by faint illumination Therefore the experiments were carried out in a dark room and very faint light was used for observing the level

Knowing the thickness of the film it is possible to draw some conclusions on the thermal conductivity and the viscosity of liquid helium II (so far as thin films are concerned)

(1) Our experiments show that the transfer of heat even in a thin film is high It is not likely to depend on convection, as the film is very thin It may be, however that the equalization of the temperature is merely due to the presence of the film and permanent evaporation of it

(2) From the recent experiments of J G Daunt and K Mendelssohn[2], who have determined the rate of transfer of liquid helium II on the surface of a solid in contact with it (an experiment analogous to that of these authors has been performed by us) one can, knowing the thickness of the film estimate the viscosity of liquid helium therein It proves to be much higher than the viscosity of liquid helium II, measured by P Kapitza[3] Of course our experiments refer to thin films only

A detailed description of our experiments will be published in one of the Russian physical journals

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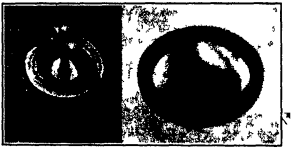
[1] Kikoin A K and Lasarew B G NATURE 141 912 (1938)
[2] Daunt J G and Mendelssohn K NATURE 141 911 (1938)
[3] Kapitza P, NATURE 141, 75 (1938)

Motion of a Spinning Top

IF a gyroscope is made with a heavy frame having a mass equal to or greater than the mass of the disk, then when the disk is set in rapid rotation about a vertical axis and the frame (provided with a supporting point) placed upon a smooth surface (Fig 1a), the friction between the axle and the frame will soon set the frame in rapid rotation In order to produce the proper amount of friction the tightness of the axle in the frame is variable by means of an adjustable lock nut As the frame rotates about the vertical axis it will take on a precessional rotation because of the pull of gravity This precession gradually increases so that at the right moment the frame is rotating partially about an axis perpendicular to its plane This angular velocity tends by centrifugal force to throw the frame into a position in which its plane is horizontal This change takes place very suddenly so that the top flipping violently from one axis to another at right angles continues to rotate about the second axis The initial and final position are shown in the photograph



(a) (b)

Fig 1

For best results the top should be rotated at high speed with an electric spinner The friction between the axle and the frame must be exactly right It is better to place the top upon a smooth metal plate, since then the frame can take up its rotation quickly without loss of energy to the supporting surface The top should be designed to withstand high rotation speeds It should not be touched after it is spinning on the plate since the tipping over is sudden and energetic

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The Theory of Nuclear Forces

ACCORDING to the theory proposed by Yukawa[1] the neutron proton interaction is due to the exchange of a particle having the elementary charge either positive or negative and a mass $m = \frac{h\varkappa}{c}$, where h and c are Plancks constant and the velocity of light and $\frac{1}{\varkappa}$ is the range of nuclear forces The proper description of these new particles, which have spin equal to one and obey Bose statistics, is obtained by quantization of the equations of Proca[2] Introducing a *complex* four vector with components U^{μ} ($\mu = 1, 2, 3, 4$) and a *complex* antisymmetrical world tensor with components $\chi^{\mu\nu}$ ($\mu, \nu = 1, 2, 3, 4$) these equations can be written

$$(1) \quad \begin{cases} \sum_{\nu=1}^{4} \dfrac{\partial \chi^{\mu\nu}}{\partial x^{\nu}} + \varkappa^{2}\, U^{\mu} = 0 \quad (\mu = 1, 2, 3, 4) \\ \chi^{\mu\nu} = \dfrac{\partial U^{\nu}}{\partial x_{\mu}} - \dfrac{\partial U_{\mu}}{\partial x_{\nu}} \end{cases}$$

where $(x^{\mu}) = (x, y, z, ct)$ are the space-time co-ordinates and $\varkappa$ is the universal constant determining the range of the forces Similar equations hold for the conjugate complex quantities $\widetilde{U}^{\mu}$ and $\widetilde{\chi}^{\mu\nu}$

The charge and current densities connected with the new particles are given by the components of the four vector

$$(2) \quad S^{\mu} = e\, i \sum_{\nu=1}^{4} (\widetilde{\chi}^{\mu\nu} U_{\nu} - \widetilde{U}_{\nu} \chi^{\mu\nu}) \quad (\mu = 1, 2, 3, 4),$$

which vanish only if the real and imaginary part of the field quantities have a constant ratio and in general represent particles of either positive or negative charge

It has already been pointed out by several authors[3] that it might be necessary to introduce neutral particles also to account for the big forces between two neutrons and between two protons, and the question has been discussed what kind of field equations are suited for the representation of such particles The only simple equations, however, which have the right spin properties and always give positive values for the energy are those of Proca, and it may therefore be of interest to remark that the solutions of (1) where the real and imaginary parts are not independent of each other and which accordingly give no contribution to the charge and current densities in (2) will just seem to be suited to represent such fields

In that case it is, of course, only necessary to consider *real* field quantities U^{μ} and $\chi^{\mu\nu}$ and the representation of the nuclear fields shows, therefore, a striking resemblance to the ordinary electromagnetic theory from which the equations (1) only differ by the terms containing the universal constant $\varkappa$ Accordingly, the quantization of these equations can be performed exactly as in quantum electrodynamics, that is, the radiation field can be treated as an infinite number of harmonic oscillators or as an assembly of quanta As regards energy and momentum these quanta will behave like material particles with rest-mass $m = \dfrac{\hbar\varkappa}{c}$ but, as in the case of photons, it is impossible to define a density in ordinary space of the heavy quanta, the particle properties of which result only from the quantization

From this point of view the field theory based on the equations (1) offer possibilities of accounting for forces between like and unlike nuclear particles of a more general character than hitherto recognized These consequences will be discussed in detail in collaboration with L. Rosenfeld in a forthcoming paper to be published in the *Proceedings of the Copenhagen Academy*.

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Copenhagen. July 9.

C. MØLLER.

[1] Yukawa, *Proc. Phys Math Soc Japan*, 17, 48 (1935) Yukawa, Sakata, Taketani, *ibid.*, 20 (1938) Kemmer, NATURE, 141, 116 (1938). Bhabha, *ibid.*, 141, 117 (1938) Fröhlich, Heitler, Kemmer, *Proc. Roy. Soc.*, 166, 154 (1938)

[2] Proca, *J. Phys*, 7, 532 (1936).

[3] Yukawa, *loc. cit.* Bhabha, *loc cit.*

[4] Landau and Peierls, *Z. Phys.*, 62, 188 (1930). Pauli, *ibid.*, 80, 573 (1933).

Spectrum of Rubidium Hydride, RbH

A BAND spectrum of the many-line type has been obtained from a discharge through a mixture of rubidium vapour and hydrogen The discharge tube with a constriction in the positive column which was originally designed for the production of the manganese hydride spectrum[1] was found to be an intense and economical source, the spectrum has been photographed on a 20-ft concave grating spectrograph with exposures ranging from 10 to 40 minutes.

The spectrum, which extends from 4800 A to 6500 A, is very similar to the already known spectra of the diatomic hydrides of the alkali metals, the bands being due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition and being strongly degraded to the red, so that the heads are poorly developed and have only been observed for some of the strongest bands So far, nineteen bands have been classified, and a preliminary analysis leads to the following approximate values of the molecular constants·

$\nu_e = 18912$ cm^{-1} $\qquad \nu_0 = 18573$ cm^{-1}
$\omega_e' = 248$ $\qquad \omega_e'' = 934$

The large difference between ω_e'' and ω_e' produces some uncertainty in the assignment of the values of v', and the values given below may have to be raised by one or possibly two units The vibrational energy terms of the upper electronic state, like those for the hydrides of the other alkali metals, are anomalous in having a negative value of $\omega_e' x_e'$

The following are the approximate positions of the heads of the strongest bands,

λ	v', v''	λ	v', v''
6277	0,3	5345	4,1
6178	1,3	5267	5,1
5871	1,2	5027	5,0
5782	2,2	4958	6,0
5694	3,2	4891	7,0
5422	3,1	4826	8,0

The investigations are being continued, and a rotational analysis is in progress

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[1] Pearse R W B, and Gaydon, A G, *Proc Phys, Soc*, 50, 201 (1938)

Surface Films of Gliadin

MITCHELL[1] has reported that under suitable conditions proteins can be spread from a solution to give films the force area curves of which show a sharp transition point in the region of 1·2 dynes/cm., the extrapolated areas of the two distinct portions of the curve being approximately 0·3 and 0·7 × 10^{-7} gm./sq. cm. respectively. The requirements for such a curve seem to be (1) a dilute spreading solution, and (2) a time interval of 1–15 hours between spreading and measurement. Since this is the first case in which a definite transition point has been observed with proteins, we have repeated the measurements using, so far as could be ascertained, the same conditions as Mitchell Dilute solutions of gliadin in 70 per cent aqueous alcohol were used for spreading on $N/100$ sulphuric acid or hydrochloric acid substrates, and the time interval ranged from 3 to 1,065 minutes.

There was no evidence at all of a transition point in any of the curves, and the time interval required for the film to reach equilibrium was only 5 minutes. If the interval was very large (greater than 1–2 hours) the curves indicated that the extrapolated area per molecule was becoming greater. Further investigation showed, however, that this effect was not real and that, in this series of experiments at least, the increase was due, not to a slow spreading of the protein, but to the inevitable accidental contamination of the surface with time. It is extremely doubtful whether a surface can be kept clean for as long a period as 15 hours without taking the most elaborate precautions[1].

The results obtained may be summarized as follows: column *A* gives the time interval between spreading and measurement, *B* the concentration of the spreading solution in grams of dried protein per 100 c.c. of solution and *C* the extrapolated density of the film in gm. × 10^{-7} per sq cm

Expt	*A*	*B*	*C*
1	3	0·0048	1·33
2	5	,,	1·18
3	10	,,	1·18
4	10	,,	1·25
5	10	0·0094	1·25
6	10	,,	1·25
7	10	,,	1·20
8	10	0·0093	1·30
9	20	0·0048	1·18
10	20	0·0093	1·24
11*	70	0·0051	1·17
12	70	0·0048	1·23
13*	120	,,	1·03
14*	260	,,	1·08
15	375	,,	1·00
16*	410	,,	0·93
17	1065	,,	0·78

* $N/100$ HCl, remainder $N/100$ H_2SO_4

For an interval of 5–70 minutes the extrapolated density of the film is fairly constant, the mean value (of experiments 2 to 12) being 1·22 × 10^{-7} gm./sq. cm. with an average deviation of 0·03 × 10^{-7}. This figure (0·82 sq. metres per mgm.) compares favourably with the value of 0·9–1·0 sq. metres per mgm. obtained for various proteins on a substrate the *p*H of which is approximately 1·0 or is at the isoelectric point of the protein[3,4,5], but it is decidedly greater than Mitchell's value, 0·57–0·85 × 10^{-7} gm. per sq. cm. After compression to 18 dynes/cm., the film could be expanded and recompressed to give a curve identical with the first compression. That the decrease in value of column *C* after 70 minutes is not due to a slow spreading was shown by correcting the curves for accidental contamination, obtained from a blank experiment over a similar period of time. Thus experiment 17 on correction gives an extrapolated density of 1·25 × 10^{-7}. The correction applied must necessarily be approximate, and the agreement with the mean value of 1·22 × 10^{-7} is better than was expected; but there seems little doubt that the real cause is contamination and not a slow spreading phenomenon.

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July 12.

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[1] *Trans. Far. Soc.*, 23, 1129 (1927)

[2] Gorter and Philippi, *Proc. Acad. Sci. Amst.*, 37, 788 (1934).

[3] Gorter and co-workers, *Proc. Acad. Sci. Amst.*, 28, 371 (1925) *et seq.*

[4] Neurath, *J. Chem. Phys.*, 40, 361 (1936).

[5] Fourt and Schmitt, *J. Phys. Chem.*, 40, 989 (1936).

Duration of Action of Natural and Synthetic Œstrogens

IN recent communications[1,2], details have been given of the œstrogenic activity of triphenyl ethylene in the mouse, the rabbit, the bitch and the monkey.

A number of derivatives of triphenyl ethylene have since been investigated for their œstrogenic effect and it has been found that triphenyl chlor-ethylene is considerably more potent.

Since a prolonged effect may be a desirable feature in the clinical use of œstrogens, experiments have been made to determine the duration of action of a number of natural and synthetic œstrogenic substances, namely, (1) œstradiol, œstradiol benzoate, œstradiol benzoate butyrate and œstradiol dipropionate; (2) triphenyl ethylene, triphenyl chlor-ethylene; (3) stilbœstrol.

The œstradiol benzoate butyrate and dipropionate were supplied by Dr. Miescher (of Ciba Ltd.) who recently described their prolonged effects in rats[3]. Stilbœstrol[4] was supplied by Dr. Carr, of B.D.H. Ltd.

The substances were tested in mice for their action on the vagina. The changes in the vaginal smear were determined in a quantitative manner by a method previously described[5]. The substances were given either (*a*) by subcutaneous injections in oil in four doses at 12 hourly intervals or (*b*) orally in a single dose in oil. The duration of the effects is shown in Tables 1 and 2.

TABLE 1 DURATION OF ACTION OF ŒSTROGENIC SUBSTANCES GIVEN BY SUBCUTANEOUS INJECTIONS.

Substance	Total dose (μ gm.)	Total duration of effect (approximate) in days	Duration until action halved (days)
Œstradiol benzoate	500	38	27
Œstradiol benzoate butyrate	50	> 120	95
Triphenyl ethylene	10,000	> 110	105
Triphenyl chlor-ethylene	500	> 130	123
Stilbœstrol	500	27	16

TABLE 2 DURATION OF ACTION OF ŒSTROGENIC SUBSTANCES GIVEN ORALLY.

Substance	Dose (μ gm.)	Total duration of effect (approximate) in days	Duration until action halved (days)
Œstradiol	500	23	18
Œstradiol benzoate	500	20	15
Œstradiol dipropionate	500	18	13
Œstradiol benzoate butyrate	500	13	8
Triphenyl chlor-ethylene	500	17	14
Stilbœstrol	500	25	20

The results show that, when massive doses are compared, triphenyl chlor-ethylene given by subcutaneous injection (Table 1) has, weight for weight, a considerably more prolonged action than œstradiol benzoate, which is the œstrogen at present in common clinical use. Œstradiol benzoate butyrate has a more prolonged action than triphenyl chlor-ethylene. The duration of action of stilbœstrol is, in comparison, very short.

When given orally (Table 2), œstradiol has a more prolonged action than any of its compounds tested, Œstradiol and stilbœstrol act for approximately the same time and their period of action is a little longer than that of triphenyl ethylene

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July 11.

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Inhibiting Effect of Sodium Chloride on the Oxidation of Ascorbic Acid

IT was recently shown that sodium chloride (0 1 *M*) at *p*H 7 0 has an inhibiting effect on the oxidation of ascorbic acid[1,2]. Kellie and Zilva[2] showed in one experiment that sodium chloride (0 1 *M*) inhibited the catalytic power of copper at *p*H 7 0, but Barron *et al.*[3] did not succeed in demonstrating the same effect at *p*H 6·0. If it is true that sodium chloride has an inhibiting effect on the oxidation, it may be of the greatest domestic importance, for it has always been the practice of man to add salt (primitive people used sea water) to the water used for cooking meat and vegetables.

Experimental. Potatoes, cabbage and ox liver were cooked in glass-distilled water with and without addition of sodium chloride at a concentration of 1 per cent. Potatoes were cooked 45 minutes, cabbage and ox liver 20 minutes. The foodstuffs were added to the water after boiling had started 10 gm. material was cooked with 200 ml. water The foodstuffs were ground up with quartz and in 10 per cent trichloracetic acid and analysed by the method of Emmerie and van Eekelen[4,5] In the table the numbers are the results of double analyses made on different materials. They are given as percentages of the original content of ascorbic acid in the raw substance.

	Cooked in distilled water			Cooked in distilled water with 1 per cent sodium chloride		
	In substance %	In water %	Total %	In substance %	In water %	Total %
Peeled potatoes	93	13 5	106 5	107	17	124
Cabbage	54	20 5	74 5	32 5	56	88 5
Ox liver	46	44	90	38	52	91

Thus we find 16–19 per cent more ascorbic acid left when vegetables are cooked in salt solution than in vegetables cooked in distilled water In agreement with McHenry and Graham[6], we found considerably more ascorbic acid in cooked than in raw potatoes. These authors claimed that ascorbic acid in raw vegetables were partially fixed as esters which are hydrolysed by cooking. Van Eekelen[7] repeated their experiments with another technique using 3 per cent trichloracetic acid for the grinding medium, and found that potatoes, in fact, lost ascorbic acid by cooking, he explained the remarkable results of McHenry and Graham as being due to action of enzymes during the grinding process. In our experiments such an action of enzymes is excluded, since we used strong trichloracetic acid as grinding medium We know of no other observations suggesting that ascorbic acid in vegetables is fixed in the form of esters In our opinion, the phenomenon is easily explained by the fact that it is very difficult to extract ascorbic acid quantitatively from raw vegetables, especially when strong trichloracetic acid is used, and the extraction has to be done quickly in order to avoid destruction of the ascorbic acid

The main purpose with this communication, however, is to point out that vegetables cooked in water containing sodium chloride appear to keep their ascorbic acid better than vegetables cooked in distilled water

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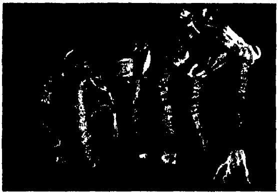
Regeneration of Root Cuttings as Influenced by Plant Hormones

ROOT cuttings (thongs) of sea-kale (*Crambe maritima*) under suitable conditions produce, whichever way up they are inserted in the rooting medium, buds and roots at the morphological apex (proximal end) and base (distal end) respectively (Fig *C*) This phenomenon of polarity has been explained by Went and Thimann in terms of the polar transport of auxin—"polarity can now be expressed quantitatively as a function of the transport of a known substance in the tissues"[1]

Experiments here tended to suggest that the production of buds and roots is possibly dependent on the local concentration of growth substances within the tissues Thongs 7 cm in length were used. The morphological apices were treated for 20 hours with a solution of α-naphthalene acetic acid (0·02 per cent) After 14 days, roots had been produced both apically and basally (Fig *A*). The length of the roots varied from 1 cm. to 5 cm No buds were produced at the apex These observations implied that under normal conditions the presence of a relatively high but quantitative amount of growth substance determines the production of roots. Bud production, on the other hand, may be associated with a relatively low concentration of growth substance. Proof of this would lie in the production of buds basally as well as apically Thus, assuming the polar transport of auxin from all regions to the base, it would be necessary to remove this accumulating auxin and therefore lower the concentration at the base. A possible method of achieving this lay in washing the thongs in running water for 48 hours, but this produced no effect upon the subsequent behaviour of the cuttings. A second method which eventually proved successful was to remove approximately a millimetre of tissue from the base and apex of the thongs every five days for a period of eight weeks. At the end of this time about 25 per cent of the thongs had produced buds at both ends (Fig *B*). Thongs which failed to produce buds basally were either still producing roots in this region or were merely callused The decapitation treatment was continued on the latter material, and after another four weeks most of the thongs had produced buds at the base with no activity at the apex

The quiescence of the apex may possibly be attributed to auxin depletion coupled with carbohydrate exhaustion. Removal of buds from the thongs bearing buds at both ends followed by total immersion of the thongs in a 0 02 per cent solution of α-naphthalene-acetic acid resulted in the production of roots over the whole length Roots and buds formed in anomalous positions showed normal subsequent growth



A Roots at both ends *B* Buds at both ends *C* Normal thong

From these experiments, it is suggested that whatever other substances may be concerned in bud and root production as proposed by Went[2], not only the subsequent growth but also the initial differentiation of meristematic tissue is determined, at least in part, by the local concentration of growth substance

Further experiments will be directed to the possible production of buds by the application of growth substances to tissue whose supply of auxin has been artificially depleted and to the estimation of auxin concentrations, if any, in the different parts of the thong.

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Nucleic Acid Metabolism of the Chromosomes in Relation to Gene Reproduction

A relation between the nucleic acid metabolism of the chromosomes and their reproduction is suggested by the localized appearance of thymonucleic acid in the chromosomes preparatory to their division[1]. The study of the nucleic acid metabolism of the salivary chromosomes and of the egg cytoplasm in certain variegated races of *Drosophila melanogaster* has now given evidence of a relation between nucleic acid metabolism and gene reproduction The variegation in these races is due to an abnormality of gene reproduction, consequent upon chromosome rearrangements[2] involving the 'heterochromatic' regions[3] Cytologically, the variegation is correlated with deficiencies in the salivary gland chromosomes for the bands closest to the point of rearrangement, and with a darkening of the immediately adjacent remaining bands which suggests a change in their nucleic acid balance[3].

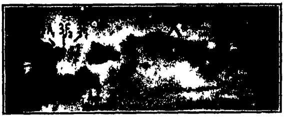

Fig 1

A photograph, taken at 275 mμ showing a normal *X*-chromosome synapsed with one of the chromosomes resulting from a reciprocal translocation between the *X*- and the fourth chromosomes. The labels on the bands are those of Bridges' reference system for the salivary gland chromosomes (*J Hered*, 1938)

Nucleic acid contents of the labelled bands in 10^{-11} mg : $3F_1$ normal 8, translocation 33, $3F_2$ normal 14, translocation 50, $4A_1$ normal 95, translocation 94

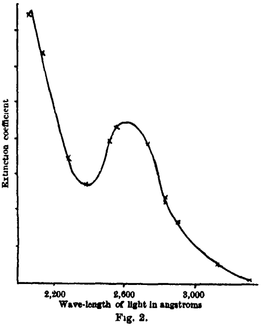

Fig. 2.

Absorption spectrum of the cytoplasm of the *Drosophila* egg.

The nucleic acid content of the bands placed close to the heterochromatic regions in such rearrangements and of their normal homologues has been measured by a photographic method[1]. An increase occurs, which is greatest close to the heterochromatic regions, and less farther away (Fig. 1). Due to the occurrence of deficiencies of various sizes (short ones prevailing in the presence of an extra *Y*-chromosome[4 5,3], longer ones without a *Y*) it has been possible to show that the closer a given band is to the heterochromatic region, the greater the augmentation of its nucleic acid content. It seems not unlikely that the increase in nucleic acid is an intermediate stage between the normal condition and the loss of a band.

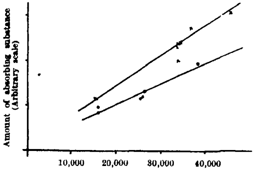

Fig 3

COMPARISON OF THE AMOUNT OF SUBSTANCES ABSORBING ULTRA-VIOLET LIGHT AT 257Mμ IN THE OOCYTES OF AN *XX*- AND AN *XXY*-FEMALE

Crosses represent the values from *XXY*, points those from *XX* ovaries The *XXY* values are consistently higher

The cytoplasm of the egg gives further evidence of a correlation between nucleic acid metabolism and variegation. Its absorption spectrum in the ultraviolet (Fig. 2) measured by a photo-electric method[1] shows the presence of a high concentration of substances containing the pyrimidine ring (hence related to nucleic acid)—a situation similar to the high concentration of nucleotides reported in marine eggs[6] A comparison of the amounts of such substances in the oocytes of *XX*-females and of *XXY*-females (Fig 3) shows an increase due to the presence of the extra *Y*-chromosome. It is known that the presence of an extra *Y*-chromosome in the mother results in the appearance of less variegation in her progeny[7]

These results show effects of the heterochromatic chromosome regions on the nucleic acid content of bands in the same chromosome (in genetical terms, a position effect), on the nucleic acid content of bands in other chromosomes; and on the amount of substances related to nucleic acid in the egg cytoplasm. They suggest that the apparent genetically inert character of these regions is merely the consequence of their specialization in performing a function also performed by all other genes—namely, the synthesis of nucleic acid. The relation of these regions to the variegation, taken together with the local appearance of nucleic acid in the chromosomes, suggests that the synthesis of nucleic acid is closely connected with gene reproduction. The structure-forming properties of thymonucleic acid[8], and its ability to form high-molecular weight polymers[9], as well as the correspondence of its X-ray diffraction pattern with that of the proteins[12], suggest a basis for this function.

These considerations have an especial interest in the case of the other self-reproducing molecules—the viruses and the bacteriophage—all of which have been shown to contain nucleic acid[10,11]. Moreover, in the inactivation of the bacteriophage by ultraviolet light, the curve for the efficiencies of the different wave-lengths does not agree completely with that of the bacteriophage, but does with the nucleic acid absorption spectrum It seems hence that the unique structure conditioning activity and self-reproduction, possibly by successive polymerization and depolymerization, may depend on the nucleic acid portion of the molecule It may be that the property of a protein which allows it to reproduce itself is its ability to synthesize nucleic acid.

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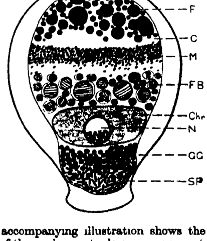
Effect of Ultracentrifuging on *Nebela collaris* Leidy (pro parte)

IN *Nebela collaris*, the cytoplasmic bodies are the glycogen granules, chromidium, mitochondria, one to two contractile vacuoles and sudanophil fat.



The accompanying illustration shows the stratification of the various cytoplasmic components according to their specific gravity after ultracentrifuging. Fat (*F*) and the contractile vacuoles (when present) being lightest, occupy the centripetal position. There follow in turn a clear cytoplasmic area (*C*), the mitochondria (*M*), numerous food-bodies (*FB*) and the chromidial substance (*Chr.*) which contains the nucleus (*N*) near its lower limit. The nuclear contents have collected towards the heavy side of the cell The glycogen granules (*GG*), which have been displaced from the chromidium, lie above the shell plates[1] (*SP*), which, as the heaviest component of the cell, occupy the extreme centrifugal position

It is interesting to note (particularly in this case where a chromidium is present) that no homologue of the Golgi apparatus appears to exist in *N collaris* and that the contractile vacuoles do not blacken with osmic acid even after prolonged periods

Singh[2], working on *Amœba proteus* Y found no homologue of the Golgi apparatus and also that the contractile vacuole did not blacken even after prolonged treatment with osmic acid

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[2] Singh B N NATURE **139** 675 (1937)

Eocene Beds in Waziristan

I SEE that Dr Heron[1] now accepts the fact that Ranikot beds exist in Waziristan The evidence for this is, indeed, overwhelming, as I have pointed out elsewhere[2] He says, however, that Dr Coulson could not state whether the Khirthar overlaps on the Ranikot to the north of Kotkai, so perhaps I may be allowed to quote my own observations

Middle Khirthar (Lutetian) beds to the north, in Waziristan unquestionably overlap on the Ranikot (Paleocene), all intermediate elements, including the Lower Khirthar, being locally absent

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[1] *Records Geol Surv Ind* **73** 83 (March 1938)

[2] *C R S S Soc Géol France* fasc 2 22 23 (Jan 1938)

Points from Foregoing Letters

DR C V DRYSDALE outlines some novel views on the nature of electrical fields of force in connexion with the flux cutting equations, which he advocates in order to facilitate the teaching of Maxwellian theory He considers that an uncharged body is surrounded by two equal and opposite electric fields, and that a linear current must be surrounded by two opposed electric fields moving translationally past each other, and being thus equivalent to a magnetic field This picture is further elaborated to account for Drude s dispersion theory, Fresnel s drag coefficient and the electro magnetic wave propagation

From observations made in the South Island of New Zealand on radio fadeouts, auroras and magnetic storms which occurred on January 20–22 and 24–26, Prof F W G White, H F Skey and M Geddes conclude that in higher latitudes a radio fadeout may be due to ultra violet radiation emitted during an eruption, or may be due to ionization by the particle radiation causing the auroras They estimate the time interval from the solar eruption to the commencement of the aurora to be about 33 hours

By means of an arrangement which allows the formation and the destruction of a thin liquid film of helium II upon a surface of known area, and allows the measurement of the amount of helium taking place in this process, A K Kikoin and B G Lasarew find the density of the helium film to be 2 to 3 × 10^{-6} cm The viscosity of the film is much higher than that determined by Kapitza for liquid helium II in bulk The heat transfer in the film is high, but may depend upon surface evaporation

Dr C Møller suggests that the part of the nuclear forces which cannot be accounted for by the idea of the heavy electron can be derived from the supplementary assumption of a heavy neutral particle with properties very similar to those of the photon

A G Gaydon and Dr R W B Pearse give the approximate positions of the heads of the strongest bands in the spectrum of RbH, obtained by means of an electric discharge through a mixture of rubidium vapour and hydrogen, and they calculate the approximate values of its molecular constants

A table showing the change with time in the extent of surface films of the protein gliadin is given by G I Jenkins and T W J Taylor The authors calculate the average density during the first 70 minutes to be $1\ 22 \times 10^{-7}$ per gm /sq cm This value decreases with time owing to contamination of the film with surface active impurities The experiments do not confirm Mitchell's sharp transition point in the region of 1 to 2 dynes/cm per cm

Tables giving the duration of the œstrogenic effects of several œstradiol and triphenyl ethylene compounds, administered orally or by subcutaneous injections, are submitted by Dr J M Robson, A Schönberg and H Ahmad Fahim Triphenyl chlor ethylene given subcutaneously has a more prolonged action than œstradiol benzoate

Peeled potatoes and cabbages cooked in water containing 1 per cent of common salt appear to retain their ascorbic acid (vitamin C) better than vegetables cooked without salt, according to experiments by A Høygaard and H Waage Rasmussen Sodium chloride is known to inhibit the oxidation of ascorbic acid

Treatment of root cuttings of sea kale for twenty hours with a solution of α naphthalene acetic acid leads to the formation of roots both apically and basally, while the removal of about 1 mm of tissue from base and apex every five days for eight weeks produces buds at both ends This, Prof R H Stoughton and W Plant point out, indicates that the initial differentiation of meristematic tissue is determined at least in part by the local concentration of growth substances

Differences from the normal values in the nucleic acid content of the salivary gland chromosomes in races of *Drosophila melanogaster* exhibiting variegation have been demonstrated by Prof T Caspersson and Dr J Schultz by optical methods Taken together with other data on viruses and chromosomes, the present results suggest the possibility that nucleic acid synthesis is characteristic of self-reproducing molecules

Lieut Colonel L M Davies states that Middle Khirthar (Lutetian) beds unconformably succeed Ranikot (Paleocene) ones in northern Waziristan.

Research Items

Physical Fitness

IN a paper contributed to the recent British Medical Association meeting, Prof. E. P Cathcart of Glasgow discussed the various factors that go to form the basis of physical fitness (*Brit Med J*, August 6, p. 273). We require to keep a broad and open mind on the problem of how best to achieve fitness—just as there is no one cause of unfitness, so there is no one solution. It will not be achieved merely by satisfaction of the needs of the body, for malnutrition of the spirit is quite as common as malnutrition of the body, and the one reacts upon the other. Discipline is essential for right living, and right living means health. As regards actual factors, muscular activity in the form of physical training is necessary, but must be of the right kind, and posture and carriage are important; but these vary to some extent for the two sexes and for different individuals. The dietary aspect was briefly considered. There is evidence that meat is not essential, and perfect fitness may be acquired on a diet of brown bread, milk, butter, cheese, fresh fruit and salad, provided it is adequate. For heavy work, fat appears to be an important source of energy Sugar and carbohydrates are known to be important sources of energy; but apparently are not immediately available, but have first to be converted into glycogen, so that Krogh *et al.* suggest that in sporting events the athlete should have two days' rest before the contest to secure a complete filling up of the glycogen stores of the body.

South American Head Hunters

THE Jivaro Indians of eastern Ecuador have long been notorious for their custom of preparing shrunken heads as trophies of their enemies killed in battle Much inaccurate information has been recorded concerning them, and their method of preparing the shrunken heads has been shrouded in much unnecessary mystery. The literature relating to their culture, including early Spanish records hitherto somewhat neglected, has been analysed and sifted by Dr W. M. Stirling, and supplemented by ethnographical material obtained in the field in 1930–31 (*Smithsonian Institution Bull*, 117; 1938) The Jivaro, who live scattered over an area of approximately 25,000 sq. miles, are everywhere of similar appearance physically, speak a single language, and their customs, beliefs, and material culture are closely interrelated. They live in small independent groups, for the most part on the head waters of tributary streams of the rivers running through their territory. The groups are constantly at war with one another Their intelligence, fine physique and independent air creates a favourable impression on the visitor. In the study of supernatural beliefs, war customs, and head-hunting, it is demonstrable that their practice, in common with other cultural traits, is not peculiar to them, but was formerly typical over a wide area in the northern Andes. Apparently the blow-gun is a post-Columbian introduction. The high civilization of the Andes at the beginning of the sixteenth century differed from the rather primitive culture of the Jivaros mainly in superficial aspects. A study of the Jivaros to-day and of the ancient tribes of the western Andes, as viewed in historical perspective, seems to indicate that they merely represent different degrees of development from a common cultural background. As regards head trophies, a number of actual examples have been recovered from graves of the ancient culture in the Nasca region These were not shrunken, though there is evidence that the people preparing them had either made shrunken heads themselves or had been in contact with a people who followed that practice. They still skewered or sewed the lips, though this process was not necessary in mummification

Chinook Culture

THE Lower Chinook have been assumed since the last decade of the nineteenth century to be extinct One member of this people furnished Dr. Boas with information in 1890–91 In 1930 Mr Verne F Ray was informed of the survival of two other members, both women of considerable age The material obtained from them by Mr Ray in two expeditions to the Willapa Bay region and the lower Columbia River have been embodied in a series of ethnographic notes (*Univ Washington Pub in Anthrop*, **2**, **2**; 1938) The name Chinook is derived from a Salishan term of the Chehalis dialect, and although the Chinook themselves have no designation for a larger political unit than a village, there is reason to believe that the people of the villages north of the Columbia River did use the term in self-reference, even before the appearance of the whites The Chinook in the early nineteenth century occupied both sides of the river for a distance of fifty miles from the mouth The term Lower Chinook is here used to designate the people of Willapa Bay and the lower river. The population in 1806 was estimated at 1,100. After the smallpox epidemic of 1853 it numbered one hundred. The Chinook lived in villages, each of which was autonomous under a chief The people were divided into upper class and lower class, with a class of intermediates, composed of wealthier members originating from the lower class, and the less energetic and unambitious, or remoter relatives, of the upper class. Class feeling was strong. There was a slave population, which relieved the housewife from the more onerous duties of domestic life. Most of the slaves were obtained by purchase from surrounding peoples The habitat was dominated by the two great connecting bodies of water, Willapa Bay and the Columbia River On these most villages were situated and most travelling was done. The region belongs to the Humid Transition plant life area, and was well supplied with trees, vegetation and animal life. It is probable that few areas of the world could have provided a more desirable habitat than that occupied by the Chinook.

Hydrodictyon in South Africa

ALGOLOGISTS will be glad that Miss Pocock is following her treatise on *Volvox* by studies of other algæ of the South African vleis. She has now given a description of first-hand observations of two species of *Hydrodictyon* (*Trans. Roy. Soc. South Africa*, **24**, Part 3; 1937). Most of the paper is concerned with *H. patenaeforme*, sp. nov., a species formerly referred to *H. reticulatum* or *H. indicum*, but now separated on account of the saucer shape of the nets and the smaller number of component coenocytes; in this connexion, Miss Pocock points out that these might be features of a permanent youth form of *H. reticulatum*, and in this case the South African plant may be only a form of the latter species associated with the absence of asexual reproduction under the local conditions. The photographs and description of the germinating polyhedra are very clear, and it is of interest that the angular thickenings of the wall are absorbed into the membrane during expansion. The whole process of zoospore and net formation was observed to take place rapidly during the first five hours following midnight. The processes of gamete formation and copulation were observed and the author emphasizes the enormous number of gametes produced. The gametes come into contact laterally and fuse whilst still actively motile, forming bi-ciliate zygospores, which also remain active for some time. In *H. africanum* asexual reproduction has not been seen, but reproduction by gametes is similar to that described for *H. patenaeforme*. The separated coenocytes, commonly occurring in the later stages of the alga, appear to have no reproductive function.

Poultry and Poultry Manure

The maintenance of grassland for poultry and the value, storage and utilization of poultry manure is the subject of an interesting bulletin by A. W. Ling and W. R. Muir (Bull. 20, Dept. of Agric. and Hort., Univ. of Bristol). Although it is only within recent years that attention has been paid in Great Britain to grassland in relation to poultry, the improvement that can be brought about on poor pasture by a folding system is now well known, it being possible to convert old down-land into a second-grade cow pasture in twelve months. The method as practised on the drier calcareous soils of the West Country consists of a number of fold units, each containing twenty-five adult birds, the folds being moved daily so that a single unit covers one acre each year. By this system the land is not fouled, the droppings are deposited evenly without loss of soluble constituents and the land is subjected to intense mechanical treatment. As regards the effect of the grass on the poultry, the birds are kept clean and provided with green vegetable matter and protein, but it is essential that the herbage be kept short, by other stock or the mower if necessary, for tufted, rank grass has but little feeding value and is refused by the birds. Frequent liming of land folded to poultry is essential, both to correct soil acidity and to counteract the excessive nitrogenous deposits, ground burnt lime at the rate of 1–2 tons per acre per annum being an average dressing. Moreover, lime in this form will act as a useful disinfectant. Potash as kainit (3 cwt. per acre every fourth year) is also recommended, as intensive poultry penning upsets the balance between phosphate and potash in the soil. The bulletin concludes with practical advice, derived from carefully conducted experiments as to the best utilization of poultry manure.

Pulp Materials

A review of the pulp and paper resources of the Empire (*Bull. Imp. Inst.*, 36, No. 2) directs attention to the general question of raw materials for the paper and allied industries that depend on timber. The outlook stresses the importance of research on new materials. The world consumption of pulp is rapidly growing. It is required not only for paper and various kinds of boards but also for rayon, 'Cellophane', plastics and lacquers. There are, however, indications that the demand for lumber as apart from pulp is slightly diminishing and so affording some relief on forest resources. In Europe, the Scandinavian countries can hold their own by wise afforestation, but cannot materially increase their output of pulp. The U.S.S.R. has vast untapped forests, but her own demands grow as transport improves and Russia is not likely to expand greatly her export. The Canadian forests will be fully taxed to meet the growing requirements of American newsprint. Newfoundland is increasing her export, but on the whole it is clear that the Empire in particular and the world in general urgently requires new pulp resources. Attention is directed to the possibilities: bamboos and other grasses, waste materials such as sisal waste, cotton stalks, rice straw, etc., and various tropical timbers. Any potential material must be available in large quantities, at low cost in a reasonably accessible area.

Advance and Retreat of Glaciers

The complicated relations between climate and the advance and recession of glaciers have recently been discussed by Prof. H. W. Ahlmann and Mr. S. Thorarinsson in an article on the Vatnajökull Glacier (*Geog. Rev.*, July). It is generally accepted that a maritime, in contrast to a continental, climate is favourable to glaciation but, the writers point out, there is a limit to the extent that maritime conditions favour glaciation. That limit is reached when the influx of humid and mild air compensates increasing accumulation by extending the ablation period. Unless a temperature reduction ensues, the glaciers will begin to waste. It is thus obvious that in differing altitudes of mountain regions various glaciers react differently to minor climatological changes: some recede while others advance. In regions with a continental climate a reduction of temperature is probably accompanied by a diminution of precipitation and so by a recession of glaciers, which, however, may leave room for the invasion of glaciers from adjacent regions where precipitation is more active and where the reduction of temperature, by checking ablation, has allowed the glaciers to grow. Another factor of importance is the thickness of the glacier. Deglaciation decreases thickness and, in time, causes rapid marginal recession. The land thus laid bare of ice reacts on the local climate and a change ensues apart from any general climatic change. Conversely the spread of glaciation may in time check the advance of humid winds and so put a stop to the advance and even promote the recession of the ice.

Soil Erosion in East Africa and Australia

The problems of soil erosion in Tanganyika have recently been discussed at length by the director of agriculture (Tanganyika Territory, 1937: Report by H.M. Government to the Council of the League of Nations. H.M. Stationery Office. 4*s*.). While not denying that soil erosion in certain areas is a serious menace, the director points out that the greater part of the territory is not seriously menaced by this threat, since the cultivated soil area is only about one thirtieth of the whole, and he calculates that, taking all causes into account, not more than one tenth is really in danger. Overstocking of grazing land is one source of this danger, but from the native point of view is frequently a necessary evil. Land with persistent vegetation favours ticks, flies and worms which harm livestock. Overstocking promotes aridity which reduces the incidence of parasitic disease, and thus is favoured by native stockowners even at the risk of occasional losses from starvation It is admitted, however, that something might and ought to be done to prevent or at least discourage overstocking. It is noted also that the tsetse-fly, by infesting grazing lands, may cause overstocking of other lands, while in some cases it decreases stock to the extent of promoting the spread of vegetation and so checks soil erosion While various methods of fighting soil erosion are advocated, most stress is laid on educative and legislative measures to govern all cultivation. The subject of soil erosion in general and its cure is also discussed at length, especially in reference to Australia, by Prof Macdonald Holmes in "The Meaning of Soil Erosion" (University of Sydney Publications in Geography No 1 Price 2*s* 6*d*).

Earthquakes and the Surface Structure of the Earth

KATSUTADA SEZAWA has recently published a paper on the amplitudes of Rayleigh waves with discontinuities in their dispersion curves (*Bull* Earthquake Res. Inst, Tokyo Imperial University, 16, Pt. 1; March 1938) In this, he follows up an earlier investigation by himself and Kiyoshi Kanai in which they obtain formulæ exhibiting the relation between the thickness of a surface layer and the amplitudes of dispersive Rayleigh waves, by calculating tables to show that the discontinuity in these dispersion curves does probably exist. The particular case considered is one in which a stratum has beneath it material which is considerably stiffer, and the results therefore apply to waves transmitted along a surface stratum up to a few hundred metres thick In such a case the ratio of wave-length to thickness of the layer is large, and the surface displacement is mainly horizontal when the usual Rayleigh waves are considered. If, however, an earlier phase of the waves the equation of which is obtained by the authors is considered, then a transmission of bodily waves of large vertical displacement should be expected. A similar, though probably more general investigation has been carried out by Stoneley-Rayleigh waves in a heterogeneous medium (*Mon. Not. Roy Astro. Soc.*, Geophys. Supp, 3, No. 6; May 1934) This work is more general in its applicability to the actual conditions existing on the earth. It can be applied to a heterogeneous layer resting on a homogeneous substratum, or to conditions in which the rigidity of the strata vary linearly with distance from the plane of junction.

Petroleum Fuels in Canada

A FURTHER bulletin (No. 789) has now been issued by the Canadian Department of Mines giving statistics of petroleum fuels delivered for consumption in Canada during the year 1936. These statistics are directly comparable with those issued by the same Department for the years 1933, 1934 and 1935 (Nos. 772 and 780). In 1936, 1,213 million Imperial gallons of petroleum products were delivered in Canada for fuel, the total being made up of 555 million gallons of fuel oil, 34 million gallons of kerosene and 624 million gallons of gasolene. In addition, more than 45 thousand short tons of petroleum coke were delivered for the same purpose. More than 89 per cent of fuel oil (as compared with 85 per cent in 1935) was processed in Canadian refineries, the remainder consisting of imported fuel oil. Of this, more than 22 per cent was used for domestic heating, 28 per cent for industrial heating and power, 6 per cent for tractor fuel and 44 per cent for rail and water transportations Kerosene deliveries in 1936 again represented only one thirty-third of the aggregate of all petroleum fuels. In fact, more than 1¼ million gallons less kerosene were delivered than in 1935 67 per cent of the total was used for domestic heating, cooking and lighting, 30 per cent for tractor fuel and 3 per cent for miscellaneous uses The sales of gasolene in 1936 showed an increase of nearly 50½ million Imperial gallons as compared with 1935.

Detection of Hydrogen Cyanide

LEAFLET NO 2 of "Methods for the Detection of Toxic Gases in Industry" (Department of Scientific and Industrial Research, price 5*s*. 6*d* net) deals with hydrogen cyanide. Leaflet No. 1 (price 3*s* 6*d*) dealt with hydrogen sulphide The leaflet No 2 describes a method of detection of hydrogen cyanide which consists in drawing air by means of a hand-pump through a test-paper impregnated with Congo red-silver nitrate or benzidine-copper-acetate, which are capable of detecting concentrations down to 1 part in 100,000 by the production of characteristic stains, specimens of which are included on a card with the leaflet.

Thermal and Photochemical Decomposition of Mercury Dimethyl

RECENT papers from Prof H S Taylor's laboratory at Princeton on exchange reactions involving the simpler saturated hydrocarbons have indicated the importance of the reaction $CH_3 + H_2 \rightarrow CH_4 + H$ as an intermediate process. In order to obtain information regarding the energetics of this reaction the thermal and photochemical decompositions of mercury dimethyl [$Hg(CH_3)_2$] have been studied by J. P. Cunningham and Prof. H S Taylor (*J. Chem. Phys* 6, 359, 1938) The thermal decomposition does not proceed at measurable speed below 290°. Above this temperature $Hg(CH_3)_2$ alone yields a complex mixture of methane, ethane and a carbonaceous deposit, most probably a polymer of CH_2. Addition of hydrogen accelerates the decomposition but now the products consist almost solely of methane and there is no carbonaceous deposit Photochemical decomposition, from 50° to 300°, in the absence of hydrogen, gives practically nothing but ethane below 200° but, in the presence of hydrogen, methane is formed at all temperatures and the higher the temperature the greater the amount of methane formed. The processes involved are the photo-decomposition of the dimethyl to give free methyl radicals [$Hg(CH_3)_2 \rightarrow 2CH_3 + Hg$] which combine to give ethane [$2CH_3 \rightarrow C_2H_6$]. The methane formed is accounted for, in the presence of hydrogen, by the reactions $CH_3 + H_2 \rightarrow CH_4 + H$; and $H + Hg(CH_3)_2 \rightarrow Hg + CH_4 + CH_3$ and, in the absence of hydrogen, by

$$CH_3 + Hg(CH_3)_2 \rightarrow CH_4 + CH_2HgCH_3$$

$$CH_2HgCH_3 \begin{array}{l} \nearrow CH_2 + HgCH_3 \\ \searrow CH_2 + Hg + CH_3 \end{array}$$

$$CH_3 + CH_3 \rightarrow CH_4 + CH_2.$$

The influences of temperature, pressure, and surface on the nature and amounts of products have been noted. The activation energy of the reaction $CH_3 + H_2 \rightarrow CH_4 + H$ is 9 ± 2 kgm.-cal.

Royal Society of Canada

Ottawa Meeting

THE annual meeting of the Royal Society of Canada was held in Ottawa on May 24–27, under the presidency of Prof. A. G. Huntsman of the University of Toronto. Twelve new fellows were elected in the scientific sections, and Dr. Victor Morin of Montreal was elected president for 1938–39.

Dr. Huntsman's presidential address, "The Problem of Life", considered the life-history of the salmon, following which it discussed philosophically the relation between the physical universe and mental processes.

MATHEMATICS, CHEMISTRY AND PHYSICS

The meetings of Section III (Mathematical, Chemical and Physical Sciences) were held under the presidency of Prof. R. H. Clark, who gave the presidential address to the Section on enzyme activators, in which he pointed out evidence suggesting that the action of such chemical materials as hormones, vitamins and bios manifests itself through the activation of some enzyme or bacteria. In all, ninety-nine papers were presented of which about half were given by title only. Among the papers read by the fellows, mention may be made of that by Prof. S. Beatty "On the Cycles of an Algebraic Equation $f(x) = 0$ Relative to Infinity" and "The Stability of Plane Poiseuille Motion" by Prof. J. L. Synge. Prof. R. L. Jeffrey indicated in a paper on "Integration in Abstract Space" the essential difference between the theories of Bochner and Birkoff. A paper of some practical importance in determining the lateral support of towers supported by guy wires was read by Prof. I. W. Campbell. Mr. R. Meldrum Stewart gave an interesting account of the new time signal clock which has been installed at the Dominion Observatory which embodies the two special features of possessing robust electrical contacts and an arrangement for synchronization directly from a precision sidereal clock. A discussion of the results of observations made at Ottawa on the redward shift of spectral lines near the solar limit was presented by Dr. R. E. DeLury.

Among the papers read in the chemical section by Dr. E. W. R. Steacie, mention may be made of one "On the Mercury Photosensitized Decomposition of Ethane" in collaboration with N. W. F. Phillips in which the reaction was traced by separate steps from C_2H_6 to C_2H_2. A series of nine papers were presented by Prof. O. Maass and his associates dealing with viscosity measurements, rates of reaction, specific heat and density measurements of various gases and liquids in the critical temperature and critical pressure region. Prof. W. Lash Miller gave further results of experiments on Wilders' bios. Dr. W. H. Barnes in collaboration with H. B. Yuen presented a translation of an interesting Chinese paper on the Chinese alchemist T'ao, the recluse.

Among the papers dealing with physical topics, Prof. J. S. Foster and Dr. A. Vibert Douglas presented the results of an investigation on the analysis of the Stark effect in helium lines in type *B* stars in which it was shown that the absorption which occurs between the known *d* and *f* lines could not be explained on the basis of laboratory experiments, Doppler effect, relative intensity changes in absorption as compared with emission, or collisional damping. Prof. J. A. Gray gave the analysis of the gamma rays of radium D and radium E in which he showed that Ra E emits no primary γ-rays but 1·5 per cent of the disintegrating atoms emit a secondary γ-ray; which varies in energy from a few thousand volts to a million volts. Prof. J. Satterly gave the results of further investigations of the inclined water jet which definitely disprove Levi-Civita's original theory.

Among the papers communicated by Prof. E. F. Burton special interest was shown in a paper on the measurement of the velocity of sound in liquid helium at ultra-sonic frequency at temperatures ranging from 4·2° to 1·7° K. The velocity varied from 180 to 230 m./sec. over this range. In another paper, by H. E. Johns and J. O. Wilhelm, the refractive index of liquid helium I at 4·2° K. with λ 5461 was found to be 1·0206 ± 0·0012 and for He I at 2·26° K., 1·0269 ± 0·0004. Prof. A. L. Clark and L. Katz described a method of measuring the specific heats of gases by a modified form of the Assmann method. Prof. J. K. Robertson and R. H. Hay gave the results of experiments on the removal of wall deposits from tubes carrying high-frequency discharges and Dr. E. A. Hodgson indicated evidence of the variation in the thickness of the earth's crust from a study of earthquake records. Prof. L. Gilchrist and associates presented papers on applied geophysics, in which the use of drill holes for the central electrode method may be mentioned. Prof. D. A. Keys and H. G. L. Watson gave the results of experiments in the Slocan district of British Columbia using the Broughton-Edge radiometer method and a modification of this arrangement for locating conducting veins of galena.

Prof. W. H. Barnes of McGill, Dr. Ralph E. DeLury of Ottawa and Prof. J. A. McRae of Queen's were elected fellows in Section III.

GEOLOGY

In Section IV, embracing the geological sciences, twenty-three papers were presented. The presidential address by E. S. Moore was on "Some Problems of the Canadian Shield". Prof. Moore, among other things, discussed the Pre-Cambrian granites, the Couchiching problem, and the questions relating to life in the Pre-Cambrian. In another paper he reviewed the problem of the Steep Rock Series, and gave as his conclusion that at Steep Rock Lake, the Steep Rock and the Seine are the same series.

Four interesting papers were given on glaciology. J. T. Wilson described an area in south-western Nova Scotia in which some 2,300 drumlins occur. They can be identified and mapped from air photographs. They are related to slate bedrock and form the good agricultural land of the area. G. W. H. Norman described the last Pleistocene ice front in Chibougamau district, Quebec, and J. T. Wilson the moraines, beaches and large eskers in a neighbouring region of the same province drained by the Harricanaw and Bell Rivers The papers throw considerable new light on the late Pleistocene history of this region R L Rutherford presented some aspects of glaciation in southern and central Alberta

Six palæontological papers were presented Alice E Wilson gave an account of some gastropods from Akpatok Island, Hudson Strait which had been collected by the Cambridge Oxford expedition of 1931 They include twenty species, ten of which are new, and permit certain correlations with the Manitoba Red formation F H McLearn gave an account of the Triassic faunas of the Peace River foothills and R T D Wickenden presented a paper prepared by F H McLearn and himself on some Cretaceous maps of the Canadian interior F M Kindle described the Devonian succession at the eastern end of Gaspé peninsula, and made certain correlations with the Devonian succession as exposed in Matapedia valley A paper by V J Okulitch on some Black River corals was read by title J A Allan described some occurrences of Cambrian rocks in Sunwapta Valley, Jasper Park, Alberta, and L S Russell gave a description of the skull of Hemipsalodon Grandis a giant Oligocene creodont, and showed illustrations of his restoration

L Gilchrist presented a theoretical study of a useful collection of equivalent magnets as an aid to the magnetic exploration of ore bodies J S DeLury discussed his views regarding the significance of association of rock and ore

M Y Williams presented a paper on submarine channels and orogenic movements along the coast of British Columbia Deep channels extend across the continental shelf for a distance of at least 50 miles from the shore line The profile of these valleys suggests a downwarping of the coastal region and verifies the geological conclusions of the existence of a land mass, Cascadia, which is believed to have disappeared beneath the sea during the Miocene

L S Russell presented his views concerning the origin of the sandstone dykes of south eastern Alberta An earlier theory that the material forming the dykes was forced up from below was not accepted Russell believes that the dyke material was introduced from above or from the side during Tertiary times J A Allan described how a relief model of the province of Alberta was prepared and told of its geological applications He also gave a short paper describing a seiche at Yellowknife Bay on Great Slave Lake which occurred while he was there last summer

A paper by N. B Keevil was read describing the application of the helium method of age determination to granites His determinations diminish considerably the commonly accepted figures for the length of geological times

BIOLOGY AND MEDICINE

Prof V E Henderson's presidential address to Section V, entitled "The Search for a Perfect Anæsthetic", consisted of a review of the anæsthetic problem and a critical discussion as to the qualities and shortcomings of some of the more commonly used general anæsthetics, such as ether, chloroform and nitrous oxide. It will be recalled that as a result of work in Prof. Henderson's laboratory in 1930 cyclopropane was introduced and has received world wide approval as a general anæsthetic possessing qualities which the older anæsthetics lack.

Frère Marie Victorin of the University of Montreal discussed certain aspects of the relic flora of Canada, and submitted that earlier views concerning this flora must be modified somewhat more importance being attached to post glacial migrations of various kinds

Mr A E Porsild of the National Museum considered the flora of Little Diomede Island, Bering Strait, pointing out, as a matter of particular phytogeographical interest, that a comparatively large number of circumpolar species common to both sides of Bering Strait do not occur on the island

Dr D C McPherson, University of Toronto, reported that air space development in the root cortex of maize resembles that in certain water plants, in that cortical cells die and their walls collapse leaving the spaces the death of the cells has proved to be due to inadequate oxygen supply

Miss Helen Farley and Prof A H Hutchinson, University of British Columbia submitted an account of ovule development in certain alfalfa hybrids

Prof R B Thomson pointed out that, in the pollen cone of the yew the radial stamen is derived from two stamens of the dorsi ventral type He also discussed the seed cone scale structure of conifers, showing how the *Taxus* or one sided line, and the pine or two sided line have evolved from the araucarian ancestral type

Dr J Ansel Anderson of National Research Laboratories reported that the superiority in malting quality of O A C 21 barley over Wisconsin 38 appears to be varietal in nature and independent of malting method

Dr R Darnley Gibbs, of McGill University, described seasonal changes in the composition of white birch trees on the Island of Montreal Sucrose is the main winter storage form of carbohydrates and doubtless plays an important role in frost resistance

Prof E M Walker showed that the remarkable insect *Grylloblatta* has closer affinities with the *Saltatoria* than other Orthopteroid groups, despite certain primitive features suggestive of the Plecoptera

A contribution from Prof C McLean Fraser, University of British Columbia, considered the distribution of the boreal hydroids, coming in from the polar region as well as those indigenous, to the Pacific area adjacent to Canada and the United States and of the tropical or subtropical species coming in from the south or indigenous to this same area

Dr E Horne Craigie reported an investigation of vascularization of the hypophysis in tailed amphibians, indicating a relation between folding and blood supply only by a superficial plexus

Dr R C Sniffen, Mr H L Collins and Miss H E Williams have been engaged under the direction of Sir Frederick Banting upon researches relating to silicosis Silicosis is caused by the inhalation of rock dust (siliceous dust) which leads to gradual destruction of the delicate tissue of the lungs, and is one of the gravest hazards which north Canadian miners have to face The method of control which shows the greatest promise is one involving the mixing of aluminium dust with the air of the mine Aluminium dust itself is innocuous, and experiments upon animals indicate that it actually neutralizes the poisonous action of the siliceous dust

Three years ago, Dr D A Scott of the Connaught Laboratories made the discovery that certain metals, zinc, cobalt, nickel, etc , are closely associated with the chemistry of insulin, and that in order to obtain crystals of the hormone at least one of these metals must be present in the animal material (beef pancreas) from which the insulin is extracted. In a paper read at this year's meeting of the Society, Drs Scott and Fisher reported on the preparation of nickel insulin crystals; these were found to contain about 0·4 per cent of nickel. Dr Scott's researches have an important practical bearing for it was soon found that zinc, like protamine (a protein material obtained from salmon sperm), prolongs the action of insulin. The improved product, protamine zinc insulin, is now in general use for the treatment of diabetes. This preparation has the great advantage over the older ones in that, owing to its prolonged action, less frequent dosage is required to control the disease—a fact cordially welcomed by the diabetic patient.

An interesting series of experiments on coronary artery thrombosis was described in a paper by Dr C H Best and Dr D Y Solandt. Coronary thrombosis was produced in animals by the injection of a chemical (sodium ricinoleate) into the neighbourhood of one of the main arteries. The electrical changes in the heart during the period of survival and the microscopical appearance of the heart muscle after death were studied.

The researches of Dr P J Moloney and his colleagues in the Connaught Laboratories, as reported in a paper entitled "The Detoxifying Action of Human Bile", reveal the fact that diphtheria toxin is innocuous after being treated with human bile.

Drs W R Campbell and M I Hanna have found that the proportions of the different proteins in the plasma of all healthy persons are approximately the same, nor are they altered in most diseases. In some instances however, they vary in such a way from that seen in health as to be of valuable assistance in recognizing certain diseases.

Dr J K W Willard, in the course of some experiments in British Columbia, accidentally injected some plant hormone into his hand. A tumour developed near the tiny wound. Fortunately it was an innocent growth.

Astronomy's Debt to Photography

THE *Photographic Journal* of April contains the thirty third Traill Taylor Memorial Lecture entitled "Photography in the Exploration of the Universe" which was delivered by the Astronomer Royal Dr H Spencer Jones, on October 19 last when he was presented with the Traill Taylor Memorial Medal of the Royal Photographic Society.

Dr Spencer Jones began by describing the modern photographic method of determining the distances of the nearer stars. From a single plate taken with the Greenwich 26 inch refractor, giving a scale of 30″ = 1 mm, the probable error of the position of a star whose parallax is being determined is about 0·024″ which is equivalent to about 0·0008 mm. The probable error produced by local distortions in the gelatin film does not usually exceed 0·0003 mm, a fact which shows how eminently suitable the photographic plate is for the measurement of minute parallactic displacements given by the changing viewpoint of the earth in its annual journey around the sun. The only visual method of parallax determination comparable in accuracy with photographic methods is that of the heliometer, which in the hands of Bessel one hundred years ago yielded with considerable accuracy one of the first three stellar parallaxes to be successfully determined. It is estimated, however, that the output of results by photographic methods is increased by a factor of 15, since the actual micrometric measures are made at any convenient time subsequent to the taking of the photograph.

At stellar distances equivalent to 400 light years, the trigonometrical method of measuring the distances of the stars breaks down, because the quantities to be measured become increasingly smaller than the probable errors of measurement, microscopic though the probable errors have been reduced to by the most scrupulous attention to every detail. For the determination of stellar distances beyond what is merely the fringe of near-by space, the astronomer makes use of the unique properties of the Cepheid variable stars, which are found not only in the star clusters of our own stellar system (some 120 000 light years in diameter) but are recognizable in the nearer and resolvable extra galactic nebulæ whose unit of distance from us is a million light years. The discovery of the period luminosity relation (which makes the Cepheids criteria of distance), announced by Miss Leavitt in 1912 and extended by Hertzsprung and Shapley was made possible by a series of photographs of the Magellanic Clouds. The yet greater distances of the spiral nebulæ whose stellar structure is beyond resolution into individual stars can be determined by extrapolating the empirical relation found between distance and radial velocity, given by Doppler shifts, of the nearer systems. The photography of the spectra of these faint objects ranging up to 250 million light years away is a veritable *tour de force*. At the focus of the telescope their images are invisible, and the setting of the slit of the spectrograph has to be made in each case by means of a near by star in the field of view whose angular distance from the nucleus of the nebula is obtainable from long exposure direct photographs.

Honours in this triumph of observation have, of course, to be shared between the photographic plate, the giant telescopes employed, the special camera lens (such as the Rayton or the Bracey lens) and the ingenuity and patience of the astronomer. From statistical results of apparent magnitudes, it is deduced that the most distant systems that can be recorded on long exposure direct photographs, on special emulsions of high threshold sensitivity, taken with the 100 in reflector at Mount Wilson, are at a distance of about 500 million light years. Within a sphere whose radius is equal to this limiting distance, it is estimated by Hubble from counts taken from photographs that there are about 100 million stellar systems—veritable universes that are units of the cosmos. A number of slides shown during the lecture and in part reproduced in the article, illustrate the perfection of results given by the photographic plate in recording the Milky Way, gaseous nebulæ, star clouds and individual star clusters, and the remote extra galactic nebulæ.

Coal Carbonization in the Public Service

SO many articles have appeared during recent years on the subject of coal carbonization and the problem is now so interconnected with political issues that one is apt to lose sight of the basic fact which should determine its technical and economic development.

Mr. E. V. Evans, in a lecture delivered at the Royal Society of Arts, on March 2, made the position abundantly clear. Coal and oil resources which are being exploited to-day took millions of years to accumulate. These resources are being used at an immeasurably greater rate than that at which they were formed and for this reason alone none of them should be wasted, no matter in what countries they are situated. It may be that in future years new types of liquid fuel will be produced from different raw materials to meet the ever-increasing demand for that commodity. At present, however, that consideration does not arise and the process of carbonization should be judged finally on its capability or otherwise of husbanding such natural resources of coal and oil as are known to exist to-day.

Carbonizing and electricity generating industries are each capable of contributing substantially towards conservation of natural resources. As a general rule, in the gas industry to-day the thermal energy of coal is distributed into coke, gas and tar in the proportions of 70 : 25 : 5 respectively. Actually 23 heat units of coke are used in the carbonizing process and therefore the thermal efficiency of the process is approximately 77. On the face of it, it would appear that coal has not been saved but the products obtained are more efficient in use, with the result that in the aggregate a greater thermal efficiency is achieved. Moreover, a certain amount of tar and sulphate of ammonia is obtained and a social benefit conferred by the elimination of atmospheric pollution.

The electrical industry has achieved striking results during recent years. In 1917, 3·7 lb. of coal was required to generate one unit of electricity, whereas to-day approximately 1·48 lb. of coal will do the same work. In addition, centralization of power generation has effected great economies. Nevertheless, there is still a tendency among consumers to regard electricity as a very convenient form of fuel and not as a means of transmitting mechanical power. In converting heat energy to mechanical energy approximately two thirds of the original heat energy of the coal is sacrificed. It is definitely uneconomic to use electrical energy for heating purposes. Actual figures can be adduced to show that the capital expended by the electricity companies is two and a half times as great per equivalent ton of raw coal as it is for the gas companies. Each of these industries provides an important public service and the most valuable contribution they can make is to collaborate with each other and be less competitive. There is a great field for expansion of the electrical industry in provision of mechanical power to save human effort, but provision of domestic heat should be the charge of the gas industry.

Special Steels in Marine Engineering

IN response to an invitation to place before the members information concerning the modern special steels with the aim of simplifying their task in availing themselves of the latest metallurgical products, Dr. T. Swinden, director of research to the United Steel Companies, Ltd., delivered before the North East Coast Institution of Engineers and Shipbuilders, on February 25, a paper in which he surveyed the developments of recent years in this sphere. Although his remarks were in many instances more particularly pointed to their applications in hulls, marine boilers, superheaters and engines, his review of the chemical and physical properties of special steels, their amenability to heat treatment, their weldability and their resistance to corrosion and embrittlement were of even wider interest to the engineering profession.

Dealing first with the carbon and low-alloy steels, Dr. Swinden explained the present position as to their special characteristics and then proceeded to enumerate the properties of the more highly alloyed steels which are of increasing importance in engine construction. In addition to comprehensive data of an orthodox character, special attention was given to the subject of fatigue and notch sensitivity, and tables showing results of research on these were included among the many numerical data which the paper contains. From a series of tests on a variety of steels ranging from 20 to 70 tons tensile, it was shown that while the fatigue limit on plain specimens is related approximately to the maximum stress, the notch sensitivity is related roughly to the ductility as measured by elongation. Surface hardening in its various aspects was treated in some detail, the several methods of case carburizing, cyanide hardening, the Shorter process, the Tocco surface hardening process and the nitriding process being discussed and their most favourable applications indicated. Dr. Swinden also dealt with the properties of steels made for use at elevated temperatures, and introduced a discussion on creep and creep strength. As a reliable value on which to base design, he commented on the safe working stress indicated by the stress relaxation method of testing for creep.

Finally, after some notes on stainless steel, Dr. Swinden discussed the possibilities of a stainless-faced composite material which consists of mild steel with a facing of about 20 per cent stainless steel. The method of production admits of the combination of plate material with any variety of stainless steel, resulting in a perfect union between the two metals. This material is extensively used in the United States and, as the author stated, one can readily visualize many purposes in shipbuilding and marine engineering where it could be used with advantage and with definite economy as compared with solid stainless steel.

Scientific Research and Social Well-being

IN his University Research Lecture, 1935–36, delivered at the University of Colorado, O. C. Lester, discussing the development and present status of graduate study and research in the University of Colorado, emphasized the importance of the spirit which animated the Graduate School and the attitude of the faculty to original creative work. The University of Colorado Studies was started chiefly as a medium for the publication of original work by members of the faculty and has been the chief medium of exchange with other universities, and gives important encouragement to creative work by affording a medium for publication.

Another obligation of the university to society is to maintain the supply of trained investigators, and the University's research fellowships and scholarships are designed to assist in discharging this obligation. It is not easy to evaluate the contributions of the faculty to research or other forms of creative scholarship, but the increasing demand for advanced work has led to the appointment of a Council of Research, one of the recommendations of which has led to the inauguration of an annual research lecture, of which Mr. Lester's is the first.

In the remainder of his lecture, Mr. Lester discussed the relation of research, the university and the social order, and particularly the question whether scientific research workers should not modify their traditional attitude of being concerned only with discovery and not with its results to society or with the social consequences of scientific progress in general. The purpose of research is the betterment of human life, and on the whole that has been its effect. Apart from the comforts and conveniences beyond the reach of the rich a hundred years ago which are now possible for the average person, research has led to the eradication or alleviation of many ills of the body. Better understanding of the many factors affecting the health and vigour of both body and mind has led to the development of preventive measures which are becoming more and more effective. Reviewing briefly the organization and support of research, he stressed the supreme importance of the university in fundamental research, both as affording the right opportunity and atmosphere and in maintaining an adequate supply of investigators. The problems of modern civilization are too numerous, too varied, too complex to be solved by a few men, however capable, and the number of research workers, their technical training and the resources at their command required increasing in proportion.

Mr. Lester does not agree that we should be better off if much of our modern science and the appliances growing out of it were scrapped. If scientific advances have disturbed and continue to disturb the economic *status quo*, the remedy lies rather in attaining comparable and co-ordinating progress in the general field of the social sciences. Failure of progress here is indeed largely due to the inability of those who have reached well-founded conclusions to get a hearing, or even to unreasoning opposition to change. We need research on how to use the results of research for the general good, and in such work universities are well qualified to take a leading part. Not merely the general good but also scientific and industrial progress depend on a better social balance. Patchwork emergency methods and methods of political expediency are wholly inadequate for solving complex social problems and must be abandoned for thoughtful planning based upon thorough investigation.

Some French Industrial Laboratories

THE University of Algiers has a small, but well-equipped, industrial testing laboratory under the direction of Prof. L. Vérain, professor of physics in the University. In a lecture entitled "Les Laboratoires industriels", delivered by Prof. Vérain, it is recorded that in 1935, some eight hundred certificates were issued by the Laboratory, the fees received being 56,000 francs.

The Laboratory's interests are many sided: electrical standards, electrotechnics and photometry; a wind tunnel; hydraulics; heat engines and refrigeration plants; the testing of wood, metal, cements, concretes, plasters and road materials; thermal conductivity; acoustic insulation; absolute pressure; viscosity; and X-rays. In connexion with the testing of accelerometers, it is remarked that in Germany a car which cannot decelerate at not less than four metres per sec. per sec. is the subject of penalties if used after warning.

In his lecture, Prof. Vérain remarks that industrial laboratories date from the latter part of last century, when scientific methods were introduced into industry, and he traces their utility in the various stages of development of a process, or in the manufacture of a material or other product. Large works, especially chemical, metallurgical or engineering, commonly have their own laboratories.

In France, the first industrial laboratory was that of the École Nationale des Ponts et Chaussées, the chemical laboratory of which was opened in 1831. The city of Paris set up an engineering laboratory in 1869, and its specifications are still accepted by other organizations. The Laboratoire d'Essais du Conservatoire National des Arts et Métiers, founded in 1900, has five departments, but is not concerned with electrical measurements, for which a laboratory was founded in 1888, under the direction of the late M. Janet. This latter includes a radio laboratory, an engineering testing laboratory, and a co-ordinating office. The French Standards Association (AFNor) has issued some 800–1,000 standards, which may be contrasted with the 5,000 prepared by the corresponding German association.

British Association at Newcastle-on-Tyne in 1838

ON Saturday, August 18, 1838, a meeting of the General Committee of the British Association was held at Newcastle-upon-Tyne preliminary to the formal proceedings of the Association, which began the following Monday and lasted the whole week Eighty members of the committee were present, and owing to the Earl of Burlington being absent on the Continent the chair was taken by Prof Whewell Among other matters it was recommended that collectors should be appointed in places where the meetings of the Association were in future held, and that they should be allowed a percentage of the subscriptions they received

The deaths of Prof. Moll, of Utrecht, and Dr Bowditch, of Boston, U S A, were announced, and it was stated that the Council had elected Prof Dumas and Prof. Liebig foreign members The report touched on the difficulty experienced in finding a qualified person to report on the effects of voltaic and thermal electricity, the question of international copyright, astronomical observations at Madras, and tidal observations, and also the laws regulating the constitution of the General Committee A discussion took place on the last matter, and it was proposed that the committee should consist of (1) the officers of the Association past and present and authors of papers prepared by direction of the Association, (2) members who had contributed a paper to a philosophical society on a subject taken into consideration of the Association; (3) delegates from philosophical societies publishing transactions; (4) delegates from philosophical societies in towns in which the Association met; and (5) foreign and other distinguished individuals whose presence might be deemed advisable

As was its usual custom, the *Athenæum* devoted much space to the doings of the Association, and in referring to the industrial establishments in the district it spoke of the collieries, ironworks, glass, soap, and colour manufactories, the locomotive works of Robert Stephenson and Co, and those of R and W. Hawthorn, where members would be able to see a Harrison patent locomotive with 10 ft driving wheels. Special reference was made to the bridge or viaduct on the Shields Railway, at Ouseburn, which was "of immense magnitude as regards both length and height". At Walker were to be seen the alkali works of Losh, Wilson and Bell, which deserved the attention of the chemist not only on account of their completeness but also because the head of the firm, Mr. William Losh, was "the father of soda-making on the Tyne". There were 250 tons of crystallized soda made per week, besides 400 tons of alkali or soda ash.

According to the *Athenæum*, the general arrangements for the meetings were excellent and nothing had been neglected to ensure a pleasant, a brilliant and a profitable meeting. "The commonalty, however, arguing from these expensive preliminaries, seem to have anticipated a Congress of Princes, or an aggregation of *millionaires*, and in many instances to have increased the rent of their lodgings at least five hundred per cent." Though such attempts were frustrated by the local members, this recurrence should be guarded against in the future, "the limited incomes of scientific men, generally not admitting of these extravagances".

Societies and Academies

Edinburgh

Royal Society, July 4.

JAMES GREGORY TERCENTENARY CELEBRATION Prof H W Turnbull. James Gregory, and his Unpublished Discoveries Prof. F. Enriques. Piccole note su James Gregory e il suo soggiorno in Italia Profs. M Dehn and E Hellinger · On James Gregory's "Vera Quadratura". Dr Adolf Prag: On James Gregory's "Geometriæ Pars Universalis"

Ordinary Meeting on July 4

C VANEY Note sur les Crinoïdes de la *Scotia* The collection is a small one, and only a part is here described Species mentioned are. *Isometra vivipara* Mortenson (Burwood Bank); *Ilycrinus australis* Clark (lat 62° 10′ S, 41° 20′ W. in 1,775 fathoms), and a new species, *Ptilocrinus brucei*, described from two specimens (lat. 64° 48′ S, 44° 26′ W. in 2,485 fathoms, and lat 52° 10′ S, 41° 20′ W in 1,775 fathoms)

H D SLACK · The association of non-homologous chromosomes in Corixidæ (Hemiptera-Heteroptera) The examination of twenty species of aquatic bugs of the family Corixidæ has revealed an unusual type of association of chromosomes during spermatogenesis in three species This consists of the fusion of terminal or sub-terminal regions of chromosomes which are not homologous pairs It is first seen at early meiotic prophase and lasts until repulsion forces separate the bivalents at diakinesis, the heterochromatic material uniting the chromosomes being drawn out into fine threads which eventually break. Owing to this association of non-homologous chromosomes, relational coiling of homologues appears to be partially interrupted, but in other respects the course of meiosis remains unaffected.

L C COMRIE and ANN B. ADAM: The female reproductive system and corpora lutea of the False killer whale, *Pseudorca crassidens* Owen. From specimens stranded in the Tay Estuary, 1935, a description is given of the female reproductive system of fœtal, immature and mature animals. Particular reference is made to the corpora lutea, and from their numbers and condition it is tentatively suggested that the age-range of the specimens is 2–20 years

N GALPIN · Factors affecting postnatal growth of brown Leghorn chickens The postnatal growth of brown Leghorn chickens is influenced both by the season of the year at which the eggs are laid, and by the individuality of the parent birds. The seasonal variation shows the same trend as do those of hatching weight and of maternal thyroid weight.

J. P. CHU · Studies on plumage in the male brown Leghorn fowl. A detailed investigation of feathering order, and of changes in feather pattern and structure between hatching and maturity, in the male brown Leghorn fowl. Experimental data indicate that the changes in plumage type are largely dependent on variations in the level of thyroid activity.

D. M. S. WATSON: On *Rhamphodopsis*, a Ptyctodont from the Middle Old Red Sandstone of Scotland: The paper gives a relatively full account of the structure of the whole skeleton of a small Ptyctodont, which shows that the group contains essentially normal Arthrodeiss, peculiar in the reduction of the body armour. Two types of pelvic fin occur, presumably in the two sexes of a single species.

W P Kennedy Seasonal trends of births in Scotland The seasonal incidence of conceptions in Scotland was examined for the period 1880 1935 and a regular seasonal variation was found from year to year the peak of the curve falling in summer the trough in winter On correlating the mean daily conceptions per month with the mean temperature of the month a positive correlation coefficient of 0 671 was found When the period is split into decades the individual correlations do not differ significantly from each other and indeed are remarkably consistent It is considered that there is a real relationship between temperature and the conception rate The higher the mean monthly temperature in Scotland the greater the chances of conception The average range of seasonal difference from the mean of the year is ± 9 per cent

Paris

Academy of Sciences June 20 (*C R* 206 1841–1932)

Henri Deslandres The universal constant of band spectra Attribution of the lines of the band to causes other than the rotation of the molecule

Alexandre Guilliermond and Roger Gautheret The action of Nile blue and cresyl blue on yeasts The reduction and excretion of these colouring matters by yeasts

François Grandjean Suppression of organs in the evolution of a homeotype series

Robert Esnault Pelterie The yield of thermal machines

Charles Pisot Some rational approximations characteristic of algebraic numbers

Henri Laugier and Mlle Dagmare Weinberg An attempt at the factorial analysis of marks in examinations for degrees Relations between the marks of the different written tests

Bernard d Orgeval A construction of multiple planes representative of algebraical surfaces of genera 1

Robert Potier Abstract spaces with affine connexion

Frédéric Roger Certain types of ensembles of zero magnitude

Ayzyk Gorny Indefinitely derivable functions

Nikola Obrechkoff Integral functions limits of polynomials the zeros of which are real and interlaced

Edmond Brun The measurement of the pressures on a body in rotation in air

Louis Viaud The study in a wind tunnel of the aerodynamical characteristics of some supporting arrangements placed near the soil

Louis Goldstein The mechanism of activation of atomic nuclei

Victor Naggiar A new method of measuring the surface tension of liquids

André Raskin The realization of a high tension generator with large yield

Nicolas Bezssonoff and Mme Mélanie Woloszyn The oxidation reduction potential developed by solutions of vitamin C in the presence of oxygen

Ernest Baumgardt The velocity of propagation of elastic waves in piezo electric crystals

Jean Paul Mathieu The optical properties of stratified cholesteric substances

Pierre Barchewitz and Maurice Parodi A spectrometer with a wire grating for the study of the extreme infra red The apparatus described serves to study the spectral region 20 μ–100 μ with an accuracy of about 1 μ

Mme Arlette Vassy and Etienne Vassy An experimental method for the comparison of the absorption of light by the lower atmosphere and by the total atmosphere

Mlle Suzanne Veil Some circumstances relating to the co precipitation of silver bromide and chromate

Mme Léone Walter Lévy Contribution to the study of the magnesium halogen carbonates

Léon Jacqué The action of hydrogen on the carbides of iron and chromium The iron carbide Fe_3C loses carbon when heated in hydrogen At a temperature of 550° C and under a pressure of 100 kgm /cm ² the whole of the carbon is removed in 50 hours The chromium carbides Cr_3C_2 Cr_7C_3 and Cr_4C_2 treated with hydrogen under the same conditions show no appreciable loss of carbon

Mlle Marie Cécile Bailly A simple and almost quantitative method for passing from the β to the α glycerophosphates On boiling a solution of the β salt with dilute sulphuric acid (4 per cent) over 90 per cent is converted into the α salt

Yves Volmar and Ernest Weil The action of antimony trisulphide on the acid alcohols

André Demay The granites microgranites and rhyolites from the eastern extremity of the massif of Guéret and particularly on the existence of tourmaline in certain rhyolites

Robert Laffitte The presence of Operculines in the formation known as pisolithic limestone in the Paris basin

Jean Pierre Rothé The Belgian earthquake of June 11 1938

Henri Grisollet Study of the light diffused by particles in suspension in the air

Gabriel Lucas The *Cancellophycus* of the Jurassic are Alcyonaria

Robert Hoffstetter The presence of Elapidæ represented by a new genus in the French Neogene

Jean Renaud The division of the nucleus of yeasts in the course of budding evidence of a centrosome and of mitosis

Roger Heim The stelliform cells of the Aphyllophorales

Pierre Chouard The formation of absorbent skins on the epidermis of the leaves of *Begonia Rex* in relation with the application of hetero auxines

G Jeanneney and G Ringenbach The density of the blood and transfusional shock

Emile Brumpt and Achille Urbain A curious verminous disease with Acanthocephalæ, endemic in the monkey house of the Museum Efficacious prophylactic measures taken with a view of arresting the disease

A Donatien and F Lestoquard The evolutionary of some *Rickettsia*

Amsterdam

Royal Netherlands Academy (*Proc* 41 No 6, 1938)

F A Vening Meinesz Second order disturbance terms (Browne terms) in pendulum observations at sea A further experimental determination of these terms with the aid of apparatus installed in a submarine

A de Kleyn Some remarks on vestibular nystagmus

J G van der Corput Contribution to the additive theory of numbers (4)

J A Schouten The relations between the geometrical quantities in an X_n and in an X_m embedded in the X_n

J A Schouten and J Haantjes The differential geometry of groups of contact transformations (4) Covariant derivatives in the $K_{2n\,1}$

A A Nijland Mean light curves of long period variables (31) γ Cassiopeiæ The period of this star is 417 8 days and the amplitude is 4 29 magnitudes (32) R V Pegasi Period 388 0 days amplitude 4 96 magnitudes (33) R Z Pegasi Period 437 1 days amplitude 4 33 magnitudes

W A Mijsberg Peaks occurring in frequency curves of the cephalic index and their supposed significance in indicating the component races and subracial groups underlying the population (1) Exposition of the problem

G C E Burger and H C Burger Determination of the rate of infection in tuberculosis

C S Meyer Contributions to the theory of Whittaker functions

K Mahler A theorem on inhomogeneous Diophantine inequalities

P G Molenaar Differential covariants of the first order of the binary cubic differential form

H G Bungenberg de Jong Behaviour of microscopic bodies consisting of biocolloid systems and suspended in an aqueous medium (1) Pulsating vacuoles in coacervate drops (2) Formation of doubly refractive membranes on gelatin gel globules by tannin

Annie M Hartsema and Ida Luyten Early flowering of the narcissus *N pseudo narcissus* var King Alfred

L J J Pop Protoplasmic streaming in relation to spiral growth of *Phycomyces*

H Knipscheer On Cretaceous Nerineas from Cuba

A de Buck The exochorion of the *Stegomyia* egg

J Lubbers Direct endophotography

Washington, D C

National Academy of Sciences (*Proc* 24 229–251 June 15 1938)

W J Robbins and F Kavanagh Evidence for a second thiamin

D L Fox and C R Moe An astacene like carotenoid from a Pacific coast anemone *Epiactis prolifera* This orange red anemone owes its striking colour to a red acidic carotenoid present entirely in esterified form, and apparently similar to acid carotenoids found in other anemones by Heilbron *et al*

Berta Scharrer and E Hadorn Structure of the ring gland (corpus allatum) in normal and lethal larvæ of *Drosophila melanogaster* During development, growth of the ring gland takes place by increase of size of cells , in lethal larvæ, both gland and cells are smaller than in normal Hence retardation of puparium formation in lethals' may be due to under-development of the ring gland

R Brauer Normal division algebras of index 5

H Bateman Lift and drag functions for an elastic fluid in two dimensional irrotational flow

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (CAMBRIDGE MEETING)

Wednesday, August 17

At 8 30 p m —The Rt Hon Lord Rayleigh F R S Part I Vision in Nature and Vision aided by Science (Presidential Address in the Regal Cinema) Part II Science and Warfare

Thursday, August 18

At 10 a m —Prof N Bohr For Mem R S Dr J D Cockcroft F R S Prof W Bothe Dr P I Dee Dr N Feather Nuclear Physics (Symposium Section A)

Prof C S Gibson F R S Recent Advances in the Chemistry of Gold (Presidential Address Section B with an introduction by Sir William Pope)

Dr S W Kemp F R S Oceanography and the Fluctuation in the Abundance of Marine Animals (Presidential Address Section D)

Prof Griffith Taylor Correlations and Culture a Study in Technique (Presidential Address Section E)
Prof R V Southwell F R S The Changing Outlook of Engineering Science (Presidential Address Section G)

Prof F Wood Jones F R S D F Thomson Prof A R Radcliffe Brown Australia (Symposium Section H)

Prof W Stiles F R S The General Physiology of the Plant Cell and its Importance for Pure and Applied Botany (Presidential Address Section K)

Sir Richard Gregory Bt F R S and H G Wells Report of the Committee on the Content of School Curricula

C S Orwin Prof J A Scott Watson S J Wright Dr F Kidd Agriculture in Relation to National Employment (Discussion Section M)

S E Urwin and W G Newton D Clarke Hall W D Seymour Tendencies in the Design of Schools (Discussion Section L)

At 11 10 a m Prof R A Fisher F R S Dr C C Craig H W Norton Dr W J Youden F Yates W L Stevens Combinatorial Mathematics in the Design of Experiments (Symposium Section A*)

At 11 15 a m —Dr F G Mann Prof L O Brockway Prof N V Sidgwick F R S Recent Advances in the Organic Chemistry of the Metals with Special Reference to the Noble Metals (Discussion Section B)

Dr H Godwin Dr W A Macfadyen H L P Jolly Dr J G D Clark C W Phillips and Prof H H Swinnerton The Post Glacial History of the Fenlands (Joint Discussion Sections C and K)

D W Young A P Long A I Felton J Macdonald A H Popert W H Guillebaud The Cultivation of British Hardwoods (Symposium Section K*)

At 11 30 a m —Prof A G Ogilvie Prof H J Fleure, F R S J McFarlane Prof C B Fawcett R H Kinvig The Scientific Delegation to India 1937–38 Geographical Impressions (Section E)

At 5 15 p m —Prof C S Gibson F R S Dr F G Mann H V Thompson and Dr F H Brain Demonstration in Section B lecture room on the production of gold films by chemical methods

Friday, August 19

At 10 a m —Dr J J Fox Prof W Gerlach, Prof F Feigl Dr Janet Matthews Dr K K Nygaard and Dr Th Guthe Modern Methods of Chemical Analysis (Symposium Section B)

Dr C G Darwin F R S 'Logic and Probability in Physics (Presidential Address Section A)

Dr C. J Stubblefield, Dr. G L. Elles, Dr W K Spencer, F R.S , Dr A Lamont "The Distribution and Migration of Certain Animal Groups in the British Lower Palæozoic Fauna" (Discussion Section C)

Prof D M. S Watson, F R S , Dr. P D F Murray, Dr J S. Huxley, Prof. R A Fisher, Prof A E Trueman, J. Z Young, Capt C Diver "The Mechanism of Evolution" (Joint Discussion Sections D and K) R. F. Harrod "Scope and Methods of Economics" (Presidential Address Section F)

A T Marston, Prof W B. R King, M A C Hinton, F R S , C F. C Hawkes, Sir Arthur Keith, F R S , Prof W E Le Gros Clark, F R S "The Swanscombe Find" (Symposium Section H).

Dr R H. Thouless "Eye and Brain as Factors in Visual Perception" (Presidential Address Section J) J Sargent "The Proper Function of Administration in Public Education" (Section L . Presidential Address) Prof F G. Stapledon : "Ley Farming and a Long-term Agricultural Policy" (Presidential Address Section M).

At 11 a m —W H Robinson, Ruth Dawson, Dr P. T Freeman, Muriel Davies "Education for a Changing Society Senior and Secondary Schools" (Discussion Section L)

At 11 15 a m —Prof E T Whittaker, F R S , Dr W G. Bickley, Dr J C. P Miller, Dr A. J Thompson "From Function to Printed Table Some Aspects of the Work of Preparing a Table of a Mathematical Function" (Section A*)

At 11 20 a m.—Prof W L Bragg, F R S , Dr. E C Stoner, F R S , Dr A J Bradley, Dr W. Sucksmith, D A Oliver "Magnetic Alloys and X Ray Structure" (Symposium · Section A)

At 2 p m —M. C Burkitt, Sir Arthur Keith, F R S , Dr. F E Zeuner, Miss D A E Garrod, A L Armstrong, Dr K P Oakley, T T Paterson "The Middle Palæolithic" (Symposium Section H).

At 2 15 p m —Prof F T Brooks, F R S , Dr E B Worthington, Dr W B Turrill, Dr. W H Thorpe, Dr C. D Darlington, Dr D G Catcheside "The Mechanism of Evolution" (Joint Discussion, continued Sections D and K)
The Right Hon The Earl of Onslow "The Importance of National Parks in the Preservation of the Flora and the Fauna of Great Britain" (Presidential Address to the Conference of Delegates of Corresponding Societies)

At 8 30 p m —Dr H Godwin · "History of the Fens" (Evening Discourse).

Saturday, August 20.

At 10 a m —Prof P M S Blackett, F R.S , Prof. W H. Furry, Prof E Regenor "High-Altitude Cosmic Radiation" (Symposium Section A).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

ESTABLISHED CIVIL ENGINEERING ASSISTANTS in the Roads Department, Ministry of Transport—The Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W C 2 (August 15)

METEOROLOGICAL OFFICER CADETS in the Eire Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (August 16)

TECHNICAL OFFICER in the Chemical Defence Experimental Station, Porton, near Salisbury—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (August 17)

ASSISTANT (grade III, mathematics or physics) in the Aeroplane and Armament Experimental Establishment, Martlesham Heath, Suffolk—The Under-Secretary of State, Air Ministry (S 2.D), Adastral House, Kingsway, London, W C 2 (August 19)

ASSISTANT (grade II) in the Air Ministry headquarters—The Under-Secretary of State, Air Ministry (S 2 D), Adastral House, Kingsway, London, W C 2 (August 19)

LECTURER IN CHEMISTRY AND LECTURER IN ENGINEERING in the Hull Municipal Technical College—The Director of Education, Guildhall, Hull (August 20)

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Bradford Technical College—The Principal (August 20)

LECTURER IN PRACTICAL MATHEMATICS AND PHYSICS in the Heanor Mining and Technical School—The Clerk to the Governors, 30 Mansfield Road, Heanor (August 22)

LECTURER IN CHEMISTRY in the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (August 24)

TWO OFFICIALS (one in African agriculture and one in South American agriculture) in the International Institute of Agriculture, Rome—The Secretary (September 15)

LECTURER IN ELECTRICAL ENGINEERING in the Royal Technical College, Salford—The Director of Education, Education Office Salford, 3

Reports and other Publications

(not included in the monthly Books Supplement)

Other Countries

Allahabad University Studies Vol 13 Arts and Sciences Pp iv + 256 + 90 + 8 plates 7 8 rupees Vol 14 Arts and Sciences Pp v + 249 + 174 + 11 plates 7 8 rupees (Allahabad The University) [147

U S Department of the Interior Office of Education Bulletin, 1937, No 3, Supplement No 1 Public Affairs Pamphlets , an Index to Inexpensive Pamphlets on Social, Economic, Political and International Affairs Pp iii + 67 10 cents Bulletin, 1937, No 12 Some Factors in the Adjustment of College Students By David Segel and Maris M Proffitt (Project in Research in Universities) Pp vi + 49 10 cents Vocational Education Bulletin No 192 (Trade and Industrial Series No 54) Training for the Public-Service Occupations By Jerry R Hawke Pp viii + 82 20 cents (Washington, D C Government Printing Office) [267

Proceedings of the United States National Museum Vol 85, No 3033 Evidence of Triassic Insects in the Petrified Forest National Monument, Arizona By M V Walker Pp 137–142 Vol. 85, No 3034 Review of the Annelid Worms of the Family Nephtyidæ from the Northeast Pacific, with Descriptions of Five New Species By Olga Hartman Pp 143–158 (Washington, D C Government Printing Office) [267

League of Nations Convention for Limiting the Manufacture and Regulating the Distribution of Narcotic Drugs of July 13th, 1931 Historical and Technical Study by the Opium Traffic Section of the Secretariat of the League of Nations (Official No C 191 M 136 1937 XI) Pp xxxix + 299 (Geneva League of Nations , London George Allen and Unwin, Ltd) 7*s* 6*d* [267

Government of India Department of Labour Triennial Review of Irrigation in India, 1933–36 Pp ii + 63 (Delhi Manager of Publications) 1 14 rupees , 3*s* 3*d* [207

Publications of the South African Institute for Medical Research No 43 Pneumococcus Types in South Africa , a Study of their Occurrence and Distribution in the Population and the Effect thereon of Prophylactic Inoculation By David Ordman Pp 27. (Johannesburg South African Institute for Medical Research) [267

Canada Department of Mines and Resources Mines and Geology Branch, Bureau of Mines Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1937 (No 785) Pp iii + 158 The Canadian Mineral Industry in 1937 (No 791) Pp iv + 100 25 cents (Ottawa King's Printer) [267

India Meteorological Department Scientific Notes, Vol 7, No 77 Distribution of Heavy Rainfall over India By V Doraiswamy Iyer and Mohammad Zafar Pp 109–118 + 5 plates (Delhi Manager of Publications) 12 annas , 1*s* 3*d* [267

South Australia Department of Mines Mining Review for the Half-Year ended 31st December 1937 (No 67) Pp 120 + 4 plates (Adelaide Government Printer) [267

U S Department of the Interior National Park Service Fauna of the National Parks of the United States, No 3 Birds and Mammals of Mount McKinley National Park, Alaska. By Joseph S Dixon Pp xii + 236 (Washington, D C . Government Printing Office) 35 cents [267

Cawthron Institute, Nelson, New Zealand Annual Report, 1937 Pp 24 + 5 plates Cawthron Lecture 1937 Science as an Aid to World Culture and Civilization By Dr H G. Denham. Pp. 22 + 8 plates. (Nelson · Cawthron Institute) [267

Department of Scientific and Industrial Research, New Zealand Meteorological Office Note No 18 Some Comparisons of the Invigorating Effect of the Climate in Different Parts of New Zealand By Dr W A Macky Pp 10 + 1 plate. Meteorological Office Note 20 Visibility and Upper Winds at Auckland, Wellington and Christchurch By L N. Larsen. Pp 28. Meteorological Office Note No 21 Climatological Observations at Eastbourne, Wellington, and some Comparisons. By Dr W. A. Macky. Pp. 16. (Wellington Government Printer.) [267

South Australia Department of Mines Geological Survey of South Australia. Bulletin No 17 Geology and Development of Ground Water in the Robinson Fresh Water Basin, Eyre's Peninsula Part 1. Geology and Hydrology, by Ralph W. Segnit; Part 2. Development, by J R. Dridan. Pp 95 + 8 plates. (Adelaide : Government Printer.) [267

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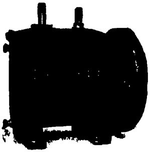

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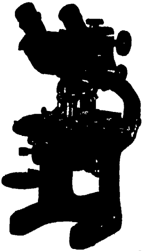

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The Significance of Vision for Scientific Progress

LORD RAYLEIGH'S presidential address to the British Association, which is printed in full in a Supplement to this issue of NATURE, is divided into two distinct parts under two titles The first part, dealing with "Vision in Nature and Vision aided by Science", is a masterly general survey of developments in this field, which have taken place largely within the last two or three decades. In simple and direct language—itself a model of what such a survey should be—Lord Rayleigh describes the fundamental aspects of human vision and passes on to review the various ways in which the mechanism of the eye, employed as a means of observation, has been supplemented. The use of lenses, the telescope, the microscope, cathode rays, X-rays, spectroscopy and colour vision, photography and the sensitization of photographic plates, the photo-electric detection of radiation and television are all touched on, the salient features skilfully emphasized and the limitations and prospects of development duly noted. This part of Lord Rayleigh's address will surely bring home the vital fact that the largest part of our knowledge of Nature has been obtained by the sense of sight, and will remind us that progress by this means is not yet exhausted but bids fair, indeed, to go forward to fresh discoveries.

Very important parts of knowledge come, we remember, by the interpretation of images obtained by various optical devices with or without intermediate detection or recording. They are generally found as two-dimensional records of some object-field, although by kinematography and allied methods, and by stereoscopy, the senses of movement and three-dimensional extension can be obtained. But it is probably true that the newer technical methods, for example, the ultra-violet microscope, the iconoscope, and the like have not been exploited to a tithe of their possibilities by those who might use them to the greater advantage. The tendency of biological workers to use the microscope more as an automatic machine, and less as a research instrument, has been regretfully commented upon by those in a position to know the modern way It is true that these methods are available, but they demand a certain training for use —a price which few are apparently willing to pay.

This is true in the extreme sense of the electron microscope, the invention which seems to open up a new world to more 'direct' observation We are, as Lord Rayleigh remarks, very far from the perfecting of such instruments , those who expect them to be sold at a cheap rate in instrument-makers' shops, and to be operated by the laboratory boy, will be disappointed. It will be necessary to recapture the spirit of the early microscopists, for whom the labour of grinding their lenses was not too tedious to be faced, although the difficulties now encountered with high-vacuum technique and the design of electron-optical lenses are quite of another character and not less formidable even to the most sophisticated The results obtained, especially in the microscopy of colloids, are extremely promising, and it seems almost certain that in some fields the method will far surpass anything possible to the optical microscope

"Seeing is believing", no doubt, but it is interesting to speculate how far 'seeing' can go, when the worlds to which we would penetrate are so far out of reach of feeling and the other senses which help to make up our world of experience.

Social and International Relations of Science

THE widespread interest in the social relations to science, which in Great Britain is witnessed, for example, by the founding of the new Nuffield College at Oxford, and of the National Institute of Economics and Social Research, London and elsewhere by the institution last year of the Committee on Science and its Social Relations by the International Council of Scientific Unions and which has since received striking manifestation at the Indianapolis meeting of the American Association for the Advancement of Science has largely been stimulated by the growing anarchy in the international sphere, whether economic or political The threat to freedom of thought inherent in the totalitarian States, the existence of which is indeed only possible through the application of scientific knowledge, provides one of the main stimulants The profound concern engendered everywhere by the increasing scale on which national energies and resources are being devoted to preparations for warfare even to the detriment of standards of living however, provides another source of such interest, both in the ranks of scientific workers themselves and in the population generally

It is, accordingly appropriate that a portion of Lord Rayleigh's presidential address to the British Association should be devoted specifically to the question of science and warfare Although he makes no claim to offer a positive contribution to the subject, at least his remarks should assist to dispel some of those misconceptions which impede that full contact and co operation between scientific workers and their fellow citizens which are essential to effective study or action

A right conception of the position and responsibility of science is a fundamental condition, and Lord Rayleigh's remarks should make it clear beyond question that the discoveries of science which have been utilized in warfare were made in no nefarious quest, and were indeed often laid aside by scientific men as of no practical value

Dismissing, therefore, the idea that scientific men are specially responsible for the application of fundamental discoveries of science to purposes of war, we can face the essential and wider problem of assisting a world anxious to accept the gift of science to make wiser use of the knowledge and powers which science can bring Lord Rayleigh, accordingly, referred to the proposal for the establishment of a Division of the British Association to deal with the social and international relations of science

The whole question has been dealt with very fully in NATURE in recent leading articles The object of the suggested Division, which of course like the various sections of the Association, would be responsible to the Council would be to further the objective study of the social relations of science The types of problems with which it might be called upon to deal would fall under the general headings of the effects of advances in science on the well being of the community, and the effects of social conditions upon advances in science The function of the committee organizing the Division would be to arrange meetings both at the annual meetings of the Association and elsewhere, to appoint speakers and to accept or reject communications It would furnish material for the information of the public co ordinate work dealing with the social relations of science both at home and abroad, and be prepared to act in a consultative capacity and to supply information It would accordingly establish relations with organizations and persons engaged in practical administration, and set up sub committees for executive purposes or for research, inquiry or co ordination

If the Division is to make any significant contribution to the solution of these questions however, the committee will require the widespread and unwavering support of all scientific workers Something more may be called for than the scientific investigation of social and international problems A resolution of the American Association pointedly refers to the inroads being made upon intellectual freedom, and it should be unnecessary to emphasize that freedom of thought and discussion are essential if the new Division is to function effectively Even if the organization of united action in that field falls outside the scope of the Division, it may at least serve to stimulate appropriate action or assist in bringing together professional associations both within and across national frontiers in defence of the most vital condition of the integrity and advancement of science itself

It should be remembered indeed that this is a matter not so much of knowledge itself as of wisdom and values. The advancement of science demands a certain immunity and tolerance to those engaged in scientific discovery and learning, and if the present threat to those liberties is to be resisted, scientific workers in their turn must recognize the normal conditions upon which such tolerance and immunity are accorded. Above all, they must be careful to maintain most scrupulously their intellectual honesty and independence of political pressure

The wise use of science, however, involves especially questions of ethics and values, and is linked up inextricably with the general conditions and standards of the society in which scientific workers are placed. In all such questions the new Division would offer a hope of corporate action in bringing the serious spirit of science to bear in fields and on problems too often the sport of political prejudice, and might well provide another vantage ground from which scientific workers might make their fitting contribution to the solution of the problems of modern society.

Ferns and Fern Allies

Manual of Pteridology
Edited by Dr Fr Verdoorn, in collaboration with A H. G. Alston, I. Andersson-Kotto, L R Atkinson, H Burgeff, H G. du Buy, C Christensen, W Döpp, W M Docters van Leeuwen, H Gams, M. J F. Gregor, M. Hirmer, R E Holttum, R Kräusel, E. L. Nuernbergk, J C. Schoute, J Walton, K. Wetzel, S Williams, H Winkler and W. Zimmermann. Pp. xx + 640 (The Hague Martinus Nijhoff, 1938.) 24 guilders

THE prodigious weight of this volume creates a desire for a light paper suitable for the reproduction of photographs It contains twenty-three chapters, varying much in length, a few in German, most of them well documented and illustrated, written by twenty authors The book is "primarily, but by no means exclusively, designed for the taxonomist who is anxious to improve his methods and broaden his outlook At the same time it offers to the general botanist working on the Pteridophytes the necessary fundamental facts about the group and a survey of the chief results of lines of investigation related to his own".

As Prof. Bower says in the foreword, the ferns and their allies on one hand and the mosses and liverworts on the other hand appear to be separated by a wide gap ; no living plants supply connecting links. He goes on to say that recently acquired knowledge of the oldest land-plants from Silurian and Devonian rocks has furnished some indication of possible transitional forms in the early stages of evolution. It is none the less true that the Bryophyta and Pteridophyta, including both extinct and recent genera, are two sharply contrasted groups. One may go farther and express the opinion that the study of ancient plants as a whole has been disappointing to searchers after missing links.

The first two chapters are by J. C. Schoute of Groningen, who contributes learned essays on morphology and anatomy which make severe demands upon the reader's power of concentration. In a concise historical introduction, Schoute pays a well deserved tribute to the genius of Hofmeister, whose famous paper of 1851 had the effect of a 'flash of lightning' We are reminded that Hofmeister expounded the theory of alternation of generations in three pages, he was master of a lost art! In an academic discussion of morphological conceptions, which contains much that is suggestive and provocative, due prominence is given to extinct types ; the author's views on the stigmarian 'roots' of *Lepidodendron* and *Sigillaria*, and their comparison with the subterranean part of *Isoetes* (quillwort), will be regarded by some botanists as heterodox.

The chapter on anatomy is less satisfactory as an exposition likely to be informative and stimulating to taxonomists who wish to know more about the ancestors of plants which are their special concern References to recent work on fossils are inadequate One would like to have a clearly written essay on, for example, the anatomical structure of the arborescent lycopods and calamites of the forests of the Coal Age as contrasted with the much simpler construction of their living allies. This criticism is equally applicable to other chapters in the volume ; authors, with few exceptions, seem to forget that they are supposed to address themselves to the general botanist. The chapter by S. Williams of Glasgow gives a well balanced and readable account of experimental morphology as an aid to the better understanding of form, development, and evolution. He adopts Prof. Lang's view that the individual development to adult structure is "the manifestation of the properties of the specific substance under certain conditions", and stresses the importance of more intensive research into the physico-chemical problems raised by the work of

Went and others on plant hormones. After quoting the dictum, "experiment cannot reconstruct history", Williams adds, with refreshing optimism "if, however, palæobotanical data and the results of comparative morphology are taken in conjunction with the data derived from experiment, then it may be found that the latter will form a useful contribution to a probable solution of evolutionary problems".

Mary J F. Gregor of Edinburgh gives a survey of work on associations with fungi and other lower plants ; the section on the fossil record is meagre , on the other hand, diseases of both generations in ferns and other Pteridophytes receive thorough treatment Prof Burgeff of Wurzburg contributes a valuable essay on mycorhiza including a particularly full account, with some admirable photographs, of the association of fungal mycelia with the prothalli of *Lycopodium.* This chapter will be of great use to teachers and advanced students A short chapter by W. M. Docters van Leeuwen is devoted to galls caused by mites and insects Cytology, exclusive of the nucleus, is dealt with by Lenette Rogers Atkinson of Amherst It is questionable whether a subject such as cytology can be usefully treated from the restricted point of view necessitated by the scope of this manual This doubt is also suggested after perusal of the chapter entitled "Karyologie" by W. Dopp of Marburg. It is pointed out that the high chromosome numbers and small size of the nuclei in some genera add greatly to the difficulty of investigating nuclear phenomena within the Pteridophyta. It may be, that despite lack of agreement in the nuclei of closely allied plants, additional information on nuclei and chromosomes will throw fresh light on natural affinity. I. Andersson-Kottö's chapter on genetics, which might have been written in less technical language, gives an interesting account of the comparatively small amount of genetical analysis so far undertaken, and directs attention to the promising lines of research presented by fern hybrids and facilitated by the relatively high degree of development of the sexual generation

Growth and tropisms are discussed by H G. du Buy of America and E. L. Nuernbergk of Freiburg : the influence of light on the development of prothalli, including the specific influence of different wave-lengths, is one of many subjects briefly treated. There is an interesting section on the physiological peculiarities of spermatozoids Karl Wetzel of Berlin contributes a chapter on "Chemie und Stoffwechsel" which is a storehouse of facts useful as a source of information for botanists having a knowledge of biochemistry. There are two chapters on the ecology of Pteridophyta : one on extra-tropical members of the group by H Gams of Innsbruck and the other by R. E. Holttum, director of the Singapore Garden Both contain much that is of general interest ; Dr Gams, like many ecologists, forgets that the ordinary botanist is not thoroughly familiar with the superabundant terminology of the subject. Mr Holttum has successfully accomplished the task of digging out references to the ecology of tropical ferns from general papers and has written a very readable and well-illustrated account mainly based on his own researches and observations in Malaya. The geography of Pteridophytes was entrusted to Hubert Winkler of Breslau who gives a good account of a fascinating subject His table of distribution is a little difficult to interpret. Max Hirmer of Munich contributes a well-informed and useful survey of the distribution of fossil Pteridophyta in space and in time ; like some other palæobotanists, he is a believer in continental drift.

Prof. J Walton of Glasgow and A. H G Alston of the British Museum give a concisely written and welcome classification of the Lycopodinæ, both fossil and recent R. Krausel of Frankfort writes with authority on the Psilophytinæ, a group of Silurian and Devonian plants which makes a special appeal to the ingenuity of botanists in search of origins and clues to phylogeny Chapters xviii and xix by Max Hirmer give concise and valuable descriptions of the two living genera of the Psilotinæ, *Psilotum* and *Tmesipteris*, and of the Articulatæ, including the single recent genus *Equisetum* and many extinct genera His account of the latter, though good, makes one wish that he had written an essay which would enable botanists to appreciate the difference between the Palæozoic articulate plants and the solitary living representative of the group.

Carl Christensen of Copenhagen provides a classification of the Filicinæ which is a noteworthy contribution towards a natural system. Fossil ferns and Pteridophyta *Incertæ sedis* are briefly treated by Max Hirmer . there is some overlapping in this as in other chapters between different authors and discrepancies in views that are unavoidable. Prof. W Zimmermann of Tübingen, in the final chapter, which is by no means easy reading, states his views on phylogeny. The Pteridophyta, with their long history and abundant remains preserved in rocks from the Devonian period onwards, would seem to offer an exceptionally rich harvest to students of evolution ; but on the whole they are disappointing. Some of the oldest genera differ too widely from any living types to throw much light on the early stages of evolution , others, from Mesozoic rocks, differ only in minor characters from genera that are still with us. The chapter contains much that is speculative much that is stimulating and yet as one reads it the question recurs Do we estimate too highly the value of these efforts of the imagination as guides to the course of evolution ?

The Manual of Pteridology is well printed and several of the comparatively few illustrations are excellent Its chief value is as a book of reference for teachers and advanced students Considered from the point of view of the editor as stated in the introduction it might have been made more generally useful had authors presented the results of recent research and adumbrated future lines of advance in a more readable less condensed and less technical form With few exceptions the editor s description of the book as a collection of essays is scarcely appropriate

Such criticism as the reviewer has made is not inconsistent with an expression of gratitude to the editor for this the latest of many services generously rendered to botanical science Dr Verdoorn with the help of a company of experts, has produced a volume representing a high standard of achievement which will be heartily welcomed by his co workers and admirers in many countries

ALBERT C SEWARD

The Problem of Time

Time and its Importance in Modern Thought By M F Cleugh Pp x+308 (London Methuen and Co Ltd 1937) 12*s* 6*d* net

THIS stimulating and useful book to which Prof L S Stebbing contributes a short foreword serves a double purpose first it puts before the reader in comprehensive and concise form the problems connected with the conception or experience or whatever we prefer to call it of time and secondly it attempts to contribute something towards their solution The fundamental importance of these problems is now fairly generally realized and it is with some surprise that we learn from Miss Cleugh how recently this realization has come As a consequence books such as this dealing with the general subject are very few in number and a new one therefore calls for some attention

After an introductory statement Miss Cleugh analyses the problem of time into its psychological physical logical and metaphysical elements and each is critically discussed The last named receives by far the greatest amount of attention and the views of Kant Bergson Alexander McTaggart and Dunne are separately dealt with A synthesis follows in which the relevance of time to prediction irreversibility becoming contingency and reality is examined and the author gives her own conclusions (if that is the right word) on the subject The book is completed by a valuable bibliography which as well as the text, bears testimony to the extent of the field surveyed

Miss Cleugh has a happy gift of expression and often makes a subtle point clear by a terse sentence but she tends to discount the effect of this quality by rather involved presentations of extended arguments In the campaign to penetrate the reader s understanding she excels in tactics rather than in strategy There are too many *firstlys secondlys* within *firstlys secondlys* to make the book easy reading and a skeleton plan of each argument would have been helpful It is not the confusion of the thought but that of the presentation which is chiefly open to criticism and the reader who makes the necessary effort can grasp the meaning without ambiguity This is so rare a characteristic of philosophical books that it seems ungrateful to ask for more but since what is lacking could have been so easily supplied it is impossible not to regret its absence

Readers of NATURE will be chiefly interested in the physical aspect of time and this unfortunately is the aspect which is least satisfactorily treated Some important points are well put but Miss Cleugh has certain misconceptions which are so common among philosophical writers on physics (and from which some physicists also are not entirely free) that it is well to point them out She believes that we have a primitive and direct perception of equality of intervals Perhaps so but when she goes on to say that it is on this that the whole of *our measurement* is based (p 40) she is definitely wrong Our measurement is based on the readings of our chosen instruments our direct perception entering only into the observation of *coincidences* not intervals If the clock contradicts our primitive perception we take the word of the clock and indeed it is an essential feature of relativity theory that we may choose a clock which grossly violates our intuitive notion of equality and our measurements will still be perfectly legitimate

Another common misconception is that in physics velocity involves duration before it can be comprehended (p 45) This is not so we speak of velocity *at an instant* and the phrase has meaning We can measure this velocity by an instantaneous observation of a Doppler effect, that is, of a colour ; we do not need to make two observations separated by a duration Again, in her discussion of simultaneity, Miss Cleugh tries to reconcile the plain man to Einstein's apparent absurdities by saying that Einstein means by simultaneity something different from the ordinary notion But this will not do . in so far as the ordinary man has a direct knowledge of simultaneity, Einstein means what he does. The point is that the plain man's direct knowledge of simultaneity is confined to events which he actually experiences, and Einstein gives unambiguous meaning not only to the simultaneity of such events, but also to that of all events occurring at *any* one place Events the simultaneity of which is ambiguous are among those which occur at different places, and of these the plain man must learn to understand that his supposed intuitive knowledge is prejudice.

Finally, Miss Cleugh criticizes the Fitzgerald-Lorentz contraction as an explanation of the Michelson-Morley experiment on the ground that "there is no obvious reason *why* we should assume that our measurements of time are accurate, and that our measurements of space are at fault, since the latter is much easier to measure" (p 53) This criticism arises from a false idea of the experiment, derived from the popular account in terms of the times of travel of the two light beams But this is purely metaphorical : time does not enter explicitly into the experiment at all. What was looked for, and was not observed, was a displacement of interference fringes, and the system of time measurement, conventionally chosen, would merely have determined the magnitude to be assigned to the earth's velocity if the displacement had been observed Space measurement was important because the rods in the apparatus had to be equally long ; but there was no clock in the apparatus, so that whatever motion did to time made no difference.

These points, however, are more relevant to the understanding of physics than to that of time, and their significance in relation to Miss Cleugh's work must not be magnified. Her main concern is with the metaphysical status of time, and our general feeling, after surveying the variety of discussion which she puts before us, is that much labour might have been spared if metaphysicians had taken a hint from science and approached their problems from the point of view of experience. "If I were to attempt to answer in a single sentence the question, 'What is time ?'," writes Miss Cleugh (p 280), "the answer would be, 'The alogical element in the universe' " , her point being that time is inseparably associated with change, and logic can deal only with what does not change. Now this will scarcely do If time is the alogical element in the universe, then the logical elements must be outside time and therefore beyond our knowledge The achievements of science show that that is not so But why drag the universe into the question at all ? Time is concerned with our experience , time is that which immediately removes experiences into the past, where they are inaccessible to change and therefore, on Miss Cleugh's own principle, may be amenable to logic If, then, we begin with experience, we can use our reason freely Problems concerning the future take on a different aspect, for the future is not experience, though it may possibly be anticipated by reason acting on static past experience From this point of view we can make intelligible problems which, from the metaphysical point of view, are involved in contradictions

Nevertheless, it is not wise wholly to ignore the labours of great thinkers, even when we feel that they are wrestling with chimeras. Miss Cleugh has given us a valuable conspectus of efforts, great and small, to reach the heart of the most fundamental of intellectual problems, and men of science as well as philosophers will be thankful for what she has done HERBERT DINGLE.

Greek Reptiles

Die Amphibien und Reptilien Griechenlands. Von Prof. Dr. Franz Werner. (Zoologica · Original-Abhandlungen aus dem Gesamtgebiete der Zoologie, Herausgegeben von R. Hesse, Heft 94) Pp. iv+117+18 plates. (Stuttgart E. Schweizerbart'sche Verlagsbuchhandlung, 1938.) 62 gold marks.

SINCE the old days of Sibthorpe and of the Expédition de la Morée, the study of the Greek fauna and flora has fallen more and more into German hands Erhard, Krüper, Lindermayer and Otto Reiser have told us wellnigh all we know of bird-life in modern Greece, and now, following on the fifty-year-old work of Bedriaga, we have from Dr. Franz Werner an account of the many Greek amphibia and reptiles. The more we learn of the Greek fauna the more thankful we may be. Its varied ecology has many interesting facts and problems for the zoologist. The mountains have a mid-European fauna, the plains are 'Mediterranean', and the Peloponnese is typically 'Greek' ;

the islands differ notably from one another, and the Asiatic or Anatolian fauna begins in Rhodes and Cos and the rest of the Dodecanese. The classical student longs to know more about the several species, their folk-lore, their vernacular names, and all that may elucidate the ancient writers. Now Dr. Werner has given us a good, but it must be confessed a dry account, with many photographs and drawings, of the abundant Greek fauna of frogs and toads, tortoises, lizards and snakes He is a good zoologist , but he very seldom quotes a Greek name, he cares nothing at all for Aristotle, he does not touch on the many ill-identified reptiles mentioned by Nicander in his "Theriaca" Nevertheless his book is of no small interest even to the classical student

There are many poisonous snakes round about the Mediterranean, but in Greece there seem to be only two—*Vipera ammodytes*, widely distributed, and *V. lebetina*, confined to the western Cyclades The Greeks, who are very poor naturalists, are often little aware of how poisonous these vipers are, while they look with superstitious fear on certain harmless toads and snakes and lizards, and show them no mercy Some of the snakes are very large, as indeed Nicander tells us. *Coelopeltis lacertina* (here called by another name) grows two yards long , while among the fierce but harmless species of *Coluber* (or *Zamenis*) the long slender *C najidum*, the σαίττα of the Greeks, common in Attica, and the rarer *C jugularis*, may grow even to three yards long Of 'Greek' tortoises, favourites of the traveller, there are three species, besides two water-tortoises, *Emys* and *Clemmys caspica* , it is the latter which is the common ἁ χελῶνα τοῦ ποταμοῦ. The chameleon, well known to Aristotle, is not found on the mainland of Greece, but only in Chios, Samos, Crete and Asia Minor ; the salamander, on the other hand, common in Greece, is absent from all the islands of the Archipelago The large lizard *Tropidosaurus algira*, commonly said to occur in Greece, is not mentioned by Dr Werner, and there are some other notions current about the fauna which his book will help to correct or dispel.

The price of this small book, 62 gold marks, is quite unconscionable D W T.

Crystal Physics

A Text-Book on Crystal Physics

By Dr W A. Wooster Pp xxii+295. (Cambridge · At the University Press, 1938) 15s net

THIS book is stated to be intended for students at universities, and the reader is forewarned that for its proper understanding a knowledge of the elements of physics, mathematics and crystallography is necessary. A very considerable acquaintance with higher mathematics will certainly be required ; indeed the book has a somewhat forbidding appearance, owing to being overladen with mathematical formulæ and Cartesian tensorial notation. The author obviously recognizes this, for certain chapters and many paragraphs are marked to be omitted at a first reading That the first chapter should be so marked, however, is disconcerting, for it is supposed to explain the tensor notation employed throughout the book.

The author is not very generous, or even fair, to previous investigators. The fallacy is repeated that little was done in crystal physics previous to the discovery by Laue in 1912 ,of the X-ray diffraction by crystal planes, the work which paved the way being entirely ignored. For the most marvellous thing about the X-ray analysis of crystals is the clinching confirmation which it has brought of the conclusions, principles, and possible types of crystal structure, derived from the previous researches, besides its conversion of relative measures to absolute ones Moreover, it is surely incorrect to say that "in particular there was an almost complete absence of researches on the variation of a given physical property in a large number of crystals having chemical or crystallographic similarities". The work of Perrot, Miers, Pope, Barker, von Groth (with his four magnificent volumes of related substances), Becke, Muthmann, Schoenflies, Barlow and Fedorov, and (in all humility) the reviewer, whose thirty years' work on the eighty Tutton salts, and fifteen related simple salts, is now being added to as regards their magnetics by Krishnan, are clear cases of work in the domain of crystal physics which appear to be ignored in the above-quoted statement.

Having said so much in diffident criticism, it must be added that there is a wealth of real value in the book There are, especially, good chapters on thermal conduction and magnetic induction in crystals, on the piezo- and pyro-electric properties of crystals, and on their elastic and dielectric constants The book is admirably printed in larger type than usual, but the illustrations are only line drawings, except two or three figures reproduced from other authors It is appropriately dedicated to the late emeritus professor of mineralogy and master of Pembroke College, Cambridge, Prof. Arthur Hutchinson. A. E. H. T.

Plant Form and Function

By Prof. F. E Fritsch and Prof. E. J. Salisbury. Pp. viii + 668. (London: G. Bell and Sons, Ltd., 1938.) 17*s*. 6*d*. net.

STUDENTS and teachers of botany have in the past made good use of the two text-books by the joint authors: "An Introduction to the Study of Plants" and "An Introduction to the Structure and Reproduction of Plants". In the volume now under review the authors have, in response to many requests, united the subject-matter of both books into a single volume. This has been done successfully by dove-tailing the chapters of the two earlier books very ingeniously, so that the new volume forms a very harmonious whole, and its composite nature can only be ascertained by a careful comparison of the text with that of the component parts. The authors may therefore be congratulated on a clever piece of synthesis The new volume will be appreciated even more than the two earlier text-books, for it gives a more complete as well as a consecutive account of the elementary features of botany and thus facilitates the study of the subject

The authors have taken the opportunity also of bringing the subject matter up to date. This is particularly apparent in the chapter on heredity and evolution, in which the more recent developments of cytology are dealt with and explained In some of the physiological chapters new matter has been added, such as an account of the growth-promoting hormones. New discoveries in connexion with the alternation of generations in the Algæ, heterothallism in the Fungi and recent work on the cytology of the basidium are all dealt with in the new volume. Students will appreciate the fact that to each of the more important sections a selected list of books is given for further reference and also conveniently listed under that heading in the index.

More than a hundred new illustrations have been added. An additional chapter on the British flora as well as the inclusion of additional families in the taxonomic section is a welcome sign that the importance of systematic botany is regaining recognition.

Bacteriology:

a Text-Book of Micro-organisms. By Prof Fred Wilbur Tanner. Third edition. Pp. xiii + 510. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1937.) 17*s* 6*d*. net.

THIS book, though by no means elementary, is designed for the use of those who are studying bacteriology for the first time. The student making use of it should possess some acquaintance with the elements of biology, and the book may then be considered as continuing his biological studies in the domain of micro-organisms, more particularly the bacterial forms, though chapters on the yeasts, moulds and Protozoa are also included. It deals especially with fundamentals, and particular attention is devoted to the structure, nutrition, metabolism and classification of the bacteria, and the action of physical agents upon them; this matter occupies the first half of the book. The second half is devoted to a consideration of the processes involving bacterial action, and chapters deal with the bacteriology of water and milk and canned foods, sewage disposal through bacterial action, and the various industrial fermentations dependent upon bacteria. Finally, the relation of bacteria to diseases, animal and plant, is considered, and the nature of immunity is briefly discussed.

The book gives an excellent survey of all the subjects with which it deals, it is very readable, and the biographical details included of the pioneers of the science increase the interest, it is also well illustrated. The only fault-finding we would register is that the author, in an appended bibliography, in many instances gives the date of old editions of text-books, when much later ones have appeared.

R T Hewlett.

The Chemistry of Antigens and Antibodies

By J. R. Marrack (Medical Research Council, Special Report Series No 230) Pp 194 (London H.M. Stationery Office, 1938) 3*s*. net

IN 1934, the Medical Research Council published, "for the assistance of workers in the field", a report on the chemistry of antigens and antibodies prepared by Prof J. R Marrack. The widespread interest in this report, not only of workers in the subject, but also of many others interested in biochemistry, has led to the decision to revise it in the light of discoveries made during the last four years, and the task has again been entrusted to Prof. Marrack

The admirably wide view of the subject adopted by the author leads to the inclusion of a chapter on physico-chemical considerations, in which topics such as the electronic theory of valency and theories of the structure of proteins are discussed. To those engaged in the field of immunological chemistry, the two chapters on the nature of antigen-antibody reaction will be of particular interest, but to all those concerned in one aspect or another of the chemistry of biological phenomena, this report can be recommended as providing a lucid and comprehensive survey of a field which is, at present, expanding at an astonishing rate

Mea Culpa:

and the Life and Work of Semmelweis. By Louis-Ferdinand Céline. Translated by Robert Allerton Parker Pp. x + 175 (London: George Allen and Unwin, Ltd., 1937.) 5*s* net.

THIS little book consists of two unequal and unconnected portions. In the first, which occupies only 34 pages, the writer, who is a qualified medical man but is best known for his authorship of the unconscionably long and dreary novel entitled "Journey to the End of the Night", makes a frenzied attack on Communism as the result of a recent visit to Soviet Russia. The second part contains a lively and sympathetic account of the great Hungarian medical man, Ignaz Philip Semmelweis, who was a pioneer in the prophylaxis of puerperal fever in the pre-Listerian era, and died insane in 1841 at the age of forty-seven years after failing to convince his contemporaries of the truth of his doctrines.

Polarographic Research on Cancer

By Prof. J. Heyrovský, Charles University, Prague

IT is believed that an account of the scientific foundation and technical details of polarographic research on cancer on which method of serological investigation three letters have recently appeared in NATURE[1,2,3] will be of general interest

A dilute aqueous solution of blood or serum is studied polarographically which means that a direct current is passed through it under increasing voltage in order to record the current voltage curve The cathode consists of mercury dropping slowly (every 3 seconds) from the mouth of a thick walled capillary with a narrow bore (0 05 0 06 mm diameter) the layer of mercury at the bottom of the beaker serves as the anode A few cubic centimetres of the solution are sufficient for carrying out the electrolysis The applied E M F is increased from zero to about 2 volts whilst the current corresponding to the applied E M F is registered photographically The current voltage curves which ensue in this arrangement are independent of the duration of electrolysis and may be repeated any number of times with great reproducibility the current being determined by the voltage and the composition of the solution The theory the practical applications and necessary apparatus for this sort of electrolysis are the work of J Heyrovský and his school * The apparatus automatically recording current voltage curves was called the polarograph[4] the resulting diagrams polarograms and this branch of electrochemistry has been termed polarography[5,6] In the latest model of the recording apparatus the galvanometer shunt potentiometric and photographic drum are all enclosed in one box the micropolarograph suitable for medical and technical applications †

In 1930 a polarographic effect of proteins was described[7] which consisted of a characteristic wave at the voltage of 1 6 on the current voltage curve of a solution of ammonium chloride containing traces of proteins this effect has been shown to be due to the electrolytic evolution of hydrogen catalysed by the presence of the protein at the cathode interphase

Since then the protein effect has been investigated in the Physico Chemical Institute of the Charles University by R Brdicka[8] who introduced a more specific polarographic reaction for the proteins by adding to the 0 1 N solutions of ammonium chloride and ammonia a solution of a cobaltous or cobaltic salt of about 0 001 N He has shown that proteins containing sulphur cause in such solutions a new wave at a smaller voltage (1 4) and ascribed this effect to the sulphydryl and di sulphidic groups of the protein This conclusion is supported by the fact that simple thio acids like thio glycolic acid cysteine or cysteyl glycine or their di sulphidic forms produce a similar catalytic polarographic effect[9] but only in the presence of salts of divalent cobalt whereas higher polypeptides and proteins give the effect also in the presence of salts of trivalent cobalt With this very sensitive and reproducible reaction Brdička was able to work out a micro analytical estimation of cystine in one short piece of hair follow the kinetics of hydrolysis of proteins and determine the proteolytic activity of pepsin[10] In 1936 he became acquainted with the work of A Purr and M Russel who found that carcinomatic blood shows in certain biological reactions less activity than normal blood F Waldschmidt Leitz and his collaborators[11] attempted to use this reaction for cancer diagnosis and expressed the opinion that the lack of activity of the carcinomatic serum is due to decreased activity of the sulphydryl groups in the proteins of blood serum

Brdička now tried his polarographic reaction, which gives the activity of the sulphydryl or di sulphidic groups in the blood serum to compare them in normal and carcinomatic serum On direct comparison of the native sera but little difference is shown However if denatured sera are compared a distinctly lower polarographic protein effect in the pathologic sera is found The denaturation may be effected by adding alkali to the serum and allowing it to stand at room temperature Another way which also leads to considerable differences between normal and carcinomatic sera is to add 0 2 c c of the serum to 5 c c of 0 05 N hydrochloric acid containing 5 mgm of pepsin and to keep the mixture at 40° C After half an hour 0 2 c c of the mixture is withdrawn added to the cobaltous Brdička solution (0·1 N ammonium chloride 0 1 N ammonia 0 001 N cobaltous chloride) and the polarographic curve of this solution is registered (between 0·8 and 1 8 v) In this manner the polarogram reproduced

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*For bibliography see Collection of Czechoslovak Chemical Communications 10 1938, p 153-173 In the same journal most of the work appeared as Polarographic Studies

†The sole polarograph maker with whom the inventor collaborates is Dr V Nejedlý Prague XIX, Kladenská 76 in America these genuine polarographs may be obtained from E H Sargent & Company 155 East Superior Street Chicago

as Fig. 1 was obtained. The denaturation or the peptic action liberates the disulphidic groups through a re-arrangement or cleavage of the micellar structure of the protein molecules, thus indicating that the carcinomatic serum contains fewer sulphur groups than the normal one This conclusion was verified by the estimation of cystine in the hydrolysates of the normal and pathologic sera examined, when Brdička obtained the same differences—both polarographically and colorimetrically—in the content of cystine as were found by his protein test[3]

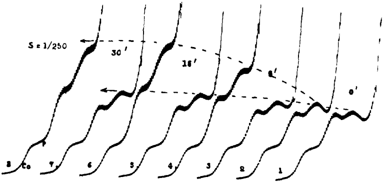

Fig 1

Liberation of the polarographically active groups of proteins by peptic cleavage Curves 1, 3, 5, 7, with carcinomatic serum, Curves 2, 4, 6, 8 with normal serum, in cobaltous Brdička's solution. Sensitivity 1/250, voltage 0 8–1 8 Curve 8. Co denotes the cobaltous 'wave', P the protein 'wave' The curves were recorded after 5, 15 and 30 min of the reaction

Another significant reaction has been worked out by K. Mayer in collaboration with Brdička in the Physico-Chemical Institute of the Charles University, involving deproteination of the serum[13] For this purpose 0 5 c c of serum is added to 1 0 c c of 0 1 *N* potassium hydroxide, and after standing one hour the proteins are precipitated by the addition of 1 5 c c 20 per cent sulphosalicylic acid , 0 5 c c. of the filtrate is added to the cobaltic 'Brdička solution' (0 1 *N* ammonium chloride, 0 1 *N* ammonia, 0 001 *N* cobaltammine, $Co(NH_3)_6Cl_3$) In this manner the liquor is freed from proteins ; however, their decomposition products—the albumoses—remain partially in solution. Investigations have shown that carcinomatic sera have a larger content of these products soluble in sulphosalicylic acid than normal sera. Consequently an abnormally high 'wave' obtained after deproteination (Fig. 2) indicates a pathological case, just as does the abnormally low 'wave' obtained after peptic cleavage (Fig. 3). The degradation of the protein molecules, which thus is shown to take place in the carcinomatic serum, may be effected artificially by treating a normal serum with alkali or pepsin, by which the products partly soluble in sulphosalicylic acid are split off and cause then the latter polarographic pathological effect.

The pathological state indicated by the abnormal height of Brdička's protein 'wave' has been ascertained to be due to carcinoma or sarcoma—if acute cases of inflammation or fever are eliminated The serum in the latter pathological state gives with either reaction an abnormal, that is, a 'positive' effect Investigations are now being directed towards distinguishing whether the decomposition products of the serum proteins due to cancer are different from those due to other diseases (inflammation, fever) so as to make the polarographic reaction in this respect more specific

The first systematic research using the polarographic diagnosis of cancer was carried out by Brdička in collaboration with Dr F N. Novák, director of the Radio-Therapeutic Institute, Bulovka, Prague . from 187 cases, the polarographic diagnosis agreed in 102 out of 107 histologically ascertained carcinomatic cases, 11 of the 13 sarcoma cases, whilst one of the 38 normal sera showed a positive polarographic reaction ; of the 29 non-carcinomatic diseases, 14 were polarographically positive and 15 negative.

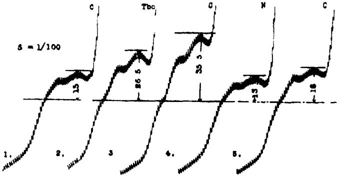

Fig. 2.

Pathological sera compared with normal serum after deproteination. (1) Ca portionis vaginalis (2) Fungus genus sinitri (Tbc) (3) Ca ventriculi. (4) Normal serum. (5) Ca ventriculi.

A similar agreement was found in the Finsen Institute and Radium Station, Copenhagen[3], where amongst the positive reactions some cases of hepatic disorder were ascertained. The polarographic cancer diagnosis is being successfully applied also in the Institute of Organic Chemistry (director Prof E Waldschmidt Leitz) and in the Gynæcological Clinic (director Prof H Knaus) of the German University Prague and at several hospitals in Czechoslovakia and in Germany

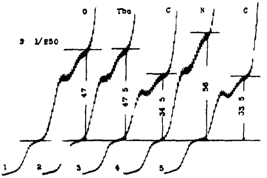

Fig 3

PATHOLOGICAL SERA COMPARED WITH NORMAL SERUM AFTER TREATMENT WITH PEPSIN CURVES 1–5 REFER TO THE SAME CASES AS IN FIG 2

General experience shows that the first reaction (with pepsin) deviates the more from normal the more developed is the stage of cancer—increasing from 3 to 50 per cent An attempt is being made to refine this polarographic diagnosis by experimenting on animals so as to distinguish an early stage of cancer Whilst there are many details still to be investigated in the polarographic reaction of cancer the diagnosis just as it is presented here, offers already substantial advantages over biological tests It is automatically registered and perfectly reproducible the chemical treatment is very simple and comparatively short (one hour standing at room temperature) only 0 5 c c of serum is needed but the reaction may even be carried out with one or two drops (0 1 c c) of blood

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[1] Brdička R NATURE 139 330 (1937)

[2] Brdička R NATURE 139 1020 (1937)

[3] Bergl F Henriques O M Schousboe J NATURE 141 751 (1938)

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[6] Heyrovský J Practical Applications of the Polarographic Method in Chemistry (in Czech) (Praha 1933) Enlarged Russian Edition (Leningrad 1937)

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[7] Brdička R Collection of Czechoslovak Chemical Communications, 5 148 (1933) *Biochem Z* 272 104 (1934)

[8] Brdička R Collection of Czechoslovak Chemical Communications 5 238 (1933) *Mikrochemie* 15 167 (1934)

Purr A and Russel M *Z physiol Chem* 228 198 (1934)

Waldschmidt Leitz E *Angew Chem* 51 916 (1936) Waldschmidt Leitz E Conrath O and Glooditscl *J Naturwiss* 25 60 (1937)

[9] Brdička R *Unio Internationalis contra Cancrum Acta*, 3 No 1 13 (Louvain 1938) *Medizin Klinik* 33 1186 (1937) *J Chim Phys* 35 89 (1938) *C R Soc Biol* 128 54 (1938)

Excavations at Njoro, Kenya

By Dr. L S B Leakey

DURING the latter part of April and the beginning of May preliminary excavations were carried out at a small rock shelter in the forest near Njoro, Kenya Colony, and as a result a new branch of the local neolithic stone bowl culture was discovered presenting certain interesting features This small rock shelter had been used during the neolithic period not as a living site but as a place for disposal of the dead by incineration and the particular method which was used in burning the bodies resulted in the preservation of a number of objects not usually found in stone age sites, owing to their perishable nature

The method in which incineration was carried out was to dig a shallow hole in the floor of the shelter, place the body in this in a contracted position, together with a variety of grave goods, cover the whole with soil and red ochre and then light a large fire on top The result of this treatment was that the bodies were baked rather than burnt, while combustible objects such as baskets, cord, woodwork and even calabashes were preserved as charcoal instead of turning to ash

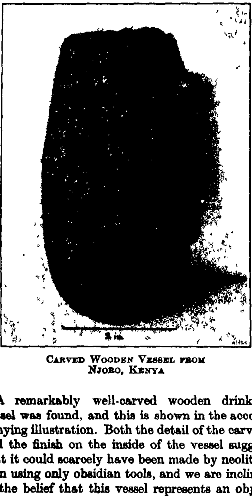
As each successive body was brought to the site to be incinerated a fresh hole was dug into the charred remains of previous burnings which were then disturbed and in course of time the deposit forming the floor of the shelter to a depth of about three feet became composed to a large extent of charcoal and burnt bone Only the bones of the last few bodies incinerated in the shelter before it was abandoned were therefore reasonably intact, and the vast majority of the skulls and skeletons were much broken up

Although only a very small part of the cave floor has been excavated the site had been so extensively used that the remains of more than seventy individuals were recovered Indeed, at one point an area of one cubic yard contained the remains of sixteen individuals

So far as can be stated at present the human remains indicate that the population was very similar to that which I have described in the "Stone Age Races of Kenya as the Elmenteitan type of man , but certain other elements appear to be present also

The human remains, however, are by no means the most interesting of the discoveries at this site, and the chief interest centres around the charred basketry and woodwork and also the many stone beads which were found

Three quite distinct types of basket work were recovered, as well as fragments of a narrow strip of finely woven string fabric which suggest a belt All of these were preserved as charcoal dust, but treatment with 'Durofix' dissolved in amyl acetate proved to be a satisfactory preservative, and the charcoal dust was transformed into a fairly hard substance Large quantities of plaited fibre string and cord were also recovered in the same way.



CARVED WOODEN VESSEL FROM NJORO, KENYA

A remarkably well-carved wooden drinking vessel was found, and this is shown in the accompanying illustration. Both the detail of the carving and the finish on the inside of the vessel suggest that it could scarcely have been made by neolithic man using only obsidian tools, and we are inclined to the belief that this vessel represents an object imported from one of the early civilizations.

While the evidence of the wooden vessel alone would be insufficient ground for postulating a trade with Kenya from one of the early civilizations, this idea is strongly supported by the stone beads. Some five hundred of these as well as a number of beautiful stone pendants were recovered, and they all exhibit a very high degree of workmanship. The semi-precious stones include fire-opals, carnelians, agates (banded and moss varieties) common opals, green quartz and Amazon stone (microcline-felspar). Of these, opals account for more than half the beads. The Amazon stone is of unusually fine quality and at first was mistaken for jade, to which it bears a superficial resemblance.

A variety of shapes of beads occur, including barrels and flat disks, the latter mainly of opal. In all cases the degree of skill shown in shaping and drilling the stone beads and the pendants contrasts strongly with that exhibited in the manufacture of the bone beads and pendants, which were certainly made by the neolithic people concerned, and this again seems to suggest that the former were made by people of superior skill and knowledge.

This view is strengthened by the fact that extensive prehistoric opal mines are connected with this site and in the surrounding area, it is difficult to believe that they were the work of neolithic man for the sake of his personal adornment without a stimulus from outside

On the evidence at present available, therefore, we incline to the view that there was influence from one of the early civilizations which initiated the mining for opals. It is even possible that there was direct contact with the traders, who employed as labour the neolithic inhabitants of the district and paid for the labour with stone beads and pendants

Besides the articles described above, the site yielded a very large number of stone bowls and pestles of a type quite distinct from those belonging to the other branches of the local stone-bowl culture complex, a number of flat grindstones and rubbers, some pottery and also some obsidian implements No trace of metal was found.

It is impossible at present to give a precise date to these new discoveries, but certain indications, such as the method of disposal of the dead, the physical type represented by the skulls and the nature of the obsidian tools all give a definite link with the Elmenteitan mesolithic culture. On the other hand, the stone bowls and pestles are definitely related to those found with other variants of the stone-bowl culture, but they are somewhat cruder typologically.

These facts seem to suggest a date intermediate between the mesolithic and the other neolithic industries previously discovered, and a *very tentative date* of *circa* 4000–3000 B.C. is therefore suggested.

Much will depend on whether the stone beads and pendants and the carved wooden vessel can be definitely linked with any of the early civilizations of the Near East or elsewhere. Any evidence which readers of NATURE can offer bearing on the subject would be greatly appreciated.

Obituary Notices

Dr. A. E. H. Tutton, F.R.S.

ALFRED EDWIN HOWARD TUTTON, who died on July 14, was born on August 22, 1864, at Cheadle Moseley, now the Edgeley district of the borough of Stockport He attended science classes at the Stockport Mechanics Institute and also the evening courses in chemistry of Prof Roscoe at Owens College, Manchester In 1883 he went to the Normal School of Science (later the Royal College of Science) and Royal School of Mines, South Kensington, with an exhibition, which he took in preference to a scholarship which he had gained for Owens College. During his period as a student, Huxley was professor of biology, Frankland of chemistry, Guthrie of physics, Judd of geology and Lockyer of astronomy, and a fellow-student was H. G Wells Tutton was a brilliant student and gained several scholarships and prizes In the meantime, Thorpe had succeeded Frankland as professor of chemistry, and under his direction Tutton began the research on the lower oxides of phosphorus in which the new oxide P_2O_4 was discovered and the lower oxide P_4O_6 was first prepared in a state of purity and definitely characterized in its properties This work was published in 1890 and 1891 In 1889, Tutton had been appointed to the post of demonstrator in chemistry and lecturer in chemical analysis at the College During this period, he also assisted Thorpe and Rucker in the magnetic surveys of Scotland and England.

On the completion of this work, Tutton turned his attention to crystallography, taking some lessons in crystal measurement from Mr H A. (now Sir Henry) Miers, who was then assistant to Prof Story Maskelyne at the British Museum (Natural History) He measured some organic compounds, including aconitine, which had been prepared in the laboratories, but his ambitions were of much wider scope in this subject. He formed a definite plan of research which was to occupy him for forty years, namely, the study of the crystal forms of chemically related series of compounds. These results, he saw, would throw light on the structure of salts, since by replacing one element in a crystalline salt by another, closely related, element, the effects on the molecular volumes and crystal angles of salts which had been generally regarded as isomorphous would be disclosed. It had early been recognized by Wollaston and by Mitscherlich that isomorphism was not absolute, and that small yet definite alterations in crystal angles resulted from the replacement of one isomorphous element by another.

The first series studied by Tutton comprised the sulphates and selenates of potassium, rubidium, cæsium, ammonium and thallium. This was followed by the double sulphates and selenates of these metals with those of magnesium, zinc, iron, nickel, cobalt, manganese, copper and cadmium, which form magnificent crystals with six molecules of water In all, ninety-one salts were studied, and the results communicated in about fifty papers from 1890 until 1929 As a result of this painstaking and accurate work, it was established that the crystallographic properties vary regularly with the atomic weights of the interchangeable elements The same result was established for the perchlorates and double chromates of the alkalis This work could be brought into relation with the structures as revealed by the X-rays when this new method became available In carrying out his crystallographic investigations Tutton showed the greatest ingenuity in devising and perfecting the measuring instruments, so that his methods became well known as representing the highest standard of crystallographic research.

In 1895 Tutton became an inspector of technical schools and moved to Oxford, where he equipped a private laboratory In his ten years in Oxford he became associated with New College and took the B Sc., D Sc and M A degrees, and in 1899 he was elected a fellow of the Royal Society In Oxford he married Miss Margaret Loat. In 1905 he was transferred to the London district and moved his home and laboratory to London. He wrote some important books during this period, his "Crystalline Structure and Chemical Constitution" being published in 1910, "Crystals" in 1911, and "Crystallography and Practical Crystal Measurement" in 1911. The last work, which gives detailed accounts of his practical methods and instruments, appeared in a second edition in two volumes in 1922, and it constitutes one of the most valuable works on experimental crystallography in any language His instruments, he recognized, could be applied to a comparison of the parliamentary and local government copies of the standard of length with the Imperial Standard Yard, and Tutton devised and supervised the construction of an interferential comparator for the Standards Department, the work being carried out in 1907–9. Further work in this direction was curtailed by his transfer to the south western district centred on Plymouth, where he resided at Yelverton, on Dartmoor. His crystallographic researches were continued, although his laboratory was not now so convenient In 1912 he became president of the Mineralogical Society. During the Great War he carried out special work for the Government.

Tutton's services as a lecturer were much sought and he delivered many courses, illustrated by demonstions with his magnificent apparatus. He visited Canada with the British Association in 1909 and spent some time in climbing the Rocky Mountains He also made many visits to the Alps, and in 1927 he published "A Natural History of Ice and Snow, Illustrated from the Alps", enriched by his own photographs. In 1929 he visited Cape Town with the British Association, also going to other parts of

Africa, and returning by way of Egypt and Palestine, which he visited.

In 1930 Tutton had resumed his work on the evaluation of the Imperial Yard in terms of the wave lengths of light. The value, published in 1931 (his last paper), was 1,420,210 wave lengths of the red radiation of cadmium in the yard at 62° F. The value published in 1934 by the National Physical Laboratory, who had used the Fabry-Perot method, was 1,420,209.

In 1924, Tutton moved his house and laboratory to Cambridge, where he participated in the university course in mineralogy at the invitation of Profs. Lewis and Hutchinson. His laboratory during this period was at its best.

Tutton entered into his retirement in 1931, his instruments being transferred to the Physics Department at the University of Manchester, which had conferred on him the honorary degree of D.Sc. in 1926.

Tutton's work stands as an enduring contribution to chemistry and crystallography. Marked by great accuracy and beauty of finish, it was achieved during a life conscientiously devoted to official duties, and hence it exhibits that peculiarly British character which is seen in the researches of other distinguished men of science who have laboured in like circumstances.

J. R. PARTINGTON.

Dr. C. E. Guillaume

BY the recent death of Dr. Charles Edouard Guillaume the world is deprived of a distinguished man of science who had taken a leading part in the advancement of the subject which, for more than fifty years, he had made his own.

His grandfather, Charles Frederic-Alexandre Guillaume, leaving France for political reasons, lived for a time in England, where he established a watch-making business, carried on afterwards by his three sons, of whom Edouard eventually returned to settle at Fleurier, in the Swiss Jura, where Charles Edouard was born on February 15, 1861.

In the course of his education, at the Gymnase in Neuchâtel, and at the Zurich Polytechnic, Guillaume showed a definite bent towards physics and, on leaving, became for a short time an artillery officer, devoting himself with enthusiasm to the study of mechanics and ballistics. So early as 1883, however, he entered the then recently established Bureau International des Poids et Mesures, at Sèvres near Paris, where he was destined to carry out his life's work. Commencing under the successive direction of O. J. Broch and J. R. Benoît, he himself became director of the Bureau in 1915, a position which he held until his retirement, after fifty-three years' service, with the title of honorary director, in 1936.

Guillaume's earliest investigations were concerned with thermometry, an ever-important subject in the science of metrology, and particularly so in the early days of the Bureau, when the new standard metre was being established. Guillaume carried out important investigations on the corrections to mercury-in-glass thermometers, and himself made detailed calibrations of thermometers used at the Bureau in the establishment of the thermal expansions of the standards of length, and for other cognate purposes. He also shared in the initial intercomparisons of the platinum-iridium copies of the International Metre which were prepared for distribution to the various countries subscribing to the Convention du Mètre, and undertook a redetermination of the mass of the cubic decimetre of water, by the method of contact, which gave a result in such excellent agreement with that found by interferential measurements by Chappuis, and by Benoît and Buisson, that it has never been thought necessary since to repeat this measurement.

Guillaume's most important contribution, however, to the science of metrology in particular, and also to industry, was his investigation of the remarkable properties of the nickel-iron alloys. A chance observation, during a search for a suitable alloy less expensive than platinum-iridium to serve as a material for the construction of secondary standards of length, showed that one nickel-iron alloy had a coefficient of thermal expansion above, and another appreciably below, that of either iron or nickel separately. Guillaume at once decided on a systematic investigation of a whole series of alloys, which immediately revealed the general features of the system. Painstaking and exhaustive researches followed, in which he was fortunate to obtain the co-operation of M. Henry Fayol, who put at his disposal the resources of the Aciéries d'Imphy, for the preparation of samples. There resulted the discovery of invar, an alloy with very low (in some cases zero or even slightly negative) coefficient of expansion, 'elinvar', in which the thermal coefficients of linear expansion and elasticity are balanced so as to give constant period of vibration, together with other useful alloys. A complete theory followed of the reversible transformations on which the peculiar properties of these alloys depend.

The introduction of invar rendered practicable the procedure suggested by Jäderin for the use of wires instead of length bars in the measurement of geodetic bases, thus leading to the establishment of the rapid methods in current use for this purpose, and incidentally directly justifying the faith of geodesists by whose insistence largely the Convention du Mètre was originally brought into being. Invar has also been used widely in instrument making and for industrial purposes, for example, for thermostats. In addition, the use both of invar for the pendulums of astronomical clocks and of the 'Guillaume' integral balance with elinvar hair spring, which eliminates secondary errors in high-grade watches and chronometers, has led to a marked advance in the horological industry with which his family was traditionally associated. It is estimated that more than a hundred million watches with 'Guillaume' balances are now in existence.

Throughout his long career, Guillaume was an ardent propagandist for the metric system, and never lost an opportunity for furthering the extension of its application. As director of the Bureau International he had naturally to give much of his time to administrative affairs, and those who had the privilege of meeting and working with him received an impression of outstanding courtesy, tact and charm In addition to other honours and decorations from all over the world, too numerous to mention, he was a Grand Officer of the Legion of Honour, and in 1920 was awarded the Nobel Prize for Physics for his work on the nickel-iron alloys.

WE regret to announce the following deaths ·

Dr. Jan Constantijn Costerus, formerly director of the first High School at Amsterdam, Holland, known for his work on plant teratology, partly with Dr. J. J. Smith, on July 31, aged eighty-nine years

Prof Jacob Kunz, professor of mathematical physics in the University of Illinois, known for his work in astrophysics, on July 18, aged sixty-four years.

Prof Earl B McKinley, dean of the Medical School, director of medical research and professor of bacteriology in the George Washington University, on July 28, aged forty-three years

Mr. F. C. Meier, plant pathologist of the U S. Department of Agriculture, known for his work on the disease of economic fruits, and on ærobiology, on July 28, aged forty-five years

Prof Nicola Parravano, professor of general chemistry in the University of Rome, aged fifty-five years

News and Views

Canadian Tour by Prof. C. D. Ellis, F.R.S.

PROF. C. D ELLIS, who holds the Wheatstone chair of physics at King's College, London, has been granted leave of absence for the Michaelmas and Lent terms in order to visit all the Canadian universities. The tour has been arranged by the Conference of Canadian Universities. The central idea of the scheme is that he should be able to spend some time, up to a week or ten days, in most of the universities, and have ample opportunity for meeting the staff and discussing matters of interest While some formal lectures will be given, it is intended to restrict such to the minimum. By adopting this somewhat unusual but enlightened scheme, the Committee of the Conference of Canadian Universities is showing a very real appreciation of the problems involved in scientific co-operation. A formal lecture, followed by a rapid tour of the laboratories, gives no opportunity of knowing the workers and appreciating their researches. With the more extended visits which Prof Ellis will be able to make, he will have an opportunity of taking a proper share in stimulating discussion Prof. Ellis is leaving England in September, and will go first to Vancouver, and will visit Edmonton, Saskatoon, Winnipeg, Ottawa and Montreal before Christmas. Starting again in January, he will visit Hamilton, London, Toronto, Kingston, Quebec, Sackville, Halifax, returning to England at the end of March.

Dr. J. E. Myers, O.B.E.

DR. J. E. MYERS has been appointed principal of the Manchester College of Technology He was educated at the Manchester Grammar School and at the University of Manchester, where he graduated with first-class honours in chemistry in 1910. Since that date, he has been continuously associated with University teaching and administration as lecturer in chemistry, secretary and tutor to the faculty of science and, more recently, assistant to the vice-chancellor in addition. He has represented the University on numerous bodies connected with higher education, and has been specially interested in student relations, graduate appointments, and the work of the Joint Matriculation Board He obtained the D Sc degree in 1917, and two years later was awarded the distinction of O B E in recognition of scientific work carried out for the Government during the Great War

Robert Warington, F.R.S. (1838–1907)

ON August 22 occurs the centenary of the birth of the English agricultural chemist, Robert Warington, who for many years worked at Rothamsted, Harpenden, Herts, and, like his contemporaries Sir John Lawes and Sir Joseph Gilbert, is buried at Harpenden Warington was the son of Robert Warington (1807–67) the practical chemist who convened the meeting at the Royal Society of Arts on February 23, 1841, which led to the formation of the Chemical Society At this time, Warington's parents were living at the Apothecaries Hall, in the City of London, and as a boy he learned chemistry from his father and from the lectures of Faraday, Brande and Hofmann When twenty years of age, he worked under Lawes at Rothamsted as an unpaid assistant, but a year later he returned to London as assistant to Frankland at South Kensington, whence he went to the Royal Agricultural College, Cirencester It was here that he commenced lecturing on the Rothamsted experiments Leaving Cirencester in 1867, he became chemist to Lawes's manure and acid factory at Millwall, but in 1876 returned to Harpenden, where he remained until 1891, publishing many memoirs on the nitrification of the soil. Leaving the Rothamsted laboratory, he lectured in America, and after his return home was examiner in agriculture to the Science and Art Department and Sibthorpian professor of rural economy at Oxford, a post he held for three years He died at Harpenden on March 20, 1907. His most successful work was his "Chemistry of the Farm", which was translated into several foreign languages and reached its nineteenth edition while he was still alive.

The Problem of Political Refugees

THE conference which opened at Evian on July 6 to discuss the plight of German and Austrian refugees was watched by a great body of opinion in Great Britain in which scientific workers are well represented A letter welcoming the initiative of the Government of the United States in this matter which was sent to President Roosevelt on May 31 bore the signatures of many eminent men of science among other leaders of intellectual life The letter urged that co operation should make it possible to facilitate the transfer of refugees to those countries where their abilities can find most scope, and to provide funds to enable them to make a fresh start, and urged the British Government to play its part both administratively and financially in the support of the great traditions of liberty, tolerance and humanity which it has in common with the United States A further letter to the chairman of the conference urged the importance of immediate, constructive and practical decisions alike on religious, humane and economic grounds if the great democracies are to retain their ancient traditions of freedom and the right of asylum

WHILE none who have welcomed the conference are blind to the difficulties of the situation, even in regard to the admission of skilled professional men and women, still more in what may be called the police problem, the actual outcome of the conference was somewhat disappointing The establishment of a permanent international committee of which, at its first meeting on August 3, when twenty seven countries were represented, Lord Winterton was elected chairman, indicates that within a limited field efforts are being and will continue to be made to deal with this grave problem The committee has prominent American representation, and since it is not a League of Nations organization, it should be easier for it to get in direct touch with all countries responsible for the main refugee problem Moreover, the term 'refugee' has been extended to include persons who, though they may not yet actually have left Germany or Austria, feel obliged to quit those countries as soon as they can because of persecution due to political opinions, religious beliefs, or racial origin While, too, the question of settlement is financial as well as territorial, the democracies have every reason, from their own self-interest as well as that of justice, to support the international committee in any steps it may initiate to bring pressure to bear on the expelling countries to release at least a proportion of the refugees' property to assist in their re-establishment elsewhere

Restoration of the Hurlers, Cornwall

FURTHER work of restoration on the Hurlers, the stone circles near Minions, Cornwall, has been carried out during the past four weeks on behalf of the Office of Works under the supervision of Mr R Ralegh Radford, director of the British School of Archæology at Rome. These circles have been under the guardianship of, and owned by the Office of Works since 1935, when certain preliminary work of investigation and restoration of the central circle was undertaken According to a statement made by Mr Radford (*The Times*, August 12) the recent investigations have been directed to the examination of the northern circle Four stones, additional to the previously known twelve, were found under modern tip heaps, and will be re erected in the original sockets Missing stones will be indicated, as in the central circle, by low stumps inserted in the original positions The damage to the interior of the northern circle by mining test holes and digging will be repaired by filling and levelling A floor of granite fragments similar to that discovered in 1935, washed out of the surface soil, has been discovered covering the greater part of the interior of the circle Its thickness is less than that of the previously discovered floor, this possibility, it is suggested, being due to it having remained in use for a longer period An interesting feature now brought to light is a rough pavement between the northern and central circles, and running along their common axis This pavement is about six feet wide but does not reach out to both circles The suggestion of a ceremonial purpose will, no doubt, be elucidated when examination is completed before the close of the season's work Flint implements, more numerous than in 1935, include several types characteristic of the early metal age, with some of an earlier period Work will be continued in 1939, when it is hoped to restore the monument to its original appearance, so far as that is possible It is also intended to explore the neighbouring barrow, in which the Rillaton gold cup, now in the British Museum, was found This has never been explored scientifically

Roman Dorchester

FURTHER finds of interest are reported from Colliton Park and neighbouring land at Dorchester, where Roman buildings, it will be remembered, have been found on the site which is being prepared for the erection of a county hall The Dorset Archæological Society, which has been responsible for supervising the work in the interests of archæology and for examining finds on the site, has recently made a cutting in Colliton Walk, adjoining the Park, which has brought to light part of the massive walls which once defended the Roman town The walls, it is stated (*The Times*, August 12), were ten feet thick and of solid masonry The ashlar facing has been removed, but the rubble core of flint and limestone, well mortared, still remains The original wall was at least twenty feet high and was banked up internally by a large rampart, on the top of which was a walk for the sentries It is hoped that further investigation may bring to light the foundations of the towers which were a feature of such fortifications The walls at this point were destroyed a hundred years ago, when the walks were laid out , but enough has now been found to show the nature of the original construction In the Park itself, where the site is now in the hands of the contractors, some further remains have been found. Among these is a water conduit, one of the open distributing channels of the Roman system of water supply It is at the bottom of a V-shaped cutting ten feet deep The channel itself is four feet wide, with a bottom of red earthenware tiles No conduit of this type had previously been found in this part of Roman Britain It appears to have gone out of use in the second century A D The foundations of the three roomed Roman building have now been cleared, and show the remarkable and unusually wide doorway, which is seven feet across

Prehistoric Civilization of Northern France

THE party of archæologists deputed by the Society of Antiquaries of London to carry out archæological investigations in northern France is now at work in Brittany and western Normandy under the direction of Dr R E Mortimer Wheeler The expedition has been undertaken with the good will of, and under a permit from the French authorities in accordance with an agreement into which the Society of Antiquaries entered with them last year This investigation will constitute the major undertaking for the time being of the Society in archæological research in the field, taking the place of the excavation of Maiden Castle, Dorchester upon which it was engaged, with Dr Wheeler as its director, for some years The purpose of the investigation in France is to search for evidence of the cross channel origin of the civilization of south western Britain in the later prehistoric period and more especially of the fortified towns which appear there suddenly in a state of mature development but of which the source is uncertain This is a department of investigation in France which French archæologists have left virtually untouched The programme of the investigators is in the first place to map the distribution of pre Roman earthworks of the Maiden Castle type in north western France and secondly to ascertain by trial excavation on selected sites what cultures went to make up these Continental works The first centre which has been chosen for excavation is Huelgoat, a well known site in the pine forest about twenty miles south of Morlaix, where a camp nearly a mile in length is under examination It is seen to have been built in the first century B C on the eve of the Roman conquest of northern France The rampart, fifteen feet high, is faced with stone and bonded with lacing timbers The ditch is in part cut out of the granite rock The search for other sites has progressed so far as to show that the great Wessex fortified sites did not originate in Finistère, though certain smaller fortified enclosures in that department can be paralleled in Cornwall Investigation will shortly move farther east to a large camp in the neighbourhood of Avranches

Fungus Diseases of Animals

A NEW journal devoted to the fungus diseases of man and other animals has recently commenced publication (*Mycopathologia*, Den Haag, Dr W Junk, 18 Dutch florins per volume 1, Fasc 1, 80 pp May 1938) The publication is international, it is edited in Italy and printed in Holland, the United States provides the first number with several authors, whilst the list of collaborators is long and geographically extensive R Ciferri, director of the Botanical Laboratory of the Faculty of Agriculture in the University of Florence, and P Redaelli, director of the Institute of Pathological Anatomy in the University of Padua, are the joint editors They contribute the first paper on "A New Hypothesis on the Nature of *Blastocystis*" This organism shows more affinities with certain algæ than with sporogenous yeasts, and the general biologist will welcome the discovery of a further link between fungi and algæ Classification of fungi belonging to the genus *Actinomyces* is considered by F Baldacci of Padua The rest of the papers in the present number demonstrate the wide scope and outlook of the journal The papers are all scientific contributions to a little known section of mycology, and a Bibliographia Mycopathologia of references to work published in 1937 adds further utility The production is excellent, both of type and plates and the volume should supply a particularly welcome quota of knowledge in Great Britain, where fungal diseases of man are apparently not common enough to provoke research on a large scale

Advances in Printing Telegraph Technique

IT is shown in a paper by A E Thompson, published in *Electrical Communication* of April, that at no period in the history of the telegraph has there been such revolutionary improvements in methods and equipment or such rapid development and expansion in its service to the community as during the last ten years The progress was initiated by the introduction of teleprinter systems which by providing instruments requiring no telegraphic skill on the part of the operators have completely changed the outlook of telegraphy and greatly stimulated development in all its branches Teleprinters are superseding all the older types of machine telegraphic apparatus Even hand Morse working, which has been the backbone of telegraphy for more than a century, has now been abandoned in the British telegraph service, the bulk of the traffic being handled by Creed teleprinters Similar developments are taking place in other countries A description is given of the new Creed No 10 tape teleprinter The improvements achieved are trustworthy service at 85 words per minute, reduced costs, quiet operation and reduced size Maintenance costs have been reduced by evolving mechanisms with a breakdown speed exceeding 100 words per minute The printer operates continuously for 300 hours without requiring lubrication Ball bearings and oil impregnated bearings as well as sliding surfaces lubricated by means of oil reservoirs are used This machine can be used by telegraph administrations and private companies as well as by high speed news and ticker services

History of Maize-Breeding

IN a recent lecture given at the Michigan State College, Mr Henry A Wallace, the United States Secretary of Agriculture, traced the history of maize or corn breeding and pointed out that up to 1890 the farmers of the corn belt had not been superior to their Indian predecessors as corn breeders, the chief improvement having been in substituting a later type of maize for the earlier ones grown by the Indians (Spragg Memorial Lectures on Plant Breeding Eighth Annual Lecture "Corn Breeding Experience and its probable eventual Effect on the Technique of Live stock Breeding" By Henry A Wallace Pp 6 East Lansing, Mich Michigan State College) The application of the genetic methods of Shull and East, that is, inbreeding of strains followed by cross breeding of particular types, has since greatly increased the yield In 1938, probably at least fifteen million acres will be planted, yielding 100 million bushels more than if ordinary open pollinated types were used It is suggested that similar methods applied to animal breeding (that is, homozygosis followed by controlled heterosis), first to egg production in fowls, then to swine, sheep, dairy cows and finally to beef cattle can produce similar results, and the methods of swine breeding in Denmark are cited Mr Wallace concludes that in mankind compulsory sterilization and selection of types under a dictatorship will not bring about the desired eugenic improvement in the human race A standardized preconception of the perfect man, after the Nazi ideal of an Aryan race , is a false eugenic idea which will lead, in the long run, to the failure of eugenic progress

Mexican Pictographic Manuscript

A DOCUMENT of extreme interest to students of American pre Columbian history and culture, the Mendoza Codex, now in the Bodleian Library, has been reproduced in facsimile by Mr J Cooper Clark Captain T A Joyce providing a foreword The Mendoza Codex is one of several pictographic manuscripts which have survived It was prepared by the authority of Don Antonio de Mendoza, who was appointed the first viceroy of New Spain in 1535 The Codex—or rather collection of codices, for there are three—consists of seventy one folio pages, the pictographs being in colour The first part is a copy of an old Mexican chronicle, now lost, of the history year by year of the Lords of Tenochtitlan now Mexico City, and a list of the towns they conquered It covers from A D 1325 until the fall of the Empire in 1521 The second part is a carefully executed copy of the tribute roll to Motecuçuma, the Mexican ruler, by upwards of four hundred towns The original from which this is copied is now in the National Museum of Mexico, and consists of fourteen folios painted on maguey leaves The third part of the Mendoza Codex is a compilation by the scribe for Mendoza s use, recording the life of a Mexican from day to day from the cradle to the grave Although some of the pictures were included by Lord Kingsborough in his book on Mexican art a hundred years ago, this valuable manuscript has never before been reproduced in accurate facsimile as a whole It has now been printed for private publication by Messrs Waterlow on hand made Whatman paper, the pictographs being beautifully reproduced in colour There are three volumes, of which the first contains Mr Cooper Clark's translation of the Spanish text with commentary, the second the interpretation of the Nahuatl place name glyphs, now for the first time rendered in English, and the third volume is the facsimile in colour of the manuscripts The subscription price of the three volumes is twenty guineas

Very Low Temperatures

THE issue by the Science Museum of Books 2 and 3, describing the exhibits and outlining the lectures delivered at the special exhibition devoted to this subject in the Science Museum from March until June last year, completes the account of the exhibition The three books have been edited by Mr T C Crawhall, with the assistance of Dr O Kantorowicz for Book 2 The first book, issued at 6*d* , gives a survey of physical principles and some applications , the second, issued at 2*s* , deals with the apparatus exhibited for temperature reduction, temperature and pressure measurement, liquefaction and solidification of gases, the properties of the products, their storage and their applications Included in the methods of cooling is that of demagnetizing a paramagnetic material The third book, issued at 1*s* 3*d* , gives accounts of the development of low temperature technique, by Prof M Travers, the industrial uses of low temperatures, by Messrs C G Bainbridge, J T Randall and I J Faulkner respectively, and the approach to the absolute zero, by Dr J D Cockroft, Prof F Lindeman and Prof F Simon respectively The three books constitute a valuable record of the present position of a subject which promises to have many applications in industry

Crocodilian Energy

IMPERIAL AIRWAYS inform us that at the end of July, while one of their pilots was taking off in a flying boat at Port Bell on Lake Victoria, a crocodile gave a remarkable display of agility The flying boat had just taken to the air when, about forty yards away, a crocodile about nine feet long leapt full length out of the water, clearing the surface with its whole body by about four feet Apart from its natural history interest, the occurrence was unusual, since, before a flying boat takes off, the surrounding water is most carefully patrolled to guard against possible obstacles, and the flying boats operate as far as possible from areas known to be haunted by crocodiles This unusual air leap of the crocodile is analogous to the leaping of salmon and other fishes, for propulsion is due in both cases to the powerful movements of the tail muscles The size of the individual, a young individual of a species *Crocodilus niloticus*, which may exceed twenty feet in length, illustrates a characteristic of many animals, that the young are notably more nimble than adults

Recent Minor Earthquakes

AFTER the first series of shocks between July 5 and 9 (see NATURE of July 30, p 203), in which buildings were badly cracked in Paliad and Botad though no lives were lost, further tremors have been recorded, and it was reported from Bombay on July 28 that all but the very poorest of inhabitants had deserted the town of Paliad It is rare to find a

(*Continued on p.* 351)

NATURE

SUPPLEMENT

No. 3590 SATURDAY, AUGUST 20, 1938 Vol. 142

Part I

VISION IN NATURE AND VISION AIDED BY SCIENCE

Part II

SCIENCE AND WARFARE

by

The Right Hon. Lord Rayleigh, F.R.S.

President of the British Association*

PART I

THE last occasion that the British Association met at Cambridge was in 1904, under the presidency of my revered relative, Lord Balfour, who at the time actually held the position of Prime Minister That a Prime Minister should find it possible to undertake this additional burthen brings home to us how much the pace has quickened in national activities, and, I may add, anxieties, between that time and this

Lord Balfour in his introductory remarks recalled the large share which Cambridge had had in the development of physics from the time of Newton down to that of J J. Thomson and the scientific school centred in the Cavendish Laboratory, "whose physical speculations," he said, "bid fair to render the closing year of the old century and the opening ones of the new as notable as the greatest which have preceded them " It is a great pleasure to me, as I am sure it is to all of you, that my old master is with us here as he was on that occasion. I can say in his presence that the lapse of time has not failed to justify Lord Balfour's words. What was then an intelligent anticipation is now a historical fact.

I wish I could proceed on an equally cheerful note The reputation of the scientific school in the Cavendish Laboratory has been more than sustained in the interval under the leadership of one whose friendly presence we all miss to-night The death of Ernest Rutherford leaves a blank which we can never hope to see entirely filled in our day We know that the whole scientific world joins with us in mourning his loss.

Lord Balfour's address was devoted to topics which had long been of profound interest to him He was one of the first to compare the world picture drawn by science and the world picture drawn by the crude application of the senses, and he emphasized the contrast between them A quotation from his address will serve as an appropriate text to introduce the point of view which I wish to develop.

"So far," he said, "as natural science can tell us, every quality or sense or intellect which does not help us to fight, to eat, and to bring up our children, is but a by-product of the qualities which do. Our organs of sense perception were not given us for purposes of research . . either because too direct a vision of physical reality was a hindrance, not a help in the struggle for existence . . . or because with so imperfect a material as living tissue no better result could be attained."

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* Presidential address delivered at Cambridge on August 17.

Some of those who learn the results of modern science from a point of view of general or philosophical interest come away, I believe, with the impression that what the senses tell us about the external world is shown to be altogether misleading They learn, for example, that the apparent space-filling quality of the objects called solid or liquid is a delusion, and that the volume of space occupied is held to be very small compared with that which remains vacant in between This is in such violent contrast with what direct observation seems to show that they believe they are asked to give up the general position that what we learn from our senses must be our main guide in studying the nature of things.

Now this is in complete contrast with the point of view of the experimental philosopher He knows very well that in his work he does and must trust in the last resort almost entirely to what can be seen, and that his knowledge of the external world is based upon it · and I do not think that even the metaphysician claims that we can learn much in any other way. It is true that the conclusions of modern science seem at first sight to be very far removed from what our senses tell us But on the whole the tendency of progress is to bring the more remote conclusions within the province of direct observation, even when at first sight they appeared to be hopelessly beyond it

For example, at the time of Lord Balfour's address, some who were regarded as leaders of scientific thought still urged that the conception of atoms was not to be taken literally. We now count the atoms by direct methods. We see the electrometer needle give a kick and we say, "There goes an atom " Or we see the path of an individual atom marked out by a cloud track and we see where it was abruptly bent by a violent collision with another atom

Again, the theory of radioactive decomposition put forward by Rutherford, however cogent it may have seemed, and did seem to those who were well acquainted with the evidence, was originally based on indirect inferences about quantities of matter far too small to be weighed on the most delicate balance Chemists were naturally inclined to feel some reserve , but in due course the theory led to a conclusion which could be tested by methods in which they had confidence—the conclusion, namely, that lead contained in old uranium minerals ought to have a lower atomic weight than ordinary lead, and in all probability to be lighter, and on trying this out it proved to be so. More recently we have the discovery of heavy hydrogen with twice the density of ordinary hydrogen, and heavy water which is the source of it.

Lastly, the conclusion that ordinary matter is not really space-filling has been illustrated by the discovery that certain stars have a density which is a fabulous multiple of the density of terrestrial matter Although this is in some sense a deduction as distinguished from an observation, yet the steps required in the deduction are elementary ones entirely within the domain of the older physics

This and many other points of view have seemed at first sight to contradict the direct indication of our senses But it was not really so They were obtained and could only be obtained by sense indications rightly interpreted As in the passage from Lord Balfour already quoted, the senses were not primarily developed for purposes of research, and we have in large measure to adapt them to that purpose by the use of artificial auxiliaries The result of doing so is often to reveal a world which to the unaided senses seems paradoxical

I have chosen for the main subject of this address a survey of some of the ways in which such adaptations have been made. I shall naturally try to interest you by dwelling most on aspects of the subject that have some novelty ; but apart from these there is much to be gleaned of historical interest, and when tempted I shall not hesitate to digress a little from methods and say something about results

THE HUMAN EYE

I shall begin with a glance at the mechanism of the human eye, so far as it is understood. I shall show how the compromise and balance between different competing considerations which is seen in its design can be artificially modified for special purposes All engineering designs are a matter of compromise You cannot have everything. The unassisted eye has a field of view extending nearly over a hemisphere. It gives an indication very quickly, and allows comparatively rapid changes to be followed. It responds best to the wavelengths actually most abundant in daylight or moonlight. This combination of qualities is ideal for what we believe to be Nature's primary purpose, that is for finding subsistence under primitive conditions, and for fighting the battle of life against natural enemies. But by sacrificing some of these qualities and in particular the large field of view we can enhance others for purposes of research We may modify the lens system by artificial additions over a wide range for examining the very distant or the very small We can supplement and enormously enhance the power of colour discrimination which Nature has given us By abandoning the use of the retina and substituting the photographic plate as an artificial retina we can increase very largely the range of spectrum which can be utilized This last extension has its special possibilities particularly in the direction of using waves smaller than ordinary even down to those which are associated with a moving electron By using the photo electric cell as another substitute for the retina with electric wire instead of optic nerve and a recording galvanometer instead of the brain we can make the impressions metrical and can record them on paper We can count photons and other particulate forms of energy as well We can explore the structure of atoms examine the disintegration of radioactive bodies and trace out the mutual relation of the elements Indeed by elaborating this train of thought a little further almost the whole range of observational science could be covered But within the compass of an hour or so one must not be too ambitious It is not my purpose to stray very far from what might by a slight stretch of language fall under the heading of extending the powers of the eye

Most people who have a smattering of science now know the comparison of the eye with the camera obscura or better with the modern photographic camera—with its lens iris diaphragm focusing adjustment and ground glass screen the latter corresponding to the retina The comparison does not go very far for it does not enter upon how the message is conveyed to the brain and apprehended by the mind or even upon the minor mystery of how colours are discriminated Nevertheless it would be a great mistake to suppose that the knowledge which is embodied in this comparison was easily arrived at For example many acute minds in antiquity thought that light originated in the eye rather than in the object viewed Euclid in his optics perhaps used this as a mathematical fiction equivalent to the modern one of reversing the course of a ray but other authors appealed to the apparent glow of animal eyes by lamplight which shows that they took the theory quite literally The Arabian author Alhazen had more correct ideas and he gave an anatomical description of the eye but apparently regarded what we call the crystalline lens as the light sensitive organ Kepler was the first to take the modern view of the eye

The detailed structure of the retina and its connexion with the optic nerve has required the highest skill of histologists in interpreting difficult and uncertain indications The light sensitive elements are of two kinds the rods and cones The rods seem to be the only ones used in night vision and do not distinguish colours The cones are most important in the centre of the field of view where vision is most acute and it seems to be fairly certain that in the foveal region each cone has its own individual nervous communication with the brain On the other hand there is not anything like room in the cross section of the optic nerve to allow us to assign a different nerve fibre to each of the millions of rods A single fibre probably has to serve two hundred of them

The nervous impulse is believed to travel in the optic nerve as in any other nerve but what happens to it when it arrives at the brain is a question for the investigators of a future generation

Use of Lenses

The use of lenses is one of the greatest scientific discoveries we do not know who made it Indeed the more closely we inquire into this question the vaguer it becomes Spectacle lenses as we know them are a medieval invention dating from about A D 1280 Whether they originated from some isolated thinker and experimenter of the type of Roger Bacon or whether they were developed by the ingenuity of urban craftsmen can scarcely be considered certain There are several ways in which the suggestion might have arisen but a glass bulb filled with water is the most likely Indeed considering that such bulbs were undoubtedly used as burning glasses in the ancient world and that the use of them for reading small and difficult lettering is explicitly mentioned by Seneca it seems rather strange that the next step was not taken in antiquity Apparently the explanation is that the magnification was attributed to the nature of the water rather than to its shape At all events it may readily be verified that a 4 or 5 inch glass flask full of water though not very convenient to handle will give a long sighted newspaper reader the same help that he could get from a monocle

The invention of lenses was a necessary preliminary to the invention of the telescope for as Huygens remarked it would require a superhuman genius to make the invention theoretically

The retina of the eye on which the image is to be received has structure We may compare the picture on the retina to a design embroidered in woolwork which also has a structure Clearly such a design cannot embody details which are smaller than the mesh of the canvas which is to carry the coloured stitches The only way to get in more detail is to make the design or rather such diminished part of it as the canvas can accommodate on a larger scale Similarly with the picture on the retina The individual rods and cones correspond with the individual meshes of the canvas If we want more detail of an object we must make the picture on the retina larger with the necessary sacrifice of the field of view If the object is distant we want for this a lens of longer focus instead of the eye lens We cannot take the eye lens away but what amounts to nearly the same thing we can neutralize it by a concave lens of equal power put right up to it called the eye piece Then we are free to use a long focus lens called the telescopic objective to make a larger picture on the retina It must of course be put at the proper distance out to make a distinct picture This is a special case of the Galilean telescope which lends itself to simple description It is of no use to make the picture larger if we lose definition in the process The enlarged image must remain sharp enough to take advantage of the fine structure of the retinal screen that is to receive it It will not be sharp enough unless we make the lens of greater diameter than the eye Another reason for using a large lens is to avoid a loss of brightness

It seems paradoxical that the image of a star should be smaller the larger the telescope Nevertheless it is a necessary result of the wave character of light We cannot see the true nature of for example a double star unless the two images are small enough not to overlap and far enough apart to fall on separated elements of the observer s retina

When the problem is to examine small objects we look at them as close as we can here the short sighted observer has an advantage By adding a lens in front of the eye lens to increase its power we can produce a kind of artificial short sight and get closer than we could otherwise so that the picture on the retina is bigger This is a simple microscope and we can use it to examine the image produced by an objective lens if this image is larger than the object under examination we call the whole arrangement a compound microscope

Given perfect construction there is no limit in theory to what a telescope can do in revealing distant worlds It is only a question of making it large enough On the other hand there is a very definite limit to what the miscroscope used with say ordinary daylight can do It is not that there is any difficulty in making it magnify as much as we like This can be done for example by making the tube of the microscope longer The trouble is that beyond a certain point magnification does no good Many people find this a hard saying but it must be remembered that a large image is not necessarily a good image We are up against the same difficulty as before A point on the object is necessarily spread out into a disk in the image due to the coarseness of structure of light itself as indicated by its wave length I cannot go into the details but it is well known that points on the object which are something less than half a wave length or say a one hundred thousandth or an inch apart cannot be distinctly separated This is the theoretical limit for a microscope using ordinary light and it has been practically reached The early microscopists would have thought this more than satisfactory but the limit puts a serious obstacle in the way of biological and medical progress to day For example the pathogenic bacteria in many cases are about this size or less and there is special interest in considering in what directions we may hope to go further

Since microscopic resolution depends on having a fine structure in the light itself something though not perhaps very much may be gained by the use of ultra violet light instead of visible light It then becomes necessary to work by photography We are nearing the region of the spectrum where almost everything is opaque In the visual region nearly every organic structure is transparent and to get contrast stains have to be used which colour one part more deeply than the other In the ultra violet on the other hand we get contrast without staining and as Mr J E Barnard has shown the advantage lies as much in this as in the increased resolving power For example using the strong ultra-violet line of the mercury vapour lamp which has about half the wave length of green light he finds that a virus contained within a cell shows up as a highly absorptive body in contrast with the less absorptive elements of the cell. So that ultra-violet microscopy offers some hope of progress in connexion with this fundamental problem of the nature of viruses

With ultra-violet microscopy we have gone as far as we can in using short waves with ordinary lenses made of matter, for the available kinds of matter are useless for shorter waves than these, and it might well seem that we have here come to a definite and final end Yet it is not so There are two alternatives, which we must consider separately Paradoxical as it may seem, for certain radiations we can make converging lenses out of empty space , or alternatively we can make optical observations without any lenses at all

THE ELECTRON MICROSCOPE

The long-standing controversy which raged in the nineties of the last century as to whether cathode rays consisted of waves or of electrified particles was thought to have been settled in favour of the latter alternative But scientific controversies, however acutely they may rage for a time, are apt, like industrial disputes, to end in compromise , and it has been so in this instance According to our present views the cathode rays in one aspect consist of a stream of electrified particles , in another, they consist of wave trains, the length being variable in inverse relation to the momentum of the particles

Now cathode rays have the property of being bent by electric or magnetic forces, and far-reaching analogies have been traced between this bending and the refraction of light by solids , indeed, a system of 'electron optics' has been elaborated which shows how a beam of cathode rays issuing from a point can be reassembled into an image by passing through a localized electrostatic or magnetic field having axial symmetry This constitutes what has been called an electrostatic or magnetic lens It is then possible to form a magnified image of the source of electrons on a fluorescent screen, and that is the simplest application But we can go further and form an image of an obstructing object such as a fine wire by means of one magnetic lens, acting as objective, and amplify it by means of a second magnetic lens, which is spoken of as the eyepiece, though of course it is only such by analogy, for the eye cannot deal directly with cathode rays. The eyepiece projects the image on to a fluorescent screen, or photographic plate.

So far we have been thinking of the electron stream in its corpuscular aspect But we must turn to the wave aspect when it comes to consideration of theoretical resolving power The wave-length associated with an electron stream of moderate velocity is so small that if the electron microscope could be brought to the perfection of the optical microscope, it should be able to resolve the actual atomic structure of crystals This is very far indeed from being attained, the present electron microscope being much further from its own ideal than were the earliest optical microscopes Nevertheless, experimental instruments have been constructed which have a resolving power several times better than the modern optical microscope The difficulty is to apply them to practical biological problems

It is not to be supposed that the histological technique so skilfully elaborated for ordinary microscopy can at once be transferred to the electron microscope For example, the relatively thick glass supports and covers ordinarily used are out of the question Staining with aniline dyes is probably of little use, and the fierce bombardment to which the delicate specimen is necessarily exposed will be no small obstacle Certain standard methods, however, such as impregnation with osmium, seem to be applicable and there is some possibility that eventually the obscure region between the smallest organisms and the largest crystalline structure may be explored by electron microscopy

USE OF X-RAYS

In referring to the limitations on the use of lenses, I mentioned the other alternative that we might, in order to work with the shortest waves, dispense with lenses altogether and in fact in using X rays this is done We are then limited to controlling the course of the rays by means of tubes or pinholes This restriction is so serious that it altogether defeats the possibility of constructing a useful X-ray microscope analogous to the optical or the electron microscope In spite of this, the use of X-rays is of fundamental value for dealing with a particular class of objects, namely, crystals, which themselves have a regular spacing, comparable in size with the length of the waves Just as the spacing of a ruled grating (say 1/20,000 of an inch) can be compared with the wave-length of light by measuring the angle of diffraction, so the spacing of atoms in a crystal can be compared with the wave-length of X-rays But here the indications are less direct than with the microscope, and depend on the object having a periodic structure So that the method scarcely falls within the scope of this address How essential the difference is will appear if we consider that the angle to be observed becomes greater and not less the closer the spacing of the object under test

COLOUR

Colour vision is one of Nature's most wonderful achievements, though custom often prevents our perceiving the wonder of it We take it for granted that anyone should readily distinguish the berries on a holly bush, and we are inclined to be derisive of a colour-blind person who cannot do so But so far anatomy has told us little or nothing of how the marvel is achieved Experiments on colour vision show that three separate and fundamental colour sensations exist It is probable that the cones of the retina are responsible for colour vision, and the rods for dark-adapted vision which does not discriminate colour But no division of the cones into three separate kinds corresponding to the three colour sensations has ever been observed Nor is any anatomical peculiarity known which allows a colour-blind eye to be distinguished from a normal one

Can artificial resources help to improve colour discrimination? In some interesting cases they can Indeed, the whole subject of spectroscopy may be thought of as coming under this head We can recognize the colour imparted by sodium to a flame without artificial help When potassium is present as well, the red colour due to it can only be seen when we use a prism to separate the red image of the flame from the yellow one Such a method has its limitations, because if the coloured images are more numerous they overlap, and the desired separation is lost To avoid this, it is necessary to make a sacrifice, and to limit the effective breadth of the flame by a more or less narrow slit, and if the images are very numerous the slit has to be so narrow that all indication of the breadth of the source is lost This, of course, is substantially the method of spectroscopy, into which I do not enter further

There is an interesting class of cases, however, where we cannot afford to sacrifice the form of the object entirely to colour discrimination Consider, for example, the prominences of the sun's limb, which are so well seen against the darkened sky of an eclipse, but are altogether lost in the glare of the sky at other times. In order to see them, prismatic dispersion is made use of, and separates the monochromatic red light of hydrogen from the sky background A slit must be used to cut off the latter but if it is too narrow the outlines of the prominence cannot be seen By using a compromise width, it is possible to reconcile the competing requirements in this comparatively easy case. Indeed, M B Lyot, working in the clear air of the observatory of the Pic du Midi, where there is less false light to deal with, has even been able to observe the prominences through a suitable red filter, which enables the whole circumference of the sun to be examined at once, without the limitations introduced by a slit

A much more difficult problem is to look for bright hydrogen eruptions projected on the sun's disk, and at first sight this might well seem hopeless. A complete view of them was first obtained by photography, but I shall limit myself to some notice of the visual instrument perfected by Hale and called by him the spectrohelioscope A very narrow slit has to be used, and hence only a very small breadth of the sun's surface can be seen at any one instant But the difficulty is turned by very rapidly exposing to view successive strips of the sun's surface side by side The images then blend, owing to persistence of vision, and a reasonably broad region is included in what is practically a single view I must pass over the details of mechanism by which this is carried out

There are now a number of spectrohelioscopes in different parts of the world, and a continuous watch is kept for bright eruptions of the red hydrogen lines Already these are found to be simultaneous with the 'fading' of short radio waves over the illuminated hemisphere of the earth, and the brightest eruptions are simultaneous with disturbances of terrestrial magnetism At the Mount Wilson Observatory, such eruptions have been seen at the same time at widely separated points on the sun, indicating a deep-seated cause. There are therefore very interesting and fundamental questions within the realm of this method of investigation

THE PHOTOGRAPHIC PLATE

We have so far been mainly considering how we may adapt our vision for objects too small or too far off for unassisted sight, and for colour differences not ordinarily perceptible This is chiefly done by supplementing the lens system of the eye by additional lenses or by prisms We cannot supplement the retina, but in certain cases we can do better We can substitute an artificial sensitive surface which may be either photographic or photo-electric

That certain pigments are bleached by light is an observation that must have obtruded itself from very early times—indeed, it is one of the chief practical problems of dyeing to select pigments which do not fade rapidly If a part of the coloured surface is protected by an opaque object —say a picture or a mirror hanging over a coloured wallpaper—we get a silhouette of the protecting object, which is in essence a photograph

Again, it is a matter of common observation that the human skin is darkened by the prolonged action of the sun's light, and here similarly we may get what is really a silhouette photograph of a locket, or the like, which protects the skin locally In this case we are perhaps retracing the paths which Nature herself has taken for the evolution of the eye is regarded as having begun with the general sensitiveness to light of the whole surface of the organism

The sensitivity of at all events the dark-adapted eye depends on the accumulation on the retinal rods of the pigment called the visual purple, of which the most striking characteristic is its ready bleaching by light We can even partially fix' the picture produced in this way on the retina of, for example, a frog by means of alum solution This brings home to us how clearly akin are the processes in the retina to those in the photographic plate, even though the complexity of the former has hitherto largely baffled investigation

There are then many indications in Nature of substances sensitive to light, and quite a considerable variety of them have from time to time been used in practical photographic processes But compounds of silver, which formed the basis of the earliest processes, have maintained the lead over all others The history of photography by means of silver salts cannot be considered a good example of the triumph of the rational over the empirical. For example, the discovery of developers came about thus The first workers, Wedgewood and Davy (1802), had found that they got greater sensitivity by spreading the silver salt on white leather instead of paper. An early experimenter, the Rev. J. B. Reade (1837), was anxious to repeat this experiment, and sacrificed a pair of white kid gloves belonging to his wife for the purpose. When he wished to sacrifice a second pair, the lady raised a not unnatural objection, and he said, "Then I will tan paper " He treated paper with an infusion of oak galls and found that this increased the sensitivity greatly It amounted to what we should call exposing and developing simultaneously. But, in using the method, it is easily observed that darkening continues after exposure is over, and this leads to beginning development after the exposure This step was taken by Fox Talbot a year or two afterwards Instead of crude infusion of galls he used gallic acid Later, pyrogallic acid was used instead of gallic acid, and still survives

The use of gelatine as a medium to contain the silver halide was a more obvious idea. But it was not so easy to foresee that the sensitivity of silver salts would be much further increased when they were held in this medium For long this remained unexplained, until it was noticed that some specimens of gelatine were much more active than others This was ultimately traced by S E Sheppard to the presence of traces of mustard oil, a sulphur compound, in the more active specimens This, in turn, depends in all probability on the pasturage on which the animals that afford the gelatine have been fed The quantity present is incredibly small, comparable in quantity with the radium in pitchblende

The value to science as well as to daily life of the gelatine dry plate or film can scarcely be overestimated Take, for example, the generalized principle of relativity, which attempts with considerable success to reduce the main feature of the cosmical process to a geometrical theory The crucial test requires us to investigate the gravitational bending of light, by photographing the field of stars near the eclipsed sun For this purpose, the gelatine dry plate has been essential and here, as we have seen, we get into complicated questions of biochemistry This is to my mind a beautiful example of the interdependence of different branches of science and of the disadvantages of undue specialization (or should I say generalization ?) We may attempt to reduce the cosmos to the dry bones of a geometrical theory, but in testing the theory we are compelled to have recourse again to the gelatine which we have discarded from the dry bones !

To come back, however, to the development of the photographic retina, as I may call it. As is well known, the eye has maximum sensitivity to the yellow green of the spectrum but ordinary silver salts are not sensitive in this region. Their maximum is in the blue or violet, and ranges on through ultra violet to the X ray region. It was not at all easy to extend it on the other side through green, yellow and red to infra red. The story of how this was ultimately attained is one more example in the chapter of accidental clues skilfully followed up which forms the history of this subject.

In 1873, Dr Hermann Vogel of Berlin noticed that certain collodion plates of English manufacture which he was using for spectrum photography, recorded the green of the spectrum to which the simple silver salts are practically insensitive. The plates had been coated with a mixture which contained nitrate of uranium, gum, gallic acid and a yellow colouring matter. What the purpose of this coating was is not very obvious. It rather reminds one of medieval medical prescriptions which made up in complexity what they lacked in clear thinking. But Vogel concluded with true scientific insight that it must owe the special property he had discovered to some constituent which absorbs the green of the spectrum more than the blue, for conservation of energy requires that the green should be absorbed if it is to act on the plate. He then tried staining the plate with coralline red which has an absorption band in the green with the expected result. With much prescience he says: "I think I am pretty well justified in inferring that we are in a position *to render bromide of silver sensitive for any colour we choose*. Perhaps we may even arrive at this, namely photographing the ultra red as we have already photographed the ultra violet." It was, however, half a century before this far seeing prophecy was fully realized. The development of the aniline colour industry gave full scope for experiment, but it has been found by bitter experience that dyes which can produce the colour sensitiveness are often fatal to the clean working and keeping qualities of the plate. However, success has been attained, largely by the efforts of Dr W. H. Mills, of the chemical department of the University of Cambridge, and of Dr C. E. K. Mees, of the Kodak Company, and we all see the fruits of it in the photographs by lamplight which are often reproduced in the newspapers.

It is now known in what direction the molecular structure of the sensitizing dye must be elaborated in order to push the action further and further into the infra-red, and the point when water becomes opaque has nearly been reached, with great extension of our knowledge of the solar spectrum. The spectra of the major planets have also been extended into the infra red, and this has given the clue as to the true origin of the mysterious absorption bands due to their atmospheres which had baffled spectroscopists for more than a generation. These bands have been shown by Wildt to be due to methane or marsh gas. Neptune, for example, has an atmosphere of methane equivalent to 25 miles thickness of the gas under standard conditions. In this Neptunian methane we have a paraffin certainly not of animal or vegetable origin, and I venture in passing to make the suggestion that geologists might usefully take it into consideration in discussing the origin of terrestrial petroleum.

PHOTO ELECTRIC SURFACES

The photographic plate is not the only useful substitute for the human retina. We have another in the photo electric surface. The history of this discovery is of considerable interest. Heinrich Hertz in his pioneering investigation of electric waves (1887), made use of the tiny spark which he obtained from his receiving circuit as an indicator. His experiments were done within the walls of one room. When he boxed in the indicating spark so as to shield it from daylight and make it easier to see, he found that this precaution had exactly the opposite effect—the spark became less instead of more conspicuous. To express it shortly and colloquially, this action was found to depend on whether or not the spark of the receiver could see the spark of the oscillator. Moreover, seeing through a glass window would not do. It was ultra violet light from the active spark that influenced the passive spark. Further, Hertz was able to determine that the action occurred mainly, if not entirely, at the cathode of the passive spark.

The next step was taken by Hallwachs, who showed that it was not necessary to work with the complicated conditions of the spark. He found that a clean zinc plate negatively charged rapidly lost its charge when illuminated by ultra violet light.

The final important step was in the use of a clean surface of alkali metal *in vacuo*, which responds to visible light, and passes comparatively large currents. This constitutes the photo-electric cell very much as we now have it, and was due to two German schoolmasters, J. Elster and

H Geitel English physicists who met them during their visit to Cambridge a generation ago will not fail to have agreeable memories of their single-minded enthusiasm and devoted mutual regard Sir J J Thomson has recalled them to our recollection in his recent book. They could scarcely have foreseen that their work, carried out in a purely academic spirit, would make possible the talking films which give pleasure to untold millions

The sensitiveness of the dark-adapted eye has often been referred to as one of its most wonderful features ; but, under favourable conditions, the sensitivity of a photo-electric surface may even be superior According to our present ideas, no device conceivable could do more than detect every quantum which fell upon it Neither the eye nor the photo-electric surface comes very near to this standard, but it would seem that the falling short is rather in detail than in principle The action of the photo-electric cell depends on the liberation of an electron by one quantum of incident energy, and under favourable conditions the liberation of one electron can be detected, by an application of the principle of Geiger's counter The action of the dark-adapted eye depends on the bleaching of the visual purple According to the results of Dartnell, Goodeve and Lythgoe, it appears likely that one quantum can bleach a molecule of this substance, and in all probability this results in the excitation of a nerve fibre which carries its message to the brain

The photo-electric cell can be used like the photographic plate at the focus of an astronomical telescope It might seem from the point of view of evolution a retrograde step to substitute a single sensitive element for the 137 million such elements in the human eye In this connexion, it is interesting to note that, in certain invertebrate animals, eyes are known which have the character of a single sensitive element, with a lens to concentrate the light upon it Such an eye can do little more than distinguish light from darkness But its artificial counterpart using the photo-electric surface has the valuable property that the electric current which indicates that light is falling upon it can be precisely measured, so as to determine the intensity of the light. In contrast with photographic action, the energy available to produce the record comes not from the original source of light, which only, as it were, pulls the trigger, but from the battery in the local circuit, and it may be amplified so as to actuate robust mechanisms. It has been applied with success to guiding a large telescope or, in a humbler sphere, to open doors, or even to catch thieves

However, the scientific interest lies more in the possibility of accurate measurement As an interesting example we might take the problem of measuring the apparent diameter of the great nebula in Andromeda As is known, modern research tends to indicate that the Andromeda nebula and other like systems are the counterparts of the galaxy, being in fact island universes But until lately there was such a serious difficulty in that all such systems appeared to be considerably smaller than the galaxy Stebbins and Whitford, by traversing a telescope armed with a photo-electric cell across the nebula, have found that its linear dimensions were twice as great as had been supposed, reducing the discrepancy of size to comparatively little

TELEVISION

But, it may be suggested, could we not go further and make a photo electric equivalent, not only for the rudimentary kind of eye, which has only a single sensitive element, but also for the developed mammalian eye, which has an enormous number ? Could we not build up on separated photo-electric elements a complete and detailed picture ? In point of fact this has been done in the development of television , and since this new art which interests us all can properly be considered as an extension of the powers of normal vision, no excuse is needed for devoting some consideration to it

We must divide the photo-electric surface into minute patches which are electrically insulated from one another This is not too difficult , but if it were proposed directly to imitate Nature, and attach a wire, representing a nerve fibre, to each of these patches, so as to connect it to the auxiliary apparatus, we might well despair of the task , for there are probably half a million such connexions between the human retina and the brain. In the artificial apparatus for television, one single connexion is made to serve, but it is in effect attached to each of the patches in rapid succession by the process of 'scanning' the image The photo-electric mosaic is on one side of a thin mica sheet, and a continuous metal coating on the other side gives the connexion, which is by electrostatic induction Each element of the surface forms a separate tiny condenser with the opposing part of the back plate.

Scanning is achieved by rapidly traversing a beam of electrons over the mosaic line by line The whole surface, and therefore each element must be scanned at least twenty times a second In the intervals an element is losing electrons more or less rapidly The scanning beam comes along, and restores the lost electrons discharges the little condenser formed by the element and the back plate, and sends an electric signal into the wire attached to this plate The strength of this signal will depend on how many electrons the element had lost since the previous scanning and thus on the luminous intensity of that part of the image An important point is that the element is in action all the time and not only while it individually is being scanned

We have thus transmuted the momentary picture into a series of electric pulses occupying in all a time of one twentieth of a second and these can be amplified and sent out as wireless signals How are they to be turned back again into a visible picture at the other end ? Well that is not, perhaps, so difficult as the first conversion of the picture into signals We must make a beam of electrons follow and imitate the periodic movements of the scanning beam at the other end The beam of electrons falls on a luminescent screen, and makes it light up more or less brightly according to the intensity of the electron beam If we use the incoming signals to modulate the electron beam, we can make them correspond with the intensities at the sending end, and the original picture is reconstructed piece by piece The reconstruction is completed in one twentieth of a second or less and the process begins again The successive pictures blend into one another as in the cinema, and movement is shown with apparent continuity

It seems not unlikely that the electric eye or iconoscope, as it has been called, may have applications apart from television Dr V K Zworykin, who took an important part in its development, suggested that it might be used to make visible the image in the ultra violet microscope, which would be much too faint for direct projection on a fluorescent screen For that purpose the sending and receiving apparatus would of course, be connected directly, without radio transmission It might also be used for rapid photography, if the photographic plate replaced the viewing screen The beauty of the device is that the energy is supplied locally, the distant light source merely releasing it The principle of amplification may thus perhaps be applied to the photographing of faint objects

I come to the close of this part of my subject Much of modern scientific doctrine appears at first sight to have an elusive and even metaphysical character and this aspect of it seems to make the strongest appeal to many cultivated minds Yet upon the whole, the main triumphs of science lie in the tangible facts which it has revealed , and it is these which will without doubt endure as a permanent memorial to our epoch My main thesis has been that these are discovered by methods not essentially different from direct scrutiny It is hoped that the present survey may remind you that if we allow for a reasonable broadening of the original meaning of the words, it remains true, after all that seeing is believing '

PART II

During the Great War itself few scientific men in any country doubted that it was their duty to do what they could to apply their specialized knowledge to the purposes of war nor was it often suggested by publicists that there was any countervailing consideration on the contrary, they urged strongly that our resources in this direction should be efficiently mobilized It is chiefly in vague general discussions that the opposite view becomes vocal

Science, it is urged, is the source of all the trouble and we may look to scientific men for some constructive contribution to finding a remedy It is worth while to inquire what basis there is for this indictment, and whether in fact, it is feasible for men of science to desist from labours which may have a disastrous outcome, or at any rate to help in guiding other men to use and not to abuse the fruits of those labours I may say at the outset that I have no sanguine contribution to make I believe that the whole idea that scientific men are specially responsible is a delusion born of imperfect knowledge of the real course of the process of discovery Indeed, very much the same complaint was made before the scientific era Let me refer you to Shakespeare's play, "Henry IV"

> "Great pity, so it was
> This villainous saltpetre should be digged
> Out of the bowels of the harmless earth
> Which many a good tall fellow had destroyed
> So cowardly "

The quotation leads us to inquire how far the further development of this particular kind of frightfulness into modern high explosives was deliberate or not

In the course of systematic study of the chemistry of carbon compounds it was inevitable that the action of nitric acid on substances like benzene toluene glycerine cellulose and the like should be tried No one could foresee the result In the case of benzene we have nitrobenzene the key to the aniline dye industry In the case of glycerine Sobrero obtained in 1846 the highly explosive liquid called nitro glycerine He meant no harm and in fact his discovery lay dormant for many years until Nobel turned his attention to the matter in 1863 and showed how by mixing nitro glycerine with other substances solid explosives could be made which admitted of safe handling Dynamite was one of them They proved invaluable in the arts of peace for example in mining and in making railway tunnels such as those through the Alps They were used by the Irish Fenians in the dynamite outrages of the eighties These attempted outrages were not very successful and so far as I know no one was inclined to blame science for them any more than for the Gunpowder Plot Like the latter they came to be considered slightly comic If anyone doubts this he may agreeably resolve his doubts by reading R L Stevenson s story The Dynamiter At all events high explosives had been too long in use in peaceful industry for their misuse to be laid directly to the account of science

Coming next to poison gas We read that Pliny was overwhelmed and killed by sulphur dioxide in the eruption of Vesuvius in A D 79 During the Crimean War the veteran admiral Lord Dundonald urged that the fumes of burning sulphur should be deliberately used in this way but the suggestion was not adopted Even if it had been scientific research *ad hoc* would obviously have had little to do with the matter During the Great War chlorine was used on a large scale I need scarcely insist that chlorine was not isolated by chemists for this purpose It was discovered a hundred and forty years before as a step in the inquiry into the nature of common salt

Coming to the more recondite substances we may take mustard gas—really a liquid—as typical It is much more plausible to suggest that here was a scientific devilment deliberately contrived to cripple and destroy But what are the real facts ?

Referring to Watts s Dictionary of Chemistry (edition of 1894) there is an article of less than forty words about mustard gas (under the heading of dichlordiethyl sulphide) After the method of preparation used by Victor Meyer has been mentioned the substance is dismissed with the words *oil very poisonous and violently inflames the skin Difference from diethyl sulphide*

There are sixteen other compounds described at comparable length on the same page So far as I know none of them is of any importance A not uncommon type of critic would probably say that the investigation of them had been useless the work of unpractical dreamers who might have been better employed One of these substances namely mustard gas is quite unexpectedly applied to war and the production of it is held by the critics to be the work not of dreamers but of fiends whose activities ought to be suppressed !

Finally at the bottom of the page begins a long article on chloroform This substance as you know has relieved a great deal of pain and on the same principle the investigator who produced it was no doubt an angel of mercy The trouble is that all the investigators proceeded in exactly the same spirit the spirit that is of scientific curiosity and with no possibility of telling whether the issue of their work would prove them to be fiends or dreamers or angels

Again there is the terror of thermite incendiary bombs spreading fire broadcast throughout great cities The notion is sometimes encountered that thermite was invented for this purpose Nothing could be further from the truth I first made acquaintance with it myself in 1901 by hearing a lecture at the Royal Institution by the late Sir William Roberts Austen on Metals as Fuel He directed attention to the great amount of energy which was liberated when aluminium combined with oxygen and showed how aluminium powder mixed with red oxide of iron would react violently with it withdrawing the oxygen from the iron and becoming brilliantly incandescent in the process He showed further how this mixture called thermite could be used for heating metal work locally so as to make welds for example in joining two iron pipes end to end I venture to say that it never occurred to him or to any of his hearers that thermite had any application in war

In discussions of this kind a distinction is often implied between what I may call old fashioned knowledge and modern scientific knowledge The latter is considered to be the special handmaid of frightfulness The futility of this distinction is easily seen by considering a special case Iron is thought of as belonging to the pre scientific era while aluminium is thought to belong to the scientific era From the point of view of chemistry both are metals and the problem of producing them in either case is a chemical one When produced they both have their function in frightfulness' iron to cut and stab aluminium to make thermite bombs to burn and destroy If modern science makes its contribution to frightfulness in giving us aluminium ancient craft did so in giving us iron It is obviously absurd to make any distinction in principle between the two cases Science properly understood includes all real knowledge about material things whether that knowledge is old or new

All these terrors have only become applicable against a civilian population by the development of aircraft Military objects were certainly not the incentive of the successful pioneers of artificial flight They were fascinated at first by the sport of gliding and afterwards by a mechanical transport problem

It is true that brilliant writers of imaginative fiction such as Jules Verne and H G Wells had foretold all and more than all the horrors that have since come to pass But it is perhaps more to the point to inquire what were the contemporary views of practical men The Wrights made their first successful flight in 1903 In 1904 I myself heard the then First Sea Lord of the Admiralty repudiate with scorn the suggestion that the Government were interesting themselves in the matter and I know with equal definiteness that even so late as 1908 the Chief of the Imperial General Staff did not believe in the military importance of flight Would it be fair then to blame the inventors for not having realized it and for not having stayed their hands ?

Summing up what may be learnt from the experience of the past I think we may say that the application of fundamental discoveries in science to purposes of war is altogether too remote for it to be possible to control such discoveries at the source

For good or ill the urge to explore the unknown is deep in the nature of some of us and it will not be deterred by possible contingent results which may not be and generally are not fully apparent until long after the death of the explorer The world is ready to accept the gifts of science and to use them for its own purposes It is difficult to see any sign that it is ready to accept the advice of scientific men as to what those uses should be

Can we then do nothing ? Frankly I doubt whether we can do much but there is one thing that may be attempted The British Association has under consideration a division for study of the social relations of science which will attempt to bring the steady light of scientific truth to bear on vexed questions We rejoice to know that our distinguished American visitors are in sympathy with this aim and we hope that our discussions with them will bear useful if modest fruit in promoting international amity

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS *

Logic and Probability in Physics

AFTER paying a short tribute to the memory of Lord Rutherford, the president of Section A (Mathematical and Physical Sciences), Prof C G Darwin, comes to his main subject, which is the inadequacy of the reasoning processes which have in the past been regarded as the proper machinery of scientific thought We have set up as the ideal form of reasoning the formal logic of Aristotle, we rarely conform to this ideal, but instead we make use of arguments having no accurate axiomatic basis, which compel belief because of some large accumulation of favourable evidence The old logic was devised for a world that was thought to have hard outlines, and now that we know that the outlines are not hard the method of reasoning must be changed The key to the modification lies in probability, but whereas in the past it was expected that probability could somehow be fitted into the old logic, the attempt has always failed, and we must recognize it as an independent principle. Our instincts only accept this with difficulty, but a similar unsatisfying state of affairs used to exist in mechanics, which has been over come by the quantum theory, and an analogy may be developed between the two cases

There follows a review of the history of the quantum theory, touching on a number of points of interest, but having special reference to the way in which it has dealt with causality The old mechanics seemed to point with all the compulsive force of a logical syllogism to absolute determinism We are still scarcely free from the feeling of this compulsion, but we know it is wrong, and we know where the fault lay. An analogy may be made between this state of affairs and our feeling about the place of probability in logic We used to feel that classical mechanics provided no room for anything outside itself, and we feel that the old logic is the only really admissible form of reasoning. Certain things refused to fit into the classical scheme and led to the old quantum theory, and we have found that the old logic is inadequate without the supplementary principle of probability. In mechanics the union is completed by the new quantum theory, but we have not yet satisfactorily blended our reasoning principles.

The sort of way the union may come about is suggested by another branch of physical theory, the kinetic theory of gases One of the most important ideas in the statistical theory of matter has been Gibbs's ensemble With the old mechanics the ensemble was a rather strange idea, and it was hard to see where it came from, but now it fits beautifully into the new mechanics, for any actual piece of gas is not merely a single member from among the countless representatives in the ensemble, but is itself the whole ensemble This example suggests a real synthesis of probability with our other reasoning processes, and gives the hope of a true reasoning adapted not to the artificially simplified world of hard outlines of the classical mechanics, but to the real world with its slightly indefinite outlines

The address concludes with a plea for a reform of our education at both school and university, so that probability and statistics should be given a proper share in our mathematical courses At present all the attention is given to things susceptible of exact proof, and none to the things of much more frequent occurrence where inaccuracies, tolerances or fluctuations are also of interest It is not so much that new special courses are needed as that the emphasis should be altered in the ordinary courses of mechanics and kindred subjects The mathematics would not be any more difficult than in the customary courses, but the train of thought is at present unfamiliar, and it would not be hard to remove this unfamiliarity In this way the student would acquire a much juster appreciation of the physical world than can ever be acquired by an exclusive attention to those things which are capable of exact proof

Recent Investigations in the Chemistry of Gold

THE recent advances in our knowledge of the chemistry of gold have for the most part been due to investigations carried out by workers in Great Britain, amongst others, H. Bassett, E G. Cox, F G. Mann, Sir Gilbert Morgan, Sir William Pope, W Wardlaw, and their respective co-workers. This work, together with that of the president of Section B (Chemistry), Prof. C S. Gibson, and his collaborators, which forms the topic of Prof. Gibson's presidential address, has emphasized the similarities and also the striking anomalies existing among the currency metals, copper, silver and gold, the metals of Sub-group 1 *B* of the Periodic

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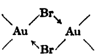
* Lord Rayleigh's presidential address, and the addresses of the sectional presidents, are being published as "The Advancement of Science, 1938". (Cambridge: B A. Reception Room London Burlington House.) 3s. 6d.

Classification These anomalies are unexplained but are to some extent correlated with those existing among the transitional metals

Copper silver and gold all exist in the univalent condition but in this state only silver is from a chemical point of view a typical metal since cuprous copper and aurous gold do not form normal salts In their compounds cuprous copper and aurous gold are always co ordinated but whereas cuprous copper may be 2 and 4 covalent aurous gold is always 2 covalent and no compounds are known in which it has a higher co ordination number Argentous silver may be 2 and 4 covalent its co ordination compounds are almost completely analogous with the corresponding cuprous compounds and the four valencies of cuprous copper and argentous silver have a tetrahedral configuration Unlike cupric copper bivalent or argentic silver is chemically not a typical metal since it only forms co ordinated complexes which may be present in electrolytes and non electrolytes When it is 4 covalent argentic silver forms compounds which are analogous and isomorphous with the corresponding cupric compounds and the four valencies of cupric copper and argentic silver have a planar configuration One striking anomaly among these metals is the non existence of bivalent gold In the tervalent or auric condition gold again is chemically not a typical metal and is always 4 covalent Consequently unlike copper and silver gold never assumes the effective atomic number (Sidgwick) of the next inert gas X ray crystallographic examination has demonstrated the planar configuration of the four valencies of tervalent gold and the linear configuration of the two valencies of univalent gold

What may be described as the new chemistry of gold has arisen from the study of the organic derivatives of the metal which were discovered by Sir William Pope and C S Gibson in 1907 and their investigation has been extended by Gibson and his collaborators during the last seven years The organic compounds of gold most readily accessible are colourless crystalline non electrolytes having the general formula $(R_2AuX)_2$ R and X representing univalent hydrocarbon radicals and halogen atoms respectively As shown by the low dipole moment and X ray crystallographic examination the molecule contains the planar ring structure



which is present in many auric and mixed auric aurous compounds

From the bromine derivatives are easily prepared deep red crystalline non electrolytes having the general formula $(RAuBr_2)_2$ These compounds have high dipole moments and contain the same planar heterocyclic ring containing two 4 covalent auric atoms to one of which two hydrocarbon radicals are attached In agreement with their constitution these compounds behave chemically as equimolecular mixtures of the compounds $(R_2AuBr)_2$ and of gold tribromide $(AuB_3)_2$ the latter compound having the same planar heterocyclic ring mentioned above

The remarkable tendency due to co ordination for auric and to a less extent aurous gold to become members of heterocyclic ring systems is further illustrated by the interesting colourless non electrolyte diethylgoldacetylacetone and also by the cyano derivatives obtained by the action of silver cyanide on the first mentioned compounds These cyano compounds are non electrolytes having the general formula $(R_2AuCN)_4$ and the molecule as shown by the low dipole moment and X ray crystallographic investigation (H M Powell and R F Phillips) contains a planar twelve atom ring having four symmetrically situated 4 covalent auric atoms These compounds have the additional interest in that spontaneously or on gentle heating they yield free hydrocarbon radicals The first stage of this decomposition yields a mixed 4 covalent auric and 2 covalent aurous compound $(RAuCN)_4$ the molecule of which again has a twelve atom planar ring structure containing two symmetrically placed auric and two symmetrically placed aurous atoms the latter being 2 covalent

There being no evidence that gold can have higher covalencies than two when it is aurous and four when it is auric precludes the possibility of obtaining optically active gold compounds in which the gold atom is the centre of asymmetry

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Development and Evolution

THE Theory of Recapitulation which at the opening of this century tended to dominate biological and palæontological thought upon the relationship of development to evolution has in these latter days fallen into disrepute This state of affairs is reflected in recent literature by a diversity of views ranging from complete rejection of the theory to almost unqualified acceptance Prof H H Swinnerton in his presidential address to Section C (Geology) seeks by reference to palæontological evidence to elucidate the causes of this wide diversity of opinion and to harmonize the observations out of which it has arisen

In so far as developmental changes reflect evolutionary changes of the past or foreshadow those which are to come the relationship of development to evolution is either retrospective or prospective Failure to keep these two aspects distinct from one another has been the cause of much of the confusion of thought which exists

The palæontological evidence used in the address is limited to well-authenticated material, made up of numerous specimens carefully collected from known horizons, and is of such a quality that the development of individuals could be worked out with reasonable fullness.

Dealing in the first place with the retrospective aspect of the problem, it is helpful to distinguish between the very early, or embryonic, stages of development and the later, or neanic stages, during which the young gradually assumes the characteristics of the adult A careful comparison of the development with the successive stages of evolution shows that in some cases there is a remarkably close resemblance between the changes passed through in the neanic period and the changes exhibited by the adults of previous generations This proves that recapitulation of evolutionary stages as manifested by adults does actually take place On the other hand, the conditions seen in the embryonic phases exhibit little or no resemblance to any known adult ancestor, but they do resemble very closely the corresponding juvenile stages both of ancestral and of allied forms. This distinction between juvenile and adult recapitulation corresponds with the different bodies of facts observed and emphasized respectively by von Baer and Haeckel, and by their present-day followers

Though the recapitulation of the complete combination of adult characters seems to be confined to the lower forms of life, the limited recapitulation of individual characters is widely spread even in the highest grades of animals

Turning to the prospective aspect of the subject, it should be noted that new characters (cœnogenetic) may appear at an early stage of development Some of these are limited in their occurrence to these stages , others may extend, in subsequent generations, to later or even adult life Where this happens, the recapitulatory record may be seriously vitiated New characters (deuterogenetic) may also appear in the latest stages of development. Such tend, in subsequent generations, to pass back to successively earlier neanic stages, and thus build up a recapitulatory record

In both these cases the rate at which the new characters attain full expression in evolution varies greatly. In some racial stocks it is attained slowly with the passage of a long period of time. In others the successive phases of expression may come quite rapidly. Occasional instances occur in which the rate of expression appears to be so rapid as to suggest simultaneous mutation In such cases a false impression of serial evolutionary change is produced by the progressive elimination of individual types in the order of the phases in the series

In conclusion, it may be suggested that the development of the individual exhibits a body of characters derived from both adult and juvenile stages in the life of its ancestors This provides a framework into which subsequent evolutionary changes may be fitted This fitting is carried out by various processes which may proceed separately, simultaneously, or in sequence in the development of different individuals of allied organisms

Fluctuations in the Abundance of Marine Animals

IN his presidential address to Section D (Zoology), Dr. Stanley Kemp directs attention to the great fluctuations in the abundance of marine animals and to the need for further study of their causes. Normal annual fluctuations, due for the most part to events which occur in the early stages of the animal's life, may be very great : it is not uncommon to find that one year-class of fish is fifty times as abundant as another The evidence at present available, drawn from the incidence of good and bad survival years in a few of the more important European fishes, is that these annual fluctuations are strictly localized—a certain species in a particular place will be affected in one way, while another species in the same place, or the same species in another place, will be affected in a different way

In recent years, it has become increasingly apparent that this is not the only kind of fluctuation to which marine animals are subject. There are others, here called long-period fluctuations, which are superposed upon the annual fluctuations and affect many, or perhaps all, species simultaneously over a wide area

Two illustrations of such long-period fluctuations are given In the Channel waters off Plymouth four separate lines of evidence show that since 1931 great changes have taken place. (1) Beginning with 1931, there has been a steady reduction in the numbers of larval fish in the offshore waters : the larvæ of summer-spawning fish have now on the average been reduced to one fifth of their former abundance and those of spring-spawning fish to one third. (2) A marked change has occurred in the constitution of the herring shoals which form the basis of the winter fishery at Plymouth. Since 1931, the proportion of the younger year classes of fish has been reduced from upwards of 66 per cent to less than 20 per cent : in the last few years the fishery has suffered greatly and it is now virtually abandoned (3) In 1930 (and though exact figures are not available it was evidently much the same in former years) the offshore plankton contained *Sagitta elegans* which is characteristic of mixed Atlantic water and *S setosa* which is characteristic of Channel water in the proportions of 94 6 but since 1932 with a single exception in 1936 these proportions have been reversed (4) The winter maximum of dissolved phosphate has over the same period shown a heavy decrease amounting on the average to about 35 per cent Comparable data from other areas are not available but the failure in recent years of the Donegal herring fishery has been accompanied by a similar change in the constitution of the shoals and may be due to the same causes

The changes in the Plymouth area are due it seems to the lack of influxes of phosphate rich water from the Atlantic Salinity and temperature records show indeed that incursions of Atlantic water have passed up the Channel but the records cannot be correlated with the biological and phosphate data and the great influx of Atlantic water into the North Sea in 1921 is known to have been detrimental to the herring fisheries It thus appears that influxes may be of more than one kind and that only water rich in phosphate or potentially rich because it carries an abundant plankton will benefit the Channel fauna

The second illustration of a long period fluctuation is from northern waters Here there have recently been great changes in the fauna owing to a rise of 1° or 2° C in the temperature of the water and this is due presumably to an increase in the strength of the Atlantic drift By reason of this change many animals have been able to extend the limits of their distribution and in almost every section of the fauna significant movements have been noted profitable cod fisheries have been established at Bear Island and in West Greenland and an unusual abundance of herring has been found on the Murman coast

Long period fluctuations are thus due to a widespread alteration in some hydrographic factor in the environment and though in the two instances given this factor is different—at Plymouth phosphate and in northern waters temperature—it is in the ocean to the west that the changes originate and it is here in the open Atlantic that the reasons must be sought At present our knowledge of the circulation in the North Atlantic is very deficient but with the work now in progress it is to be expected that the main features will shortly be better known To the biologist however it is the irregularities in the system which are of primary importance and it is only by regular and repeated observations carried out over a wide area that the causes of these long period fluctuations can be discovered

In conclusion attention is directed to the need for greater activity in fishery administration throughout the Empire for though there are some notable exceptions it appears that the lessons we have learnt in Great Britain are not generally understood elsewhere In almost every problem in marine biology it is essential to possess a background of fundamental knowledge which can only be obtained by long years of patient study In many parts of the Empire not even a beginning has been made in the acquisition of such knowledge there are vast areas in which no single species of fish can as yet be recognized in all its stages of development while little or nothing is known of such matters as rate of growth spawning periods food migrations and fluctuations in abundance The importance of such information cannot be over estimated for the opportunity of dealing effectively with a fishery problem will almost invariably be lost unless knowledge has been obtained in advance and is ready for application

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Correlations and Culture A Study in Technique

PROF GRIFFITH TAYLOR S presidential address to Section F (Geography) falls into three divisions In the first the field of cultural geography is considered in the second a technique which has been found invaluable in that subject is discussed and illustrated finally suggestions are made as to the aspects of culture which should be included in a general education The relation of geography to history anthropology sociology and philology is emphasized It is shown that there are common fields of research in which the technique of the physical scientist can be used by the cultural geographer to aid in problems in the humanistic disciplines

The aid geographers can give to historians is illustrated by examples from the Weald and from the blue grass country of Kentucky The characteristic cultural development in both is shown to depend on structure primarily though most historians ignore this important correlation The use of *isopleths* (lines of equal abundance) can be used with profit in an interpretation of the essential features of the Renaissance As an indicator of *trends* and *salient features* they might well be more extensively used by the historian

The geographer s task should be to teach the student to doubt dogmas involving distribution and to make his own deductions from fundamental data In a general education this is a far more valuable function than memorizing economic data which fills so much of geographic teaching to day

One of the main purposes of the address is to show that from the *map* of the distribution of culture-facts, the investigator can deduce the cradle of the various cultures and the order of their evolution This principle, long used by the botanist and biologist, is of great value to the anthropologist, sociologist and philologist The *distributions* of man, of various industries and populations, of languages, etc , belong to the field of the geographer A lengthy study of such distributions leads to views often much at variance with those accepted as orthodox Some examples discussed are the cradle-land of man, the differentiation of the races, the inaccuracy of the terms 'Caucasian' and 'Mongolian', the spread of cultures from Asia into the Pacific, and the probable cradle of civilization In many of these problems the implications of the isopleths have been ignored by most researchers

It is suggested that a new term is needed for groups which are linked by *culture*, but are not racial units. An extension of the use of the word '*cult*' is suggested Thus there is no Jewish *race* in Europe, or French *race* in Canada , but it is logical to talk of a Jewish or French 'cult' Race should denote 'breed', and is purely a *biological* concept The problem of the Jews and of the Aryans is used to illustrate a glaring example of dangerous ignorance on the part of powerful political groups A new technique of approaching linguistic relationships—based on distributions—is discussed. It seems to offer clues as to the relationships between, and the origins of, Aryan, Basque, Altaic, and other linguistic groups Prof Griffith Taylor believes that the Aryan languages originated near the Caspian. He suggests that the isopleths support the view that the Nordic race originally spoke Finn or some allied *non-Aryan* language

Geographers may be classified in three groups *theocratic* (that is, teleological), *environmental* or *possibilist* A belief in environmental control, to which the name "Stop-and-go Determinism" has been given, is favoured It is opposed to the orthodox views of geographic philosophy

A drastic revision of the programme for a general cultural education is required, especially in the Dominions. Educators must abandon the technique of Augustine of Canterbury for that of Aristotle. The latter tried (in a living language) to put the youth of Greece *en rapport* with the vital problems of the day. He did not insist on their spending years trying to learn the long-dead language of Tutankhamen.

It would seem desirable to swing the attention of youth for a generation or two from a study of classics or of the problems of physical science to the more difficult and dangerous problems of social science There is no risk to-day, though there was in the past, in stating that the earth is a globe, revolves around the sun, and is of infinitely small importance in the cosmos But there is grave danger in many circles in stating the truth about Communism, Socialism, Judaism, Nordicism, and many other -isms which conflict with established or dictatorial interests These creeds are cultural facts, which can be more readily understood if tackled in a *graphic* manner It is no quibble to say that they are to-day more vital to the man of culture, that is, with a well-rounded education, than is the well-recognized and valuable culture based on art, music, or classics Thus the geographer whose interests lie not only in the economic but also in the *cultural* field can feel that he is working right on the battle-front in man's progress towards a higher type of civilization

Eighteen ecological diagrams form an essential feature of the address

Scope and Method of Economics

THE object of the presidential address by Mr R F. Harrod to Section F (Economics) on *method* is threefold . (1) An attempt is made to show the kind of knowledge on which the practical recommendations, which economists have been in the habit of giving with a considerable degree of assurance, are grounded. (2) An attempt is made to define precisely the empirical basis of the general laws which constitute traditional economic theory (3) Attention is given to the new ground over which contemporary theory, more tentative and more empirical, is striving to advance.

The recommendations do not issue from a set of 'laws' relating to the causal sequence of events The scientific groundwork of these recommendations is a systematic classification of different kinds of economic activity and a simultaneous conspectus of the system as a whole For example, the condemnation of protection is not based on precise knowledge of the sum of consequences likely to result from it , but when we have made a systematic classification of the purposes of economic effort and grasped the mode of operation of the system of a whole, we see that protection fails to take account of this, implicitly assumes a different working of the system and, save in exceptional circumstances, produces a net residue of frustation.

The economist's criterion of the good as that which is preferred is defined, and it is shown that it may be validly employed whatever the moral or political objectives of the society may be. The economist's criterion is free from moral or political bias, and it has to be employed even if the economist is asked to advise subject to some stated political objective, such as national self-sufficiency

In addition to the system of prescriptions, traditional economics has provided a body of general laws relating to the sequence of events These have been largely deductive, because they spring from a single simple principle, which has an empirical basis, but one derived from an immensely wide human experience, namely the law of demand or the law of diminishing utility This is almost axiomatic and further investigations are unlikely to reinforce the authority it already has By the aid of it and of its corollaries it is possible to derive a theory of supply and demand, by which the effect of specified changes on the course of prices, wages employment, etc may in principle be determined But this law and its corollaries are of very wide generality and consequently are of little use for prediction in any particular circumstances

To have greater predictory power in this field, it would be necessary to be able to state the laws governing the demand for particular commodities, etc in quantitative terms Owing to the plurality of causes it is extremely difficult to derive such laws from the data of observation The quantitative laws would certainly be far more conjectural than the general qualitative results derived from the demand axiom Interesting attempts have been made along these lines But it is probable that the future of quantitative empirical economics lies elsewhere Indeed the success of deductive reasoning up to a certain point has probably caused an excessive concentration of effort on this branch of the subject

The wealth of recommendation which has characterized past economics, may be reconciled with its paucity of predictory power, when it is appreciated that the power does not rest on the few general causal laws which we have but on classificatory and survey work

Contemporary study is seeking new approaches to the establishment of general causal laws, outside the ambit of the traditional laws of demand and supply It is not yet certain whether greater success is likely to be obtained by the hypothetical deductive method, which must depend on suitable data being thrown up by the facts of the working world to take the place of the crucial experiment, or by a more radically empirical method, which seeks by constant study and re classification of the facts to make them speak for themselves and suggest new laws

In one field at least Mr Harrod hopes for a further successful outgrowth of deductive theory. The laws of demand and supply, already referred to, which are sometimes known as static theory', may be compared with the laws of statics relating to bodies at rest It should be possible to develop a system of laws, which by analogy may be called dynamic theory, relating to the behaviour of a system when the fundamental magnitudes, population, capital, etc , are increasing (or decreasing) Mr Harrod suspects that we are on the verge of formulating one or two simple axioms, based on very wide experience and having almost as great an authority as the law of demand in static economics from which a quite complicated set of laws relating to a system in motion may be derived Such an axiom may be that people save a larger amount if they have a larger income Since our society is in fact growing and not stationary the hypotheses which theorists will be disposed to make in this department will be subject to easier verification than those of static theory

This is, however but one out of many possible lines of advance A greater tendency towards the empirical may safely be predicted Empirical work in economics is exceedingly laborious and can only flourish if there is ample endowment for full time research workers The branch of statistical theory of especial use to empirical economists is at present displaying a welcome vitality

Economists should be keenly alive to the findings of workers—sociologists anthropologists, etc on the periphery of their subject But the suggestion recently put forward by one or two eminent persons that economics is in a parlous state requiring salvage by workers in sister subjects is rejected with contempt Of all the social studies economics has been most successful in attaining valid general laws of interest and authority, and it is at the moment in a condition in which an advance over a wide front may reasonably be expected

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Changing Outlook of Engineering Science

IN Section G (Engineering), seeking a topic of concern to both practising and academic members of his audience, the president, Prof R V Southwell, undertakes a general stocktaking—to view the trend of engineering science regarded both as an art and as a field for study, teaching and research He divides his presidential address into three main sections, dealing (1) with policy in regard to the teaching of engineering science, (2) with policy in regard to engineering research, and (3) with 'foreign policy'—the relation of the engineer to the community , its keynote throughout being that in the changing circumstances of to-day engineers, whether practical or academic, must frame their policies in collaboration, not wait for action to be forced on them by pressure from without

Among changing circumstances are (1) the trend of modern physics (2) the attitude of industry towards the university graduate and (3) the national organization for applied research each has implications which no engineer can afford to neglect In regard to the training of university students which usually occupies five years divided between laboratory and works he urges the desirability of planning for this period as a whole and he suggests that university courses are too often overloaded so that insufficient time is left for those divergent pursuits which do most to develop the personal qualities that industry has come to value Matters appropriate for treatment in the lecture need not necessarily be included in the examination syllabus

Engineering research Prof Southwell believes will continue to be prosecuted in universities not withstanding its increasing demand for specialized knowledge of mathematics physics and chemistry and the increased provision which now exists in Government institutions and in industrial research departments Compared with professional physicists chemists and mathematicians academic engineers have a special point of view and one that is needed Their work will come to approximate more and more to what in the last century was called pure physics schools of engineering will find problems different from those which engaged their energies a generation ago When a problem can be turned over to trained men who will work on it full time it is uneconomic both of brains and of money to pursue it at universities in occasional spells of leisure from the duties of teaching and administration

Under his last heading—public relations—Prof Southwell utters a protest against an implication in much that is written nowadays that because the range of engineering includes guns battleships aeroplanes tanks therefore engineers are to be regarded as a class more than others responsible for the horrors of modern war Wars are not made by engineers but by communities we all have responsibility but as citizens and not as specialists It is vain to talk as though we could have had the benefits of science without its risks and its temptations Either we must choose deliberately impotence as preferable to the power of doing evil or we must accept knowledge for the double edged tool it is vowing to use it wisely

The Orient and Europe

THE distortions of prehistory on the Continent to fit biased and distorted political dogmas and the travesty of the subject broadcast by the B B C a year ago challenge archæologists to justify their membership of an association for the advancement of science by criticizing their hypotheses impartially and objectively in the light of rapidly accumulating concrete facts Prof V Gordon Childe attempts such an examination in his presidential address to Section H (Anthropology)

Prehistory as expounded in Britain rests upon a complex of assumptions collectively constituting the Orientalist position classically formulated by Montelius in Der Orient und Europa published in 1899 His position involved the following assumptions (1) civilization in the Orient is extremely ancient (2) civilization can be diffused (3) elements of civilization were in fact diffused from the Orient to Europe (4) the diffusion of historically dated Oriental types provides a basis for bringing prehistoric Europe within the framework of historical chronology (5) prehistoric European cultures are poorer than contemporary Oriental cultures that is civilization is later in Europe than in the East

In 1899 all these propositions had to be treated as axioms Now systematic excavation in Hither Asia and the Balkans has furnished experimental data by which the foregoing axioms can and must be tested

(1) Excavations at Erech and Ur Tel Asmer and Khafaje Nineveh and Tepe Gawra have dramatically provided concrete proof of the immense antiquity of settled agricultural life in Mesopotamia Estimated dates of the order of 6000 B C for the Tel Halaf phase that is separated from the earliest historical horizons by stupendous accumulations of settlement debris are at least as plausible as similar geological estimates of the age of the North European mesolithic Similarly excavations at Alisar Huyuk Troy and Thermi have vindicated the antiquity of metal using cultures in Anatolia too

(2) The exploration of Anatolia has also provided fresh evidence for cultural connexions with Mesopotamia Taken in conjunction therewith Heurtley s work in Macedonia has established irreversibly the Anatolian origin of the Macedonian Early Bronze Age culture At the same time the Late Neolithic culture that immediately precedes and may partly overlap it proves to be to all intents and purposes identical with that revealed at Vinca and other sites in the south east of the Middle Danube basin Thence culture is well known to be continuous right up to the Rhine whither Mediterranean *Spondylus* shells were imported even in the first neolithic period or Danubian I A cultural continuum can now be traced from the Tigris to the Rhine and affords opportunities for the diffusion assumed in axiom (2)

(3) Oriental prototypes for arbitrary forms of

personal ornament, distinctive of the Early Bronze Age of Central Europe, have been multiplied surprisingly during the last five years. Ingot torques, lockrings and ear-rings with flattened ends, scroll, knot-headed and racquet pins are now all known from Mesopotamia.

(4) In Mesopotamia, however, all these types emerge unexpectedly early. The *terminus post quem* for the beginning of the Central European Bronze Age or Danubian IV is accordingly nearer 2800 than 1800 B.C. Moreover, types distinctive of previous phases of European prehistory have come to light in still earlier contexts in the Orient: battle-axes, for example, such as belong to Danubian III, can be traced back to the Uruk or even the al Ubaid phase in Mesopotamia. Still adhering to a strict application of axiom (4) we can raise the absolute dates attributed to the several phases of the New Stone Age in Europe to meet the estimates of botanists and geologists.

(5) Even so, axiom (5) would remain intact. At the beginning of the Central European Bronze Age about 2800 B.C. we should survey a cultural continuum over which we descend by regular gradations from the great cities of Egypt and Mesopotamia with their fully literate civilization through Anatolian and Ægean townships of illiterate, but metal-using communities to Central European villages where metal was virtually restricted to weapons and ornaments, neolithic hamlets in North Germany and Denmark and pure food-gatherers farther north. At the beginning of the European neolithic period, a couple of millennia earlier, similar relations would hold good: a chalcolithic Assyrian township like Arpachiya would have to be compared to a self-sufficing temporary hamlet of twenty households like Koln Lindenthal, while the boundaries of food-gatherers would be extended southward to the edge of the loess in South and Central Germany.

Even on such a maximal chronology, the orientalist position remains unassailable. But that chronology has been advanced only tentatively to see how archæological deductions fit the hypotheses of other disciplines. It need not be accepted as even plausible unless geologists and botanists become more unanimous and confident.

Eye and Brain as Factors in Visual Perception

IN his presidential address to Section J (Psychology), Dr. R. H. Thouless deals with the implications for the theory of visual perception of the fact that the physiological mechanism of vision is not only the retinal surface but also the whole system which includes retina, optic nerve, visual area of the cortex and, to some extent, other sensory areas of the brain as well.

It was assumed in much of the earlier work in vision (as in that of Helmholtz) that the basic process in vision is the formation of an optical image on the retina and its transmission to the visual centres of the brain by means of the optic nerve. Differences between the sensations transmitted to the brain and the finished perception were attributed to the action of the higher processes of judgment and the influence of past experience. This may be called the 'transmission theory' of vision. Within a certain limited field—that of the sensory physiology of the retina—it proved itself a fruitful guide to research. Modern researches on visual perception have, however, now made it clear that the transmission theory is wrong, and that a wholly different way of approaching the problems of visual perception is necessary if we are not to be led astray.

The modern attack on the transmission theory started from Wertheimer's experiments on the so-called phi movement which is seen when two retinal points are successively stimulated at certain time intervals. This is one of many known examples of the appearance in perception of something which does not exist in the pattern of stimulation.

The same conclusions may be reached by a study of the apparent shape of an inclined object. This apparent shape is not identical with the retinal shape but lies between this and the real shape. Careful consideration of this experiment makes untenable the view that the retinal shape is given as 'sensation', which is modified by a process of 'perceptual judgment'. There is no evidence that the 'sensation' is in any way an ingredient of the experienced shape. Rather the experienced shape appears to be a direct product of both the shape of retinal stimulation and of such perceptual cues as indicate the real shape of the object.

Individual differences are characteristic of the cerebral side of perception. Although the optical system of the eye may not differ much in different individuals, their perceptual responses may be very different. The amount of "phenomenal regression to the 'real' characters of objects" (that is, the extent to which apparent shape, size, and brightness are determined by the real shapes, sizes and brightnesses of objects, irrespective of inclination, distance, and illumination respectively) differs widely from one individual to another. These differences are not generally suspected until they are shown by experiment. The measurements of any one individual, on the other hand, show high self-consistency, even when the period between two measurements is as long as two years.

These differences are not merely of interest to scientific curiosity; they may also have practical consequences. Research has confirmed the prediction (originally made on theoretical grounds) that a high tendency to see objects in their real sizes irrespective of distance should be of advantage to the drivers of motor vehicles The amount of this tendency may be altered by the action of drugs and by the presence of mist and fog, and this change may affect driving. One case has been reported of its change in a neurotic condition

The psychology of vision can no longer be treated as if vision were a function of the eye alone The foundations of a psychology of vision were firmly laid by the work of Helmholtz and his contemporaries, who made a scientific study of the sensory physiology of the eye The most fruitful field of research at present is in those wider problems of visual perception in which the eye and the higher centres co-operate

Physiology of the Plant Cell

PROF W. STILES, in his presidential address to Section K (Botany), defines the general physiology of the plant cell as those vital activities of plants which are manifested by every living cell, and are thus distinguished from those special processes such as photosynthesis, which are restricted to certain specialized organs. These general activities of living matter are respiration and the absorption and excretion of water and dissolved substances

The usually accepted meaning of respiration is that it provides the energy for plant movements and the building up from the products of photosynthesis of substances of higher energy content than these products. Yet as respiration is a constant property of living matter, even when there is no movement and no formation of fresh material it may be questioned whether this current view of respiration is complete. As regards the synthesis of proteins and other complex substances, while there is evidence of the linkage of anabolic processes with the breaking down of carbohydrate, this anabolism only concerns the re-formation of carbohydrates, and no evidence has yet been obtained which sheds any light on the way in which energy released in respiration is transferred to the processes involved in the synthesis of proteins and other substances of higher complexity than those forming the respiratory substrate.

The absorption of water and dissolved substances by plant cells was formerly assumed to be a simple process of diffusion through cell membranes, but during the present century experimental work has shown that while the absorption of non-electrolytes may sometimes take place in this way, the absorption of electrolytes is a much more complex process, for the unequal absorption of the two ions of a salt, and the entrance of the ions of a salt against their own concentration gradients are very general phenomena Theories based on adsorption and interchange of ions have been put forward to account for these observed facts, but while such processes probably operate, it is doubtful whether they afford a complete explanation of the phenomena

The connexion between respiration and the salt relations of tissues was pointed out in 1927, and since then further evidence has been forthcoming which has emphasized the connexion between respiration and the diffusion of salts into plant cells against the concentration gradient. The energy required for the entrance of salt thus is presumably provided by respiration, and theories have been enunciated which regard the absorption of ions as a continuous interchange of the former with the hydrogen and bicarbonate ions continuously produced within the cell as a consequence of respiration While this interchange may be a factor in salt accumulation, there is evidence that the connexion between respiration and accumulation is generally much more indirect, and that the failure of cells to accumulate salt when respiration is lowered through deprivation of the cells of an adequate oxygen supply is related to their generally lowered vitality under this condition.

It is emphasized that salt accumulation, like respiration itself, is a vital process dependent on the protoplasm, while there is some evidence that in the absorption of water by the plant cell, there is in some, though not all, cases an active secretion of water. It is thus clear that a further analysis of the protoplasmic system is necessary for a better understanding of general cell physiology.

The general physiology of the cell is not only of fundamental importance for plant physiology in general, but it is of similar importance for all ecological investigation which is not merely descriptive, while it also impinges on the important fields of mycology and cyto genetics. Cell physiology is the scientific basis of many important plant industries, including those of food preservation and storage

Administration of Public Education

IN his presidential address to Section L (Education) Mr. John Sargent discusses the part which administration, and local administration in particular, ought to play as a medium through which the basic principles of educational science, as revealed either by *a priori* reasoning or as the result of research and experiment, may be translated into action so far as the public system of education is concerned

Attention is directed in the first instance to a change during the last century in the conception of the function of government which has exercised a profound influence on the whole theory and practice of administration This transition is from the idea of the State as essentially a policeman to that of an active promoter and provider of facilities for enabling all citizens to live fuller and happier lives This change of conception as to function is connected with the abandonment in favour of the idea of human progress of the Platonic principle that any social and political order however perfect is bound sooner or later to decay It is clear that both the nature and the aims of an administrative system which is inspired by the belief that it can and should assist individuals along the road to perfectibility will differ fundamentally from those of one which only hopes to postpone inevitable decay

The consequence of regarding the State as some kind of universal provider has been a vast increase in the legislative activities of government and has led in turn to greatly increased devolution of executive functions from the central to the local authority An examination of the capacity of the present local education authorities to cope with their continually increasing burden reveals certain defects, many of which derive from the historical and traditional considerations which have determined the boundaries of English units of local government In brief, the main defects from which local education authorities appear to be suffering are inherent in their large number and in the great variety in their sizes resources and the powers delegated to them , the result being possibilities of overlapping, friction and in many cases of almost intolerable financial strain It is admitted that some of these difficulties are being successfully overcome by co operation but co operation of itself cannot be regarded as an ideal method of administration

A more serious defect arising from the same set of circumstances, lies in the increasing difficulty in securing men and women with the necessary time and intelligence to devote to the business of local government This applies particularly to the unpaid partners in the administrative system The increase in the demands which the business of local government makes on the time of members of authorities, and the parallel increase in similar demands arising from earning a livelihood, are working together to deprive local bodies of the services of persons in the prime of life and actively engaged in industry and commerce The type of disinterested administrator on whom local government was able to rely a generation ago is steadily dying out

It is recognized that any attempt to remedy these defects may involve changes in the traditional boundaries of local government areas and would certainly bring the reformer up against that formidable factor known as local patriotism It is however suggested that fewer authorities with areas and powers more uniform than at present would not only simplify the problems of administration but would also widen the choice so far as personnel is concerned A further suggestion is that consideration might be given to modifying the duties performed respectively by members of the committees and their officials with the view of reducing the present calls on the time of the former Failing this the only alternative would appear to be to attempt to counteract any deterioration in the amateur element by raising the standard of the professional although it is realized that any development along these lines would raise a natural suspicion of undue bureaucratic control and would need adequate safeguards in this respect

A Long-Term Agricultural Policy

PROF R G STAPLETON in his presidential address to Section M (Agriculture) stresses the importance of ley farming in relation to the present day needs of the nation and in general he discusses the bearing of systems of farming on the formulation of a long term agricultural policy He urges that the needs of the nation must be made to govern the activities of the farmer In considering national need it is pointed out that account must be taken of future contingencies as well as of present requirements Thus as well as producing an abundant supply of fresh food our agricultural policy must take heed of war danger, fall in the population and the influences of soil erosion over seas The essential matter is therefore to maintain our acres in a fertile condition, while it is also desirable that we should conduct our farming in such a way as to make possible the maximum of flexibility in commodity production, and to make ourselves altogether less dependent upon imported feeding stuffs

The main features of the arable, permanent grass, nondescript (much permanent grass and a little arable land per farm) and ley systems are outlined, and it is shown that the arable and ley systems are those which accord best with national needs Permanent grass allows of the minimum of flexibility, and does not afford the best means of turning grass as such to the most profitable account By adopting alternate husbandry (ley-farming) it is possible to lime land under the plough, which is always the correct way to apply lime, to maintain the fields of the farm in maximum fertility, and to cash the fertility by means that are not wasteful

Technical details governing the establishment and management of leys for different purposes are considered in some detail, and finally Prof Stapledon considers the action that is necessary in order in the first place that the present condition of our acres may be accurately gauged, and in the second place, to hasten forward the ploughing up of land in permanent grass that is capable of being used to better advantage. He emphasizes the necessity of conducting a proper survey on a uniform basis on the land itself, particular attention being given to the classification of the acreage in permanent grass and in rough grazings

The crucial difficulties standing in the way of ploughing up are lack of facilities and lack of working capital A strong case is made for the extension of credit facilities granted for the explicit purpose of ploughing up and other contingent improvements It is urged, however, that credit facilities should only be given to carefully selected farmers, and then only to those who will contract to work to an agreed plan over a sufficiently long run of years. Apart from credit facilities, much might be achieved by a re-orientation in the financial and other arrangements made between landlords and tenants, and it is urged that ley-farming, if it became more general, would make it possible to adopt a variety of systems of share farming in directions not at present feasible

National Parks and the Preservation of the Flora and Fauna of Great Britain

IN his presidential address to the Conference of Delegates of Corresponding Societies on the use of national parks in Great Britain for the preservation of the fauna, Lord Onslow points out that the term 'national park' covers any natural reserve or open space to which the public have access regardless as to whether it is to be devoted to the preservation of fauna and flora or not, and Lord Onslow discusses methods of utilization of such national parks. The question of the desirability of re-introducing and acclimatizing animals now extinct in Great Britain, such as the reindeer, wild pig, beaver, Irish stoat and lemming, has also to be considered.

Granting the desirability of creating a national park in Great Britain, the first consideration is where to put it. The west coast of Scotland seems to be an ideal spot for such a venture In those counties there exist thousands of acres of deer forest land, which lends itself readily to the creation of a national park Such a forest already contains a considerable number of the animals which it is sought to preserve and it may be hoped that others could be acclimatized there Probably the most attractive animals in a park will be the deer In Great Britain there are three species of deer—red deer, roe deer, fallow deer Whether the latter is actually indigenous or was imported at some remote period has not been decided, but if they are not really wild animals, they exist all over the country in a feral state Other beasts which might well be added to the stock of a national park are the so-called park cattle These, as is well known, exist in a wild state at Lord Tankerville's estate at Chillingham The Chartley and Cadzow herds strongly resemble the Chillingham , a herd of these cattle allowed to exist in a wild state would prove a valuable addition to a national park Then in Scotland there are a few wild goats, which might well be preserved in a national park Perhaps the most interesting animals would be the carnivorous animals Foxes, badgers, stoats and weasels are common enough and exist in Scotland as well as in England and Wales There would be no difficulty about them nor would there be about otters, provided, of course, the park had streams, rivers and burns to provide fish But there are three species which are becoming very scarce indeed, and deserve every effort being made to retain These are the wild cat, the pine marten and the pole cat Perhaps the most difficult beasts to acclimatize in Scotland would be the rarer bats, most of which have only been found in the south of England Rodents are common enough, so their preservation would present no difficulties

Turning from mammals to the birds, one may say that if birds are unmolested, generally speaking they will be present, at least those which are suitable to the district The national park should form a strict bird sanctuary, and if possible part of the park should be near the sea so that sea birds could be encouraged o breed there

As regards finance, forest country in Scotland is now cheaper than it used to be, and it should be possible to acquire the necessary land for the public generally, either under the Government or by means of public subscription A national park would not be so expensive to maintain as a deer forest. In the first place there would be an income coming in, as there is in the National Kruger Park, which makes quite a handsome income. There would have to be a hotel or rest house, and roads and footpaths would have to be made so that people could get about and see the animals.

As regards staff in the park itself, the number employed would probably not be great as in the average deer forest.

The method of management of a national park in Scotland has been ably discussed by Sir Peter Chalmers Mitchell He would put the arrangements for its popular functions in the hands of delegates appointed by Edinburgh, Glasgow, Dundee and Aberdeen, working with delegates appointed by the council or councils of the county or counties in which the park was situated He would add to the governing body of the national park a panel of persons selected for their special knowledge of wild Nature in all its aspects. At least one botanist, one zoologist, one geologist, and two 'field naturalists', one with special knowledge of plants, the other an ornithologist He thinks these might be selected by the principals of the four Scottish Universities, and the presidents of the Royal Society of Edinburgh and of the Highland and Agricultural Society. Moreover, apart from the staff concerned with the general regulation of the park, there should be one warden or ranger selected by the naturalist panel, whose sole duty should be the constant study of wild life in the park and all its fluctuations

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beneficial earthquake, but one such was reported from Cannes by *The Times* correspondent on July 29 An earthquake shock near the village of Réotier in the Hautes Alpes has removed an obstruction to the water supply which experts for many years have been trying to locate The village fountain, dry for many generations, is now gushing forth water and the acute water shortage is at an end On August 13, a small earth tremor was felt at Pwllheli in Wales, but no damage was done It was probably due to subsidence in underground mine workings.

Scientific Survey of the Cambridge District

WHILE those who are visiting Cambridge for the first time—and indeed many who are re-visiting their *Alma Mater*—will have found the little "Concise Guide to the Town and University of Cambridge", originally written by John Willis Clark, of the utmost value and interest, an even wider audience will have welcomed the book "A Scientific Survey of the Cambridge District" specially prepared for the meeting by the local committee in Cambridge and edited by Dr H C Darby In fifteen chapters, the geology, physiography, climate, biology and history of Cambridge and the Fen District are summarized by specialists, with numerous references to the literature, and with appropriate maps and diagrams In particular, there are, as would be expected, chapters on the drainage of the Fens and on the Breckland The fact that this customary survey of the *venue* of the meeting is now sent out to members a week or so before the meeting opens gives the scientific worker time to learn in advance of the local topics and places likely to be of especial interest to him. The Survey is to be printed as usual in the Annual Report, and additional copies are also on sale (price 2*s*.).

The Darwin Library at Down House

THERE is at present a small collection of books, etc., known as the Darwin Library, at Down House, Downe, Kent, the home of Darwin from 1842 until 1882, which is now in the hands of the British Association. The major part of the existing collection consists of Darwin's own library, which belongs to the professor of botany in Cambridge for the time being, and was generously replaced in Down House by Sir Albert Seward during his tenure of that chair, an action confirmed by his successor, Prof. F. T. Brooks. For the rest, the number of Darwinian books in the possession of the Association is not large, whereas inquiries concerning such books are not infrequently made by visitors and others. The Down House Committee of the Association is endeavouring to collect (*a*) all biographies of Darwin; (*b*) contemporary works on Darwinian theories and kindred subjects; further (*c*) the collection of Darwin's own publications (books and papers) is not complete; and (*d*) the Committee would gladly receive and preserve contemporary reviews of Darwin's works. Those who may be in a position to offer appropriate books or papers are asked, in the first instance, to communicate particulars thereof to the Secretary, British Association, Down House, Downe, Kent, in order that duplication may be avoided.

German Trans-Atlantic Flight

THE four-engined German monoplane *Brandenburg* landed at the Floyd Bennett Field, New York, at 15.54 (New York time) on August 11 after the first successful non-stop flight from Berlin The time taken for the 3,942 miles' flight was a little more than twenty-five hours The machine flew over Newfoundland and the Gulf of St Lawrence, and at noon passed over St. John, New Brunswick She encountered head-winds coming down the coast from Canada, and was flying at a height of 2,000 ft. at 155 miles an hour The return flight was completed successfully on August 14 in just under twenty hours The machine is said to have room for twenty-six passengers, and the flight was designed to show the feasibility of commercial non-stop travel between Germany and America It is an all-metal monoplane with a wing-spread of 108 ft, it carries four 720-h p engines, and has a cruising speed of 196 m p h.

International Geological Congress

AT the seventeenth session of the International Geological Congress held in Moscow in 1937, the Geological Society of London extended an invitation, which was accepted, to hold the eighteenth session of the Congress in London in 1940 The first circular, which has just come to hand, contains preliminary details of the arrangements proposed These include sessional meetings in London on July 31–August 8, 1940, and an attractive programme of excursions—always an important and valuable feature of Congress activity—which will cover most of the important geology of Great Britain and Eire, and will afford the members of the Congress unrivalled opportunity of visiting many of the type-localities under expert guidance. A provisional list of fourteen subjects for discussion at the actual sessional meetings in London is given in the circular Among these we may note magmatic differentiation, the geology of iron ore deposits, the geology of coal seams, the geology of petroleum, the distribution of early vertebrates, earth movements and evolution, the geological results of applied geophysics and the geology of sea and ocean floors The organizing committee, mindful of the fact that this important Congress has not met in Great Britain since 1888, is anxious that the arrangements for the meeting in 1940 shall be as widely known and complete as possible The office and headquarters of the Congress are at the Geological Survey and Museum, Exhibition Road, London, S.W.7, and all communications should be addressed to the general secretaries at that address

Agricultural Research Scholarships and Awards

ON the recommendation of the Agricultural Research Council, the following awards of agricultural research scholarships, studentships for research in animal health and veterinary scholarships have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: Dr. R E. Taylor (King's College, Newcastle-upon-Tyne) a three-year research scholarship in plant pathology, the first year to be spent at Cambridge;

I F Storey (Victoria University, Manchester, and the Imperial College of Science and Technology) a one year research scholarship in plant pathology at the Imperial College D C Thomas (Imperial College of Science and Technology) a two year research scholarship in entomology, the first year to be spent at Cambridge, G W Cooke (University College Nottingham) a three year research scholarship in soil chemistry, the first year to be spent at the Rothamsted Experimental Station, M R F Ashworth (Oriel College, Oxford) a one year research scholarship in soil chemistry at the Macaulay Institute for Soil Research, D J Finney (Clare College, Cambridge) a two year research scholarship in agricultural statistics, the first year to be spent at University College London, A N Worden (Royal Veterinary College Camden Town) a three year studentship in animal health, the first period to be spent at the Lister Institute J A Campbell (Downing College Cambridge) a four year veterinary scholarship at the Royal Veterinary College Camden Town, J L McGirr (University of Glasgow) a four year veterinary scholarship at the Royal Veterinary College, Camden Town The object of these research scholarships and studentships is to train research workers in agricultural science and the science of animal health and in the case of the veterinary scholarships, to enable graduates with honours in science to obtain a veterinary professional qualification, with the view of undertaking research in animal health This year for the first time two veterinary scholarships have been awarded

Announcements

Mr Hugh Lett consulting surgeon to the London Hospital, has been elected president of the Royal College of Surgeons of England.

Mr Sydney A Hurren, head of the Department of Radio Technology at the Northern Polytechnic, has been nominated, for the third year in succession, for election as president of the Institute of Wireless Technology

A new Institute for Atomic Physics has been inaugurated at the Royal Hungarian University for Technical and Economic Sciences, and Prof Z Bay, formerly professor of theoretical physics in the University of Szeged, at present director of the Tungsram Research Laboratory of the United Incandescent Lamp and Electrical Co, has been appointed the first professor of atomic physics

In Nature of August 13, p 287, reference was made to a record crossing of the Atlantic from east to west by the *Queen Mary* On the return voyage, completed on August 14, another record was set up, the *Queen Mary's* time for the distance from the Ambrose Channel lightship to the Bishop Rock was 20 hr 42 min, and her average speed 31 69 knots

The Metro Goldwyn Mayer Corporation is to produce a film of the life of Mme Marie Curie early next year Mr Aldous Huxley will prepare the scenario for the film from an account of Mme Curie's life written by her daughter, Mlle Eve Curie It will be recalled that Mlle Eve Curie was the author of the book entitled Madame Curie" published this year (see Nature of June 18, p 1079) Miss Greta Garbo has agreed to play the part of Mme Curie

A valuable addition to the collection of statuettes of pioneers of the British Empire in the Imperial Institute, South Kensington is the figure of David Livingstone (1813–1873), which has been placed in the Northern Rhodesian Court The cost of the statuette has been defrayed by the Northern Rhodesian Government, to whom a replica is being sent to Livingstone This statuette, like those of Cabot, Van Riebeeck Raffles and Brooke which immediately preceded it in the collection, is a bronze of half life size and the work of Mr Herbert H Cawood, of Sheffield

A Franco Czechoslovak Medical Congress will be held at Prague on September 15–17 Further information can be obtained from the general secretary M A Ravina 254 faubourg Saint Martin Paris

The fifty first Annual Conference of the Sanitary Inspectors Association will be held at Edinburgh on September 5 10 under the presidency of Sir Leonard Hill The subjects for discussion will include shell fish inspection of meat, laboratory control of the milk supply, food and drugs legislation, housing, sanitation, atmospheric pollution, the disposal of trade effluents and a comparison of English and Scottish sanitary practice Further information can be obtained from the Secretary, 19 Grosvenor Place, London, S W 1

The thirteenth Italian Congress of Occupational Diseases will be held at Bari under the presidency of Prof L Ferrannini on September 10–12, when the following subjects, among others, will be discussed occupational pathology of aviation, occupational pathology of athletics, adaptability of the Italian workman to the climate of East Africa, results of the application of compulsory insurance against occupational diseases in the first four years Further information can be obtained from the Secretary, R Clinica Medica, Bari, Italy

The Association for Education in Citizenship is arranging two conferences during October A conference at Birmingham will discuss "The Meaning of Citizenship', and will be held at the University on October 8–10 Mr Anthony Eden, M P, and Sir Norman Angell are among the speakers The second conference will be at Bristol, on "Education for Democracy and the Modern World", on October 14–16 Lord Allen will give the introductory speech on "Democracy—Britain's Need of a Political Religion, and among other speakers are Miss Rathbone, M P, Prof N F Hall, John Bell, Gordon Barry, W McG Eagar and Harold Shearman Further information can be obtained from the Secretary at the Association's offices, 10 Victoria Street, S W 1

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 360

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Reflection of Atmospherics by the Ionosphere

IN a previous letter to NATURE[1] evidence was given that some atmospherics are reflected at the ionosphere Further oscillographs obtained with an improved technique (see Figs 1 and 2—photographic records on a rapidly moving film of the electric field of atmospherics) have led us to the conclusion that all atmospherics are reflected at the ionosphere The electrical discharge which appears to be lightning in all the observations we have made radiates an electromagnetic disturbance which is propagated as a ground wave and as a series of sky waves which are reflected 1 2 *n* times at an ionized layer at a height *h* km Assuming the velocity of all the waves is that of light and that the sky waves are optically reflected then the intervals of time between the arrival of the ground wave and of the sky waves are given by the expression stated in the previous communication[1]

When an oscillogram enables the times of the arrival of the ground wave and of the first second *n*th sky waves to be determined without ambiguity (Fig 1 is such an oscillogram) the application of this expression is straightforward

In the case of many oscillograms before the identification of the sky waves is possible an assumption needs to be made as to whether the electrical discharge is periodic or aperiodic, and whether the electromagnetic disturbance which it radiates is a damped wave or a single pulse Fig 2 is one of seven almost identical oscillograms observed during a period of 12 minutes We interpret these oscillograms as being due to an oscillating disturbance of five half periods, the first three half oscillations being undamped, and the fourth and fifth damped Further the sky wave once reflected at a height of 95 km arrived 470 µsec after the ground wave and came from a thunderstorm which was known to be at a distance (*d* km) of 70 km The value of the observed maximum electric field strength agrees with this distance This sky wave arrives at an angle of 20° to the vertical and it is emitted at the same angle If the radiator is a vertical lightning flash the intensity of this wave will be proportional to sin 20° and thus the intensity of reflected waves from near sources is small

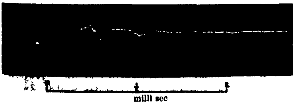

Fig 1

A DAMPED WAVE WITH A SERIES OF REFLECTED WAVES TIME 0115, *d* 190 KM , *h* 88 KM *E* 1 14 *V*/*m*

If the disturbance (on the other hypothesis) is a single pulse then there are sky waves reflected once twice 7 times at a height of 56 km from a source distant 290 km Actually no evidence of lightning at that distance exists and the observed maximum field strength is too large for such a distant storm

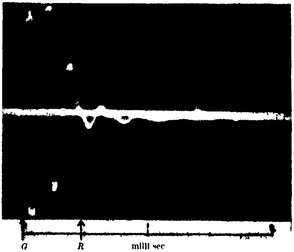

Fig 2

A DAMPED WAVE WITH REFLECTED WAVE ARRIVING 0 47 M SEC AFTER THE GROUND WAVE TIME 1347 *d* 70 KM *h* 95 KM *E* 3 30 *V*/*m*

A characteristic of the observed oscillograms is that all those taken within a short interval of time and probably from the same thunderstorm are closely similar in form This is attributed not to some constant characteristic of the storm itself but to the fact that since a storm is usually of small extent, *d* and *h* would remain approximately constant for the periods of time in question and that this observed fact means that *d* and *h* mainly determine the character of an oscillogram

Date	Time	*r*	*h*	*d*
Feb 20 1937	0115	7	88	190
Feb 27 1937	1104	6	9	200
Feb 20 193	0130	7	88	340
Feb 20 1937	014	6	88	350
Feb 4 1937	1525		6	390
Nov 6 1937	1700		86	4 0

The accompanying table contains the values of *h* and *d* calculated from oscillograms for which a satisfactory identification of the arrival of the sky waves has been made

The equivalent wave length of an atmospheric may be taken as 17 000–40,000 m The values of h in the table mean that if 100 km is the height of the E layer, the conditions of ionization and collision frequency required for the reflection of long waves exist in the upper atmosphere 10–30 km below the boundary of the E layer as determined by the reflection of short waves We have sought for evidence of a D or lower ionized layer, but have found none (If an atmospheric at its source is a single pulse then as stated above, Fig 2 could be interpreted as evidence of the existence of low layers, but the balance of evidence, we think, does not support this interpretation)

An accepted expression for the attenuation of long waves propagated along the ground makes $E\,d$ constant, where E v/m is the field strength at a distance d km from an electromagnetic radiator of constant power $E\,d$ is found to range in our atmospheric observations from 170 to 350 This agrees with evidence previously found by C T R Wilson[2], Munro and Huxley[3], Boswell and Wark[4], that a lightning flash does not vary greatly in its initial electric moment and in its radiating power

In the observations discussed above, the electrical discharge was 70 km or more from the observing instruments

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Melbourne, N 3
June 22

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[1] Laby T H Nicholls F G Nickson A F B and Webster H C NATURE 139 837 (1937)

[2] Wilson C T R *Phil Trans Roy Soc* A 221 73 (1920)

[3] Munro G and Huxley L G H *Rept Aust R R Bd* No 5 (1932)

[4] Boswell R W and Wark W J *Quart J Roy Met Soc* 62 499 (1936)

Time and Probability

TIME has recently been the subject of much discussion More than a year ago my colleague, Dr F L Arnot, in connexion with a cosmological theory summarized in NATURE of June 25, directed my attention to the relation between kinematic or atomic time, t, and planetary or pendulum time, τ This may be expressed in the formula

$$\tau = t_0 \log (t/t_0) + t_0,$$

t_0 being a constant of integration representing the present age of the universe at ourselves, reckoned on the t scale" (Milne)

The use of a logarithmic time scale was suggested by de Sitter in 1933, but the further development of such a scale is mainly due to E A Milne Although Milne speaks of t as "probability time ' (1937), this aspect of the time scale does not seem to have attracted much attention, and it is the object of this letter to stress the close relationship between time *as measured* and probability

Boltzmann s formula

$$S - S_0 = k \log (W/W_0),$$

connecting entropy S and "probability ' W, is similar in form to that which connects de Sitter's two varieties of time The entropy formula "corresponds with the fact that entropies are additive and probabilities multiplicative When a system moves into a more probable state, its entropy is increased and its probability is multiplied by a factor (Ubbelhode)

The mathematical resemblance between the time formula and the entropy formula is an indication of the fact that kinematic time t may be interpreted as a probability , and consequently time as measured by an astronomer or physicist is a statistical quantity Illustrations of this statistical interpretation are not difficult to find In using a sand glass we may be able to detect on close examination the motion of individual grains of sand, but we note the passage of time by observing the fall of an assemblage of grains We are dealing with a statistical result and assume that on the average the time taken for the total quantity of sand to pass is the same in successive operations of the hour glass In the water clock, or clepsydra, the same principle is applicable, but the moving particles are of smaller dimensions When a rigid body, a pendulum or rotating planet, is used for the measurement of time, we are again concerned, from the point of view of atomic or molecular theory, with a statistical result

Eddington s picturesque description of entropy as ' time s arrow need not be taken too seriously In Philosophy and the Physicists , Stebbing has taken objection to the view that entropy may be regarded as the signpost of time The experimenter must be aware of the order of his observations before he can draw conclusions from them In the majority of his experiments, he is dealing with statistical results The familiar phrase the tide of time is in some measure suggestive of a statistical interpretation of time

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July 21

Cosmological and Atomic Constants

IN view of some recent contributions[1] it may be considered not altogether useless to point out a few more relations (or 'coincidences') between some fundamental magnitudes that occur in astrophysical theory and very large dimensionless numbers that can be constructed from atomic constants and the constant of universal gravitation G If γ_1 and γ_2 represent the large numbers constructed from (e, c, m_H, G) and ($\hbar$, c, m_H, G) respectively, then

$$\gamma_1 = \frac{e^2}{m_H{}^2 G} \sim 1\ 23 \times 10^{36},\ \gamma_2 = \frac{\hbar c}{m_H{}^2 G} \sim 1\ 87 \times 10^{38} \quad (1)$$

$$\text{and } \alpha \equiv \frac{\gamma_2}{\gamma_1} = \frac{\hbar c}{e^2} \sim 137,$$

where $\hbar$ is Planck's constant (multiplied by $1/2\pi$), c the velocity of light, e the electron charge, m_H the mass of the proton, and m the mass of the electron

It is known[2] that the usual theory of the white dwarf stars, when combined with the theory of pressure ionization predicts a maximum radius for a cold body, that is, a stellar mass composed of matter degenerate in the sense of Fermi-Dirac statistics Let $R_{\text{max.}}$ denote this maximum value of the radius and M_0 the corresponding mass, then it is interesting to note that the large (astrophysical) dimensionless numbers M_0/M_H and $R_{\max}/\left(\frac{\hbar}{mc}\right)$ which we can construct from the fundamental magnitudes M_0 and $R_{\max}$ are very simply related to γ_1 and γ_2

In fact, apart from numerical factors of order not far different from unity, the theoretical expressions for $R_{\text{max.}}$ and M_0 show that

$$\frac{M_0}{M_H} \simeq \gamma_1^{3/2} \sim 10^{-2} \bigcirc, \frac{R_{\text{max}}}{\frac{\hbar}{mc}} \simeq \alpha^{1/2} \gamma_2^{1/2} \sim 0\,1\, R_0, \qquad (2)$$

where $\bigcirc$ is the mass of the sun, R_0 its radius Further, if M_1 denotes the (Chandrasekhar–Stoner)[3] upper-limit to the mass of the completely degenerate configuration, then again apart from numerical factors

$$M_1/M_H \simeq \gamma_2^{3/2}, \quad . \quad . \quad . \quad . \qquad (3)$$

a 'coincidence' which has already been pointed out by Chandrasekhar. It is interesting to see that

$$\frac{M_0}{M_1} \simeq \left(\frac{\gamma_1}{\gamma_2}\right)^{3/2} \div \alpha^{3/2} \quad . \quad . \quad . \quad . \quad . \quad . \qquad (4)$$

It will be observed, as has been noted by Chandrasekhar (though in a slightly different form) that if the power of γ_2 be taken not as $\frac{3}{2}$ but $\frac{3}{2} + \frac{1}{4}$ and $\frac{3}{2} + \frac{1}{2}$, it gives (roughly) the order of the number of particles in a galaxy and the 'universe' respectively.

It may be further pointed out that if γ_2 in (2) be similarly given powers of $\frac{1}{2}$, $\frac{1}{2} + \frac{1}{4}$ and $\frac{1}{2} + \frac{1}{2}$, we obtain the order of the maximum radius for a *cold* body (roughly) the radius of a galaxy and the Universe respectively.

The time-dependence of γ_1 and γ_2 according to the ideas of Dirac and Milne will be reflected in a corresponding time-dependence of M_0 and R_{max}[2] and other astrophysical magnitudes.

D S KOTHARI

Physics Department,
University of Delhi
July 9.

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[1] Dirac, *Proc Roy Soc*, A, **165**, 199 (1938), Chandrasekhar, NATURE, **139**, 757 (1937), Schrödinger, NATURE, **141**, 410 (1938)

[2] Kothari, *Proc Roy Soc*, *A*, **165**, 486 (1938)

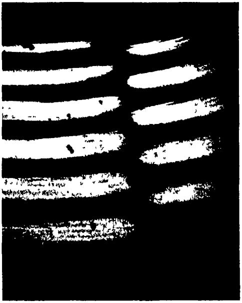
[3] Chandrasekhar, *Mon Not Roy Astro Soc*, **91**, 456 (1931)

Interference Patterns with Liesegang Rings

ANYONE who is experimentally familiar with the production of Liesegang rings in gelatine films and other allied phenomena might well feel tempted to believe that such periodical precipitates are to be regarded as wave-patterns. Indeed, several workers in the field appear to have felt that the analogy between the Liesegang phenomenon and a wave-effect is not merely superficial, and have sought for more positive evidence in support of it. Leduc and others, for example, claimed that Huygens' well-known optical principle gives an explanation of the form of the rings observed when a precipitating agent diffuses through a narrow aperture in an obstacle cutting across the film More recently, some Russian workers[1] have gone further and suggested that the periodic precipitation itself is to be explained in terms of the de Broglie waves associated with the movement of the precipitating agent, and claim to have been able to measure the 'refractive index' of such waves in passing across a boundary separating regions of different concentration of the gelatine.

The distinguishing character of a true wave is the existence of phase relationships, and connected therewith, the possibility of interference effects. In the course of some studies made by us, we have observed some phenomena with Liesegang precipitates which are unmistakably in the nature of interference effects. To make the significance of our results clear, it is necessary to make here a remark regarding the structure of an interference field When two wave trains crossing at an angle are superposed, we have, of course, regions of maximum and minimum disturbance If the minimum disturbance is actually zero along a given line, the wave fronts on either side of it show a difference of phase of half a wave. This is an exceedingly characteristic interference effect and can easily be recognized in ripple photographs

When on a gelatine film containing a very small concentration of sodium chloride a drop of silver nitrate is placed, the Liesegang pattern consisting of thousands of closely spaced rings of silver chloride precipitate may be observed. On an examination of the precipitate, it is often seen that the patterns are not of uniform intensity everywhere, but show lines of minimum and maximum disturbance, and the effects observed are closely analogous in some cases to beats, and in other cases to interferences of the individual waves In the latter case, the difference of phase of half a wave-length on either side of a line of zero disturbance is invariably to be observed.



INTERFERENCE PHENOMENON OF SILVER CHROMATE RINGS IN GELATIN.

Even more striking are the interferences which we have observed in suitable circumstances with silver chromate rings in gelatine. In this case, the pattern really consists of a great number of fine rings, the intensity of which varies in such manner that they form a succession of widely spaced groups. Not only the individual waves, but also the groups, show interference phenomena with the characteristic discontinuity of phase of the group on either side of a line of zero disturbance The accompanying photograph shows this in a striking way.

C. V RAMAN.
K SUBBARAMIAH.

Department of Physics,
Indian Institute of Science,
Bangalore.
July 13.

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[1] Nikiforov and Kharmonenko, *Acta Physicochimica U R.S S*, **8**, 95 (1938)

Some New Anthocyanin Types

A WIDE survey of anthocyanins occurring in the angiosperms (and a few gymnosperms) has revealed the overwhelming predominance of pigments based on pelargonidin, cyanidin and delphinidin and methyl ethers of the last two The only exceptional cases are the nitrogenous anthocyanins typified by the beet colouring matter, gesnerin from flowers of *Gesnera fulgens* which is the sole representative of the flavylium class related to flavones rather than to flavonols, and certain yellow pigments such as those of *Papaver nudicaule* and *Celosia cristata aurea*

The colouring matter of the yellow Iceland poppy has been isolated, it is nitrogenous, and will be described elsewhere That of the yellow *Cristata* resembles it in some respects but differs in others, it is doubtful whether either is a flavylium salt

We have recently found that the red colour of certain *young* fern fronds (the coloration soon disappears) is due to entirely new anthocyanins in some cases, *in others the familiar pigments have been* identified

Among the Pteridophyta examined we may mention *Davallia divaricata* as containing mixed pelargonidin and cyanidin dimonosides in an acylated form This shows that normal anthocyanins may occur in the cryptogams

The new types occur in *Osmunda regalis* var *Hillii*, and *O palustris Didymochloena truncatula, Pteris aspericaulis, Blechnum brasiliense Dryopteris varia Adiantum Vietchianum* and *Polypodium rhodoleuron*

The anthocyanins include monoglycosides and diglycosides, the anthocyanidins, of which at least three kinds have been recognized, are not identical with any known polyhydroxyflavylium salts They resemble however, 6 hydroxypelargonidin and 6 hydroxycyanidin

J R Price
Violet C Sturgess

John Innes Horticultural Institution,
Merton Park, London, S W 19

R Robinson
Gertrude M Robinson

Dyson Perrins Laboratory,
Oxford
Aug 2

By-products in Aromatic Nitration

IT was known fifty years ago that hydroxy by products arise in small quantities in the nitration of benzene and toluene, and their significance was discussed by Armstrong and Rossiter in 1891 Since that time little has been added to the subject apart from a number of observations of the increased production of such by products in the presence of mercuric salts

We have now found that, in the nitration of aromatic compounds with *meta* directive groups, hydroxy by products are formed in considerable quantity in the nitration of nitrobenzene, for example, styphnic acid is produced in amounts varying from 0 5 to 6 5 per cent according to the conditions

The process appears to involve the direct introduction of a hydroxyl group in the *meta* position, followed by complete tri nitration (directed by the hydroxyl group) The resulting substance then either appears as such—for example, hexanitro 3 3′ dihydroxybenzophenone formed in the nitration of benzophenone or the original directive group, now subject to the influence of three nitro groups is displaced by hydroxyl, and styphnic acid is isolated—as for example in nitrating nitrobenzene, phenyl methyl sulphone or diphenyl sulphone

G M Bennett
P V Youle

The University
Sheffield

Quantitative Measurement of Vitamin B_1 and its Phosphoric Esters and their Synthesis in Animal Tissues

RECENTLY, in NATURE, Westenbrink and Goudsmit[1] described estimations of the vitamin B_1 and cocarboxylase content of animal tissues based upon the observation that thiochrome phospho esters do not pass into a butyl alcohol layer[2]

In results described to the Biochemical Society on May 5, 1938[3], and embodied in a paper just sent to press, we have given estimations of these two forms of vitamin B_1 by different methods in rat and pigeon tissues Our methods of estimation are based upon the use of yeast enzymes, and are in some sense complementary to those of the above authors, because the cocarboxylase as estimated by us can only be the diphospho ester, whereas *in their method it* is possible that the mono ester is also included, on the other hand our method does not distinguish between vitamin B_1 and its *mono*phospho ester It is interesting that our main conclusion was substantially the same, that there is more cocarboxylase than vitamin B_1 in most tissues, though muscle in our experiments contains relatively more of the latter We also found that vitamin B_1 injected into the avitaminous animals is rapidly taken up by the liver, giving an accumulation of both forms of the vitamin, differing from them, however, slightly increased amounts of free aneurin were found in brain and muscle soon after injection It will be interesting if the points of difference are due to the presence of the mono phospho ester

We may add that (as already mentioned to the Biochemical Society) liver slices produce cocarboxylase from vitamin B_1 Liver slices or 'brei may convert 25–30 per cent of the vitamin into cocarboxylase in 30 minutes at 38° The synthetic reaction has a markedly alkaline *p*H optimum (about 8 5), it is inhibited by iodoacetic acid (0 0009 mol) and little affected by fluoride (0 04 mol) or by addition of phosphoglyceric acid and adenylpyrophosphate, whether separately or together Other tissues show either a very limited activity (brain, muscle) or none at all (intestinal mucosa), kidney tissue has not so far been investigated by us We have recently found that the synthetic reaction can also be obtained with liver extracts, this is being further investigated

S Ochoa
R A Peters

Department of Biochemistry,
Oxford
July 23

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[1] Westenbrink H G K, and Goudsmit J NATURE 142 151 (1938)

[2] Kinnersley H W, and Peters R A, *J Soc Chem Ind* 56, 447 (1937)

[3] Ochoa S and Peters R A *J Soc Chem Ind* 57, 470 (1938) See also Ochoa, S NATURE 142, 831 (1938).

Season and Rate of Conception

THE many difficulties of studying the effect of season upon birth rate (or conception rate) have been listed in Huntington's recent book Season of Birth Factors such as birth control, a popular season for marriages, the return of males at holiday seasons, etc , all tend to obscure the actual relationship Because conception—but not the number of young resulting from it—can be influenced in these ways, it seemed wise to find the seasonal effect by studying the ratio of multiple conceptions to single conceptions (It is assumed that the seasonal factors affecting single conceptions act in the same way, though to a greater extent, in affecting multiple-conceptions) Suitable data are difficult to find , the best I have been able to obtain are those from medical officers of health in the large cities, and the accompanying table summarizes those very kindly extracted for me by the Medical Officer of Health for Liverpool They cover the two years 1935–1937 (To medical officers of health, births must be notified within thirty-six hours ; the Registrar General's figures are not so reliable, as births may be notified up to forty two days)

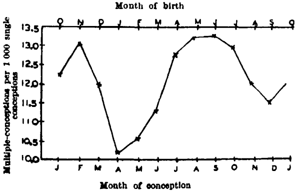
THE NUMBER OF MULTIPLE CONCEPTIONS PER 1 000 SINGLE CONCEPTIONS AT DIFFERENT SEASONS OF THE YEAR

Month of conception	No of single conceptions*	No of multiple conceptions*	Multiple conceptions per 1 000 single conceptions	Month of birth
Jan	2915 25	35 50	12 18	Oct
Feb	2753 00	36 00	13 08	Nov
Mar	2812 75	33 75	12 00	Dec
April	2965 00	30 25	10 20	Jan
May	3057 75	32 25	10 55	Feb
June	3128 50	35 25	11 27	Mar
July	3035 25	38 75	12 77	April
Aug	3116 00	41 25	13 24	May
Sept	3088 50	41 00	13 27	June
Oct	3012 50	39 00	12 95	July
Nov	2978 75	35 75	12 00	Aug
Dec	3024 50	34 75	11 49	Sept

* Standardized to month of 31 days and smoothed by formula $\frac{a+2b+c}{4}$

The numbers of single conceptions by month of the year do show a seasonal trend but are subject to the influences mentioned above

The ratio of multiple conceptions to single conceptions (1 pair of twins or triplets = 1 multiple conception) shows two distinct peaks, as illustrated by the accompanying graph, one around mid February and another around the middle of August to September. It is suggested that this curve shows the seasonal effect uninfluenced by artificial control and that the increasing hours of daylight to the first peak and decreasing hours to the second offer the best explanation of the phenomenon An increase in temperature and improvement in environmental conditions (summer holidays, etc) could not explain the rise in January and February although they might explain the more extended effect in the second peak Conversely, the cumulative effects of a debilitating winter environment finally overcoming the light effect at the beginning of the year might explain the low level in April



It is hoped to study the question further with more data in Great Britain and with data from other countries in different latitudes

JOSEPH EDWARDS

School of Agriculture,
Cambridge
July 19

Development of the Inert Regions of the Salivary Gland Chromosomes of *Drosophila*

THE present communication is closely connected with my letter entitled Development of the Giant Salivary Gland Nuclei of Drosophila"[1]

To the genetic conception of inert and active regions of the chromosomes corresponds the morphological conception of the heterochromatin and euchromatin[2] The heterochromatin regions are situated in the metaphase chromosomes near the spindle fibre attachment point, that is on the proximal ends of the rod like chromosomes and on both sides of the spindle attachment constriction in double armed chromosomes

The heterochromatin regions come closely into contact in the telophase, and according to Heitz[3] they fuse and form the chromocentre of the resting nuclei (Fig 1*a*) The study of the development of the salivary gland nuclei of *D funebris* has shown an opposite process, namely, the chromocentre is transformed into the heterochromatin region of the *X* chromosome

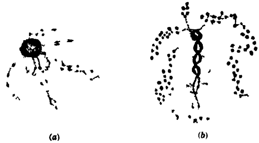

(*a*) (*b*)

Fig 1

(*a*) NUCLEUS OF FAT BODY CELL OF AN IMAGO OF *D funebris* (*b*) SALIVARY GLAND NUCLEUS OF A LARVA OF *D funebris* ABOUT 2 5 MM LONG (×3,200)

The dimensions of the chromocentre of the resting nuclei depend on the total quantity of heterochromatin of all the chromosomes In *D funebris* the chromocentre is very large (Fig 1*a*) and is often divided into parts In the salivary gland nuclei of small larvæ (2 5 mm long) the chromocentre lengthens and divides lengthwise into chromomeres arranged in two rows On the chromocentre, however, two chromosomes twisted together with symmetrically arranged chromomeres are clearly seen in Fig 1*b* The distal end of this changed chromocentre passes over into the euchromatin region of the *X* chromosome The heterochromatin and euchromatin regions differ profoundly according to the intensity of Feulgen s reaction The proximal ends of the autosomes continue to unite with the heterochromatin region of the *X* chromosome in the same way as they united formerly with the chromocentre

When the chromosome bands begin to form the heterochromatin region extends still more and the small number of chromomeres of early stages disintegrate lengthwise into a greater number When the genonemata become double the number of chromomeres in the row is also doubled in both euchromatin and heterochromatin chromosome regions Thus a typical picture of the inert region of the *X* chromosome of *D funebris* in the salivary gland nuclei of large larvæ is obtained

When the bands in the salivary gland chromosomes of *D melanogaster* are formed the round chromocentre of a resting nucleus divides into parts belonging to separate chromosomes These chromosome parts divide into chromomeres later on

In *D repleta* the double armed *X* chromosome is represented only by one banded chromosome in the salivary gland nuclei This can be explained only by the fact that the second inert arm forms the chromocentre which in the large salivary gland nuclei does not differ externally from the chromocentre of the resting nuclei In other words, this arm retains the same compact condition as in the resting nucleus

In the large salivary gland nuclei of *D virilis* and *D robusta* the chromocentre of a resting nucleus is retained as in *D repleta* but is decreased in dimensions This can be explained by the fact that in young larvæ small parts separate from the chromocentre and disintegrate into chromomeres Later on the number of chromomeres doubles exactly in the *same way as in the euchromatin chromosome regions* The remaining part of the chromocentre represents a fusion of small parts of heterochromatin, proximal ends of all the chromosomes in *D robusta* and in *D virilis* all the heterochromatin of chromosome III in addition

The differences of the structure of the point of union of the proximal ends of all the chromosomes in the salivary gland nuclei of large larvæ of different species of *Drosophila* can thus be explained whether the whole or a section of the chromocentre of a resting nuclei is transformed into the inert chromosome regions, that is obtains a chromomere structure

The thread leading from the chromocentre to the nucleus is formed during the transition from telophase to the resting nucleus Its nature has so far not been made clear

S FROLOVA

Institute of Experimental Biology
Moscow June 17

Frolova NATURE 141 1015 (1938)

[2] Neitz *Biol Zol* 54 11/12 (1934)

[3] Heitz *Z Zellf u micr Anat* 19 (1933)

Chromosome Numbers in *Cimex*

A SUB SPECIES of *Cimex*, phenotypically intermediate between *C lectularius* and *C columbarius* and obtained from laboratory white rats has been found to comprise two forms differing in the number of chromosomes In most cases the haploid number of autosomes is twenty four but in occasional specimens it is sixteen No variation in phenotype, correlated with this change in number, has been observed, nor is the normal course of meiosis affected

This suggests that eight autosomes in this sub species either represent a duplicate set the functions of which can be performed by the remainder of the complement or are genetically inert

All *C lectularius* material so far examined has yielded a haploid autosome count of twenty Since these three karyotypes form a series having chromosome numbers which are multiples of four there is reason to suppose that (*a*) the genus is polyploid in origin, (*b*) the stem number in *Cimex* is four and not six as was suggested by Slack[1] and Vandel[2] for the Heteroptera

H D SLACK

University
Glasgow
June 28

Slack H D British Association Nottingham (1937) (unpublished)

[2] Vandel A *Proc Zool Soc* A 107 519 (1937)

Time Sequence of Crossing-Over

MATHER[1] has answered the challenge of Charles[2] regarding the time sequence of crossing over Like Charles, I feel sceptical of Mather s evidence[3] that crossing over begins near the centromere

Mather suggests that the experiments on the effect of age, temperature and inversions in *Drosophila* show the differential effect between the centromere and the ends of the chromosome to be expected on his hypothesis Before he can use this evidence as a support for his hypothesis he must first show that the genetically unsplit region near the centromere behaves similarly to the ends of the chromosomes in all other respects than crossing over It is perfectly reasonable to suppose that the genetically unsplit region and its neighbourhood react quite differently to external influences Indeed there is much evidence for this but it is not necessary to assume as Mather does, that the observed changes in linkage are due to the fact that the first formed chiasma is proximal to the centromere If for example an increase in temperature influences the distance at which the *chromosome is genetically split at the time of crossing* over, the changes in linkage values will be observed no matter where crossing over started on the chromosome

The precocious splitting in unpaired parts of trivalent or univalent chromosomes provides more factual evidence than that adduced by Mather The papers by Charles, Schweitzer and Mather are most useful in suggesting novel modes of attack, but indicate the dangers of jumping to conclusions, however reasonable which are derived from the cytological or statistical methods at present favoured by many

Until the mechanics of chromosome pairing are understood, it is difficult to utilize the data of pairing in structurally changed forms in the way Mather has done A juxtaposition of the centromeres at early meiotic prophase as seen in salivary glands would account for the behaviour of the heterozygote of the Delta 49 inversion, but without factual evidence such a suggestion is as useless as Mather's It is possible that Mather is correct in his assumption regarding this theory, but more genetical evidence is required before acceptance is possible

F W SANSOME

Botanical Department,
University of Manchester,
Manchester, 13
July 25

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[1] Mather K NATURE 142 157-158 (1938)

[2] Charles D R *J Genet* 36 103-26 (1938)

[3] Mather K *J Genet* 33 207-35 (1936)

'Bridlington Crag' Shells

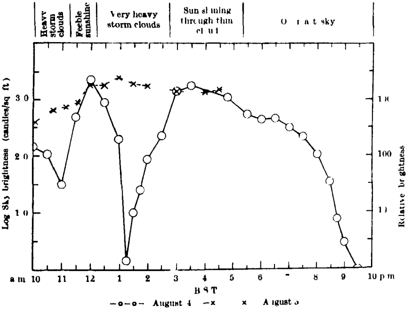
Many years ago, Mr W Headley, a relative of the late G W. Lamplugh, had an extensive collection of shells from the so called 'Bridlington Crag' exposed during excavations near the shore at Bridlington This contained a number of 'types' which had been referred to in the *Quarterly Journal of the Geological Society of London*, vol 47, 1891 We have been endeavouring to trace these, but have recently ascertained that, before he died, Mr Headley sold some of his collections, and possibly these were among them Inquiry has been made as to their whereabouts in the most likely channels, but without result Is it possible any readers of Nature can help us, as it is desirable to know where they can be consulted ?

T Sheppard

Municipal Museums, Hull

Sky Darkening Associated with a Severe Thunderstorm

It may be of interest to record some observations made here of the abnormal degree of sky darkening associated with a very severe thunderstorm which affected a large area of south-west England during the morning and early afternoon of Thursday, August 4, 1938



Observations of the brightness of the sky in the zenith were made by me at frequent intervals during the day with a Weston photo-electric (barrier layer) photometer calibrated directly in brightness units, namely, candles per sq foot A neutral (silver deposit) screen of known transmission factor, used in conjunction with the photometer, enabled measures to be obtained of brightness values which lay outside the scale range of the instrument The photometer was exposed in a horizontal position, the sky radiation received being restricted to a cone of solid angle 60°. The complete series of observations is shown graphically in the accompanying figure, the logarithm of the photometer reading being plotted in order to form a convenient ordinate scale A scale of relative brightness has been added to facilitate interpretation of the graph The comparison (broken) curve is that for the following day, August 5, when no precipitation took place during the period of observation, and the sky was continuously overcast Notes of sky conditions along the upper margin of the figure refer to the day of the storm

It will be seen that, during the period of most intense storm activity, a wide and rapid fluctuation of sky illumination occurred Within a period of one hour, from 12 15 p m to 1 15 p m B S T, the brightness value had fallen from 1500 to 1 5 candles/sq ft It would appear that the latter value, the absolute minimum recorded, is an unusual one seldom associated with storm centres developing in these latitudes The abnormally low brightness of the sky is here indicative of a great vertical extent of the cumulo nimbus cloud layer passing over the observer

An equally striking return of skylight ensued as the storm centre moved away in a north west direction Half an hour after the minimum brightness had been recorded a reading of the photometer indicated a ten fold increase in the illumination, and by 2 30 p m B S T the reading had risen to 225 candles/sq ft the storm clouds being then in process of dispersion Thereafter, with a broken sky veiled in alto cumulus and cirro stratus cloud through which the sun shone feebly, the sky brightness approached a more normal level, a value of 1770 candles/sq ft being recorded at 3 30 p m B S T By reference to the figure it will be seen that at 9 15 p m B S T the normal twilight illumination had fallen to the same value of sky brightness as that observed soon after midday, when the most severe phase of the thunderstorm was being experienced

D R Barber

Norman Lockyer Observatory,
Salcombe Hill, Sidmouth,
Aug 6

Dillenian Correspondence

In the notice in Nature of July 2, p 18 of the recent acquisition by the Department of Botany, British Museum, of a large number of drawings by Dillenius and some manuscript, a 'feeler' was put out about the possibility of Dillenius's correspondence similarly coming to light

A day or two later, having occasion to consult Dawson Turner s correspondence of Richard Richardson (1835) -a book much less well known than it deserves to be as it contains much information about eighteenth century botanists—I happened across a footnote in the preface (p ix) since, so far as my inquiries go, this seems to have been overlooked by botanists, it seems worth reprinting

'As, in speaking of the correspondence of Sloane and Sherard, I have mentioned the advantage derived to science from the preservation of such letters, so is it right here to notice an unfortunate event of an opposite tendency, whereby it is impossible to say how much we may have lost The event I allude to is the destruction of Dr Sibthorpe s papers, and, I fear, with them, of all those of the older Botanists belonging to the Oxford Garden This, I the rather notice, not only inasmuch as my so doing may serve as a warning, and because the papers in question were in a measure connected with the present volume but as affording an opportunity of clearing the late Dr Williams from blame in the transaction Mr Upcott had mentioned to me, that he had found upon a druggist s counter at Oxford, sundry letters written by Sibthorpe Dillenius, &c and that the druggist had told him they were a portion of a large quantity he had bought from the Botanic Garden , so large that, after keeping what he wanted for himself, sufficient remained to be worth sending to a neighbouring paper mill Dr Daubeny the present Professor of Botany, to whom I mentioned the circumstance was kind enough to investigate it, and to write to me as follows The fact is, that, on the pulling down by the street commissioners of the house belonging to the Professor of Botany, various papers, for which there could not have been room in the only apartments that then remained attached to the garden (the present lecture room,) were removed to Dr Sibthorpe's private dwelling house, which, on the death of the son and afterwards of the father, fell into the hands of Lady Sewell, daughter of the latter, and sister of the author of the *Flora Græca* On the decease of that lady some years back, the effects were sold, and amongst them was the lump of old papers you mentioned With regard to the share which my predecessor, Dr Williams, had in the transaction all the information I have been able to obtain, leads me to conclude that at the time of the sale he was not aware of such papers being put up to auction On the contrary, I have been told that, he had several times made application to the Sibthorpe family for the restitution of the books or papers belonging to the garden in their possession , but that they never attended to his request , and that at the sale he actually purchased and restored to the garden several volumes that he had reason to consider as public property

J RAMSBOTTOM

British Museum (Natural History)
London, S W 7
July 25

Points from Foregoing Letters

OBSERVATIONS are recorded by Prof Laby and his colleagues which lead them to conclude that *all* atmospherics are reflected at the ionosphere and lightning is an oscillatory discharge (In a previous letter to NATURE evidence was given that *some* atmospherics are so reflected) In principle, this means it is possible to infer from one oscillogram of an atmospheric the height of the ionosphere, and the distance of the lightning from which the atmospheric was radiated The latter is of considerable practical importance to meteorology and aviation

A logarithmic time scale was suggested by de Sitter in 1933, and Milne has used two time scales connected by a logarithmic expression Prof H S Allen points out the similarity between this expression and Boltzmann s formula connecting entropy and probability Atomic time may be interpreted as a probability, and consequently time as measured by an astronomer or physicist may be regarded as a statistical quantity

Further numerical relations between fundamental atomic constants and the universal gravitation constant, which coincide roughly with values ascribed to the number of particles in, and radii of, the galaxy and the universe are pointed out by Dr D S Kothari

Sir C V Raman and K Subbaramiah submit photographs of Liesegang rings of silver chromate, showing an interference pattern with characteristic difference of phase of half a wave length on either side of a line of zero disturbance

A chemical investigation of a nitrogenous anthocyanin pigment obtained from the yellow Iceland poppy, and of other new anthocyanin pigments from certain young fern fronds and other plants, is announced by J R Price, V C Sturgess, Prof R Robinson and G M Robinson

Prof G M Bennett and Dr P V Youle find that in the nitration of nitrobenzene and other aromatic compounds with a meta directive group, hydroxy acids (for example, styphnic acid) are produced in appreciable quantities

Dr S Ochoa and Prof R A Peters have determined by an enzymic method the cocarboxylase and vitamin B_1 (or monophosphate) content of animal tissues and obtained independently similar results to those of Westenbrink and Goudsmit, except for muscle and brain , it is suggested that the differences may lie in the methods Liver (both slices and extracts) synthesizes cocarboxylase from vitamin B_1 *in vitro*

A graph showing the ratio of multiple conceptions (twins and triplets) per 1,000 of single conceptions at different seasons of the year is submitted by J Edwards It shows a peak around mid February and another around the middle of August to September

Diagrams of cell nuclei from the fruit fly, ***Drosophila funebris***, showing the distal end of the chromocentre passing over into the 'euchromatin region of the *X* chromosome, are submitted by S Frolova to illustrate the development of inert regions in the chromosome

From the consideration of autosomes as distinct from sex chromosomes, Dr H D Slack finds difference in chromosome numbers in *Cimex*, which suggests that polyploidy has played a part in the evolution of the present karyotypes

Dr F W Sansome considers that more genetical evidence is needed before Mather's view that crossing-over begins near the centromere can be accepted

Observations by D R Barber made with a photoelectric photometer of the brightness of the zenith sky throughout the progress of the storm over south west England on August 4 indicate that, during the most severe phase, the sky light was reduced to less than one thousandth part of that normally received from an overcast sky at summer noon

Research Items

Christmas and New Year Among Serbian Gypsies

Dr. Alexander Petrovic concludes his study of feast days among Serbian gypsies with an account of Christmas, New Year and Easter observances (*J. Gypsy Lore Soc.*, **17**, Ser. 3, 1938). Gypsies have many Christmas customs borrowed from the Serbs. These are rites to secure them a favourable year as regards stealing, while on New Year's Day the most important rites are connected with money—the world at large must be informed how much money each gypsy family possesses. If they have money on that day, they will assuredly have it throughout the year. Among the Serbs, Christmas as a holy day occupies a special place. It is a time of joy and merriment, and, as it were, the beginning of a new life. There must be no quarrels, and all kinds of work must be begun to bring good luck. On Christmas Eve, straw is brought into the house and corn is threshed symbolically. The head of the house stands in the centre with a whip and slashes at the women, who represent horses, as they run round him in a circle. Among the gypsies of Kragujevac straw is purchased in conformity with the Serbian custom that straw must be brought into the house, but a few straws must be stolen to accord with gypsy custom. The women go from house to house among the peasants on Christmas Eve and try to steal something from each for their bags, so that their bags may be full throughout the year. At Kopljari, though the peasants observe no special rites on New Year's Eve, the gypsies repeat nearly all the Serbian customs of Christmas Eve. Branches of the Christmas log are used to stir the fire and branches of cornel are brought into the house for the sake of the health of everybody. These used to be decorated with coins, but now banknotes are used, while on New Year's morning all the money in the house is thrown into a blanket spread in the middle of the floor after being poured over branches of the Christmas log. These branches are thrown into a rapid stream to induce money to flow into the house. Among 'Turkish' and Mohammedan gypsies the ceremonial dismemberment and disposal of a turkey play a great part.

Typhoid-Paratyphoid Vaccination in the British Army

Lieut.-Colonel J. S. K. Boyd read a paper at the recent meeting of the British Medical Association on recent advances in the preparation of prophylactic typhoid-paratyphoid vaccines in the British Army (*Brit. Med. J.*, August 6, p. 307). The original vaccine used in the Army was prepared from a strain of the typhoid bacillus of low virulence. Later, doubts were expressed regarding the suitability of this typhoid strain for vaccine preparation, and several researches suggested that the degree of protection afforded by a typhoid vaccine corresponded directly with the virulence of the typhoid strain employed. It was also shown that the reaction caused by vaccines of virulent strains was no more severe than that given by the old strain. A mixed vaccine of *Bact. typhosum*, and *Bact. paratyphosum*, *A* and *B*, of proved and tested virulence, was, therefore, brought into general use in the Army in 1933. The results of this measure can best be studied by following the incidence of typhoid fever in the British Army in India. The curve of incidence showed an upward trend until 1919. The vaccine used was then changed to embody 50 per cent of a 'smooth' variant of considerable virulence. From 1929 a decline in incidence occurred, which was sharply accentuated in 1934 following the introduction of the new vaccine. There was no corresponding decline in the incidence of other intestinal diseases, which seemed to show that the improvement in the enteric figures could not be solely attributed to an improvement in general sanitation.

Abnormalities in the Blood of Cancer Patients

In the *Spisy Lékarské Fakulty Masarykovy University* (Publications of the Medical Faculty of the Masaryk University of Brno (**16**, 97–306; 1937), Dr. L. Havlásek gives an important and lengthy account (with many tables, graphs and 318 bibliographical references) of blood changes in cancerous women. His conclusions are based upon prolonged observations and series of tests made with 57 patients in varying stages of uterine cancer and who were undergoing treatment with radium, X-rays or by administration of certain salts (thiosulphates). The investigation included the determination of the hydrogen ion concentration of blood and urine using the quinhydrone electrode, carbon dioxide determinations and estimations of bicarbonate and hæmoglobin. In addition, the red and the white blood corpuscles were counted and the arterial blood pressure calculated. From these determinations made over a long period before, during and after treatment it was observed that though the results were not uniform there is a definite trend towards the normal figures as the patient approaches recovery.

Flora of Certain Moravian Lakes

The ecology of certain lakes and ponds near Třebíč and Studenec, in south Moravia, is the subject of a recent paper by Dr. F. Nováček (*Proc. Moravian Sci. Soc.*, **10**, 1–70). The lakes which have existed for centuries, lie in the valleys of the Rivers Jihlavka and Oslava, which flow into the Morava and thence into the Danube. The district is studded with pine forests, but with very large clearings. The waters have a sandy bottom, more or less covered with mud and sometimes with humus. More than a hundred species of higher aquatic plants are described and the flora shows a marked zonation with littoral, sedge, rush, loosely attached and floating associations. The condition, composition and extent of the zones is influenced by weather conditions, being markedly different in wet or dry summers. Among the plants in the floating associations, the Lemnaceæ predominate, with *Ricciocarpus* near the banks. *Zygnema* and *Mougeotia* types flourish in June and July whilst *Spirogyra* and often *Cladophora* are abundant in spring and autumn. The plants of the other zones are those usually present in stagnant fresh water, for example, species of *Phragmites*, *Typha*, *Glyceria*, *Alisma*, etc., near the water's edge and *Sagittaria*, *Potamogeton* and *Elodea* towards the deeper parts of the lakes.

Crossing-Over in Chromosomes

Important ramifications of crossing over have recently been reviewed by K. Mather (*Biol. Rev.*, 13, 182–293, 1938). The genetical evidence from euploids and aneuploids, structural hybrids and diploids, together with the cytological work of recent years, establishes the conditions of chiasma formation on a firm basis. The inter-relationships of chromosome pairing, chiasma formation, disjunction and segregation and crossing over are discussed, and it is shown that precise estimation can be made of segregation, linkage and the gametic output of structural hybrids and polyploids. The author also explains his previously published theories, in which he claims that the first chiasma formed is proximal to the centromere, and that there is a localization of the position of the proximal chiasma on the chromosome.

Mycology of the Philippines

THE first two numbers of vol. 65 of the *Philippine Journal of Science* are devoted to a compendious paper on 'Philippine Mushrooms' by José Miguel Mendoza (128 pp. + 79 plates, January–February 1938). The account is written upon a scientific basis, but is designed to instruct the Philippine population in edible and poisonous species. This it does to the extent of outlining culinary uses of various kinds, describing methods for cultivating *Volvaria esculenta*, and indicating the antidotes to fungal poisons. Mycological descriptions are given with sufficient macroscopic detail to allow comparison with other regions, while the plates provide further artistic delineation of many species. A strong European element is noticeable in the flora as here portrayed, but as the text is not critical, any purely Philippine element may not as yet be sufficiently evident.

Seismological Research in Japan

USING Miss F. F. Bellamy's Index Catalogue of Epicentres for 1913 to 1930 as data, Seiti Yamaguti has discussed anew the Seasonal Distributions of Earthquakes in the World (*Bull. Earthquake Res. Inst.*, Tokyo Imperial University, 16, Part 2, June, 1938). It is found that, on the average, the season number with maximum frequency seems to increase from western to eastern longitudes and from northern to southern latitudes, with the second season (June–August) as the mean. When the earthquake frequencies are plotted against the months, it is notable that the curves for Japan and the Mediterranean coast are opposite in phase. The Fourier coefficients for the annual distribution, the relative amplitude of the annual term, and the phase of maximum have all been evaluated and compared with what may be expected as the result of fortuitous happenings. It is found that the times of maximum frequency change in the northern hemisphere from June to November successively, according to latitudes, a succession that is too regular to be attributed to chance. In the same bulletin, Prof. K. Sezawa discusses the "Anomalous Dispersion of Elastic Waves", notably Love waves and Rayleigh waves in certain defined conditions. Altogether there are eighteen papers ranging from pure geology to mathematical seismology; thirteen of the papers are in English and the remainder in Japanese with summaries in English. Accompanying the *Bulletin* is the "Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University, 1937, Part 3–4 (July 1–December 31, 1937) which gives a list (in Japanese) of earthquakes sensible in Tokyo for the period stated, and which is adjoined to a map indicating the epicentres of these earthquakes.

Atomic Weights and Isotopes

THE reports of the committees on atomic weights and atoms of the International Union of Chemistry (*J. Chem. Soc.*, 1101, 1110; 1938) propose some changes of atomic weights and report some new isotopes. Among the former the most interesting are (older values in brackets): hydrogen 1·0081 (1·0078), helium 4·003 (4·002), and carbon 12·010 (12·01). Attention is also directed to the atomic weight 207·205 found for lead from a specimen of galena occurring in a vein which cuts one of the pitchblende veins of the Great Bear Lake deposit; this appears to be common lead, and if so it is one of the oldest to be examined. A new rare isotope of tungsten (180) and a very rare isotope of osmium (184) have been discovered. It has proved impossible to detect the isotopes 197 and 203 of mercury.

Research at the Cape Observatory in 1937

H.M. ASTRONOMER at the Cape, Dr. J. Jackson, reports that during the year 1937 the large number of 15,490 transits of stars were obtained with the reversible transit circle. During the daytime, 883 observations were made including transits of bright stars in the equatorial belt generally between 9 a.m. and 11 a.m. South African Standard Time. With the 8-inch transit circle, the observation of reference stars for the Cape Astrographic Zone, − 35° to − 40°, was completed; the observation of similar stars for the Zone − 52° to − 56° was commenced. The Victoria telescope—a Grubb photographic refractor of 24 inches aperture—continues to be used for the determination of stellar parallax; 3,476 plates were obtained. Since this programme was started in 1926 at the Cape, the parallaxes of 836 stars have been published. Another 18 parallaxes await publication, including the parallax determinations of the very bright stars, Sirius, Canopus and Antares. The result for Canopus, a super-giant star, indicates a considerably larger parallax than that generally adopted. The Victoria telescope has also been used for photographing galactic clusters south of − 30°, the exposures ranging from 5 minutes to 2 hours. In pursuance of a programme of photographic zone observations, according to methods developed by Prof. Schlesinger, the triplet lens of 6 inches aperture is now being employed on Zone − 52° to − 56°. All plates for the Zone − 30° to − 35° have been measured and reduced, 12,500 stars having been measured in both direct and reversed positions on each of two overlapping plates. The time service and wireless time signals have been maintained. Photographs of the sun were taken on 343 days; these negatives are sent to Greenwich for inclusion in the series to be measured for sunspot positions and areas. The mean temperature for the year was 63·4° F. (mean of maxima and minima), the absolute maximum was 98·0° F. on February 17 and the minimum 38·1° F. on May 16. The total rainfall—the highest since 1905—was 28·12 inches, or 4·69 inches above the adopted normal. In concluding his report to the Secretary of the Admiralty, H.M. Astronomer refers to the valuable services of two members of the staff who have retired on pension, Mr. A. Pilling and Mr. T. R. Miller.

The International Congress of Anthropological and Ethnological Sciences

A SESSION of the International Congress of Anthropological and Ethnological Sciences took place in Copenhagen on July 31–August 6, and was followed by a two-day tour through parts of Denmark for members of the Congress who could spare the extra time required. Actually it was only the second time that this most newly fledged of congresses had met, and its great success testifies to the ever-growing interest throughout the world in the study of man, as well as to the immense trouble taken by the Danish organizers to see that everything should proceed smoothly and without any hitch. More than seven hundred members and associates were present, some 29 countries and 177 learned societies and institutions being represented.

The official opening meeting of the Congress did not take place until the afternoon of August 1, but already there had been a reception on the previous evening to enable members to meet one another. This was an excellent arrangement. After all, the main function of these international gatherings is not so much to facilitate the announcement of startling discoveries as to permit specialists from various countries to meet each other and discuss together their ideas and problems, the papers in general being little more than pegs upon which friendly, often almost informal, discussions can be hung. In this respect, the organization at Copenhagen was perfect. On several evenings there were after-dinner receptions in museums, etc., where innumerable discussions took place, helped by a liberal supply of Carlsberg beer and light refreshments!

The official opening ceremony was dignified by the presence of H.M. the King of Denmark, to whom delegates from several countries were presented. Inaugural ceremonies can easily become somewhat tedious functions: not so this one. His Majesty's presence testified to the importance of the occasion and, further, the proceedings were kept commendably short. Besides the necessary speeches of greeting from some of the national delegates and an oration from Dr. Thomas Thomsen, head of the Department of Ethnography in the National Museum and president of the Congress, there was a short orchestral symphony by Kunzen (1761–1817) which helped to lighten the proceedings. Later in the afternoon there was a motor-bus tour of the city.

On Tuesday morning, the work of the sections began and continued daily until the final closure on the Saturday afternoon, with the exception of Thursday, which was devoted to an all-day excursion. There were seven sections, a number of which were subdivided. From A to G they were severally concerned with physical anthropology and allied matters; psychology; demography; ethnology; ethnography, there being sub-sections dealing with Asia, Africa, America, Oceania, the Arctic and Europe; sociology and religion; linguistics and writing. Obviously it is not possible to discuss all the papers here, for that one must await the publication which will appear in due course. But mention can be made of one or two.

"What is a Human Race?" was discussed in Section A by Dr. Nordenstreng of Uppsala, where, too, Dr. F. Weidenreich tabulated a "Classification of Fossil Hominids" definitely placing the existence of *Homo sapiens* in a period anterior to that of our well-known fossil remains of *Homo primigenius*. Questions of blood groups also came up for discussion in this section. In Section D (Ethnology) a paper by Prof. Hatt on the ownership of cultivated land in early times produced an interesting discussion, as also did those by Prof. Herskovitz on the economic surplus and its disposal and by Prof. Firth on the characteristics of a primitive economy. In this section, too, the problems of the development of primitive agriculture and of the horse in Neolithic times were dealt with by Dr. Miles and Dr. Gandert respectively, as well as the first cultivation of wheat and the spread of agriculture, by Mr. Harold Peake.

The sub-sections of Section E provided a wealth of papers. Perhaps one may mention especially those by Profs. Arik and Kansu on recent excavations and palæolithic discoveries in Turkey and by Sir Theodore Tasker on the archæological wealth of the State of Hyderabad, not that there were not many other papers of importance but because these three bore witness to the anthropological work that has recently been so successfully started in those distant regions. Among other British anthropologists present who read papers were Profs. Hutton and Daryll Forde and Dr. Lindgren. Any account of these sectional papers is, however, bound to be invidious at this stage, since the writer was only able to listen to a limited number and to gain information from his friends who had been to others.

A few joint meetings of various sections took place where slides and films were shown. Thus Dr. Morley demonstrated the results of twenty-five years of research in the Maya area of Middle America, while at another time ethnographical films were projected. A general meeting to see films of Greenland, Old and New, was arranged for one evening, and this was preceded by a talk from Mr. Daugaard-Jensen, the chief administrator in the country, who gave us an impressive account of what Denmark has done and is doing for the Greenlanders.

Throughout the period of the Congress, the National and other museums were open free of charge to members. The National Museum has been recently reconstructed and enormously enlarged. Not only are the prehistoric collections from Denmark and the immense series of Eskimo objects unique in the world, but also the arrangement of the Museum is most carefully thought out. It is not a mere storehouse of specimens: to follow the sequence of galleries is an educational experience. If only the British Museum could be rearranged in a like manner! One evening, a reception was held at the Museum and the closing scene was really emotionally memorable. At 10.30 p.m. everyone assembled in the great courtyard, where there are model megalithic monuments in the open air. Then a museum showcase was opened and two great Bronze Age *Lurer* were taken out and handed to two trumpeters who, standing on some steps above the assembled members, proceeded to play stirring duets upon them. The effect was electric—were we not listening to instruments which had first been played more than 3000 years ago?—and it was enhanced by the knowledge that the performance can seldom be repeated, the authorities being justly fearful lest the vibration might shatter these ancient and beautiful trumpets.

The excursion on Thursday was to Elsinore and the Castle of Frederiksborg. At the former place, in the great hall of Hamlet's Castle, a lecture on "Natural Philosophy and Human Culture" was delivered by the distinguished physicist Prof. Niels Bohr. The municipality of Marienlyst, a seaside resort close to Elsinore, most kindly provided a lunch which was preceded by a display of water acrobatics by Greenlanders in their kyaks—and an astonishing display it was. On the last evening members dropped their science and became ordinary human beings. After a really sumptuous dinner *chez Nimb* they either danced or passed into the Tivoli (Copenhagen's White City), where the learned were seen happily smashing plates at 5 shies for *6d.* or careering madly down the scenic railway—of such is a true League of Nations!

In conclusion, unstinted praise must once again be given to the organizing committee, and in this connexion the name of Dr. Birket Smith must especially be mentioned. He was always helpful and always at hand. Everything worked splendidly, and anyone who has ever had to organize more than 700 people on excursions, at lectures, for entertainments and meals will realize what this means. Nor did the consideration of our Danish hosts confine itself to the full members alone. As always, a number of associates, wives of members and others, were present who might perhaps be expected to be less interested in attending religiously the meetings of the sections, and for these people special activities, including a ladies' lunch at the Yacht Club, were arranged by a ladies' committee. Parties, for example, visited the porcelain works and the not less famous Georg Jensen silver works. There is no doubt that everyone worked very hard to make the Congress the success it was, and certainly their labours were much appreciated. Fortunately, the opportunity occurred to tender the thanks of the guests both formally at the closing meeting and, more informally, a little earlier during an afternoon reception in the Town Hall given by the Municipality of Copenhagen. The Portuguese delegate, when replying to a speech of welcome from the Burgomaster, took full advantage of this opportunity. Finally, in this connexion the name of Prof. J. L. Myers cannot be forgotten. As one of the general secretaries he has had to work hard behind the scenes for many months past to ensure that the gathering should be the very great success it assuredly was. Members and associates will long remember the second meeting of this Congress held in Copenhagen.

M. C. BURKITT

The International Astronomical Union

THE sixth triennial meeting of the General Assembly of the International Astronomical Union was held at Stockholm on August 3–10 under the presidency of Prof. F. Esclangon. The meeting was the largest and most representative held so far, with more than four hundred people present, including nearly a hundred from the United States. Germany has so far not seen its way to join the Union, but there were more German astronomers present than on any previous occasion. The local organization under Prof. H. von Zeipel, Prof. B. Lindblad and an indefatigable secretary, Dr. Y. Öhman, was extremely good, and combined with perfect weather to contribute to the complete success of the meeting.

After the opening meeting, when the Union was welcomed by the Minister of Justice, the president of the Royal Swedish Academy of Sciences and the chairman of the Swedish National Academy of Sciences, the Union settled down to the task of discussing the reports of the thirty-one committees through which its work is carried out between meetings.

In addition to the specialist discussions carried on in these separate small bodies, there were arranged this time two symposia with a wider range of interest —one on the formation of bright lines in celestial spectra and one on the problem of galactic structure.

Sir Arthur Eddington presided over the first meeting and the speakers were Prof. H. N. Russell, Dr. H. Zanstra, Prof. D. H. Menzel and Dr. P. W. Merrill. At this meeting, M. B. Lyot showed slides of his direct photographs of the corona and the coronal spectrum secured at the Pic du Midi and also a striking cinema film of movements in prominences taken by direct photography. This aroused such enthusiasm that it had to be shown on a second occasion during the meeting. It included one remarkable instance of an existing prominence being blown up by an uprush of fresh matter from below, numerous instances of matter flowing upwards and still more frequently of matter streaming horizontally or downwards in striking arch formations. The second symposium was presided over by Prof. Lindblad, and the speakers were Dr. B. J. Bok, Prof. Lindblad, Prof. H. Shapley and Dr. Becker. Dr. Baade's photographs showed what striking advances in photographic sensitivity had been achieved recently in the red.

Both discussions led to useful contributions from other speakers and they formed a valuable innovation. It was felt in certain quarters that the symposia and the lavish Swedish hospitality had encroached to some extent on the time usually allotted to the work of the committees, but the excursions, especially that on a steamer in the archipelago of Stockholm, gave ample opportunity for another and very valuable side of the activities of the conference—the discussions between small groups of colleagues gathered together from all over the world.

Among the resolutions adopted by the Committees and later by the General Assembly, a few may be mentioned as having a field of interest outside too specialist a range. A list of standard notations was agreed to; arrangements were confirmed for studies on early Egyptian and Russian astronomy and a recommendation adopted that the scientific letters of Sir Isaac Newton should be edited and published. Owing to the failure of the world schemes of longitude determination by radio signals carried out in 1926 and 1933, to show any evidence of longitude variation, it was decided to carry out no further scheme of a similar nature for another ten or twelve years at least. Steps were agreed to for hastening the completion of the catalogue of the *Carte du Ciel*, the co ordinates of stars in the *FK3* catalogue were adopted for time determination from January 1 1940 The Union adopted the specification of the primary standard of wave lengths formulated in 1935 by the International Committee of Weights and Measures, and adopted fresh secondary iron standards in the ultra violet and solar standards in the infra red, it also agreed to a standard notation for describing lines A special grant was made towards the expense of reproduction of the Utrecht photometric solar atlas giving the profiles of all Fraunhofer lines from Mount Wilson plates between 3300 and 8900 A

It was agreed to give presidents of commissions wider powers to form sub commissions with the view especially of developing work in subjects bordering on the special work of two or more commissions and an additional commission on inter stellar matters was created

An invitation to hold the next meeting in 1941 in Switzerland was accepted very cordially and the executive committee for the next three years was elected as follows *President* Sir Arthur Eddington (Great Britain) *Vice Presidents* Prof G Abetti (Italy) Dr W S Adams (U S A) Prof O Bergstrand (Sweden) Prof W Brunner (Switzerland) and Prof Ch Fabry (France) *Secretary* Prof J H Oort (Holland)

Humidity in the British Isles

THE importance of humidity as a climatological element has been increasingly realized in recent years Until quite recently however, comparatively few summarized data were available for the use of industrial technologists bioclimatologists and others to whom the humidity of the air in the British Isles is a matter of concern There were in fact only two published collections of average values W F Stacey s averages with charts for 91 stations in England and Wales[1] and Section 6 of The Book of Normals[2] containing hourly averages for five observatories with isopleth diagrams of hourly averages for seven additional stations

In both these publications relative humidity was the only element treated Stacey s averages were based on readings at 9 h during the ten years 1901 10 and his stations were sufficiently numerous to give a fair representation of the average distribution of relative humidity over England and Wales at 9 h It is difficult however to draw any useful conclusions from charts and averages based on observations at 9 h, an epoch at which relative humidity is normally in process of descending from the early morning maximum to the afternoon minimum This limitation will be realized if one imagines how incomplete our information about air temperature would be if we had nothing beyond the readings of an ordinary thermometer at 9 h

Apart from relative humidity, there are at least two other hygrometric elements for which scarcely any summarized data have hitherto been available namely vapour pressure and moisture content Averages for the principal observatories are given in Bilham s Climate of the British Isles[3] but it is clearly desirable that values of these two important elements should be available for a large number of stations

These needs have now been met by an official publication* recently issued In view of the fact that the book contains an explanatory introduction 21 pages of tabular matter and 26 charts it may be described as extraordinarily good value for money The main table contains monthly and annual averages for 44 synoptic stations, six columns of data being given for each station The first four columns refer to 13 h and contain 15 year averages of air temperature, relative humidity, vapour pressure in millibars, and moisture content in grams per cubic metre The remaining two columns contain averages of relative humidity at 7 h and 18 h In Table II we have hourly averages of relative humidity at nine stations These have in the main been reprinted from previously published averages for first order observatories, but data from two new stations Sealand and Cranwell have been added to improve the geographical distribution Table III contains hourly averages of vapour pressure at Kew and Eskdalemuir This is followed by an appendix containing the standard values of the vapour pressure and moisture content in saturated air at all temperatures from 0° F to 120° F These are based on the determinations of Scheel and Heuse and are given to two places of decimals[4] In combination with the data contained in Table I they afford the means of calculating average values of such quantities as saturation deficit and dew point the methods of doing so being explained in the introduction

The charts show the distribution of relative humidity and vapour pressure at 13 h over the British Isles in each month and the whole year The scale though small is sufficient to display the general features of the geographical distribution and to permit of the possibility of interpolating values for particular places with fair accuracy The charts show that the distribution of mean relative humidity at midday is as might be expected complementary to that of mean maximum temperature the lowest values being found in the inland areas where the afternoon temperature is high In addition there are clear indications of Föhn effects in winter months, patches of relatively dry air being located along the Great Glen on the east coast of Scotland and along the Welsh border The dry air during the night hours in the Great Glen results in Fort William having the lowest daily mean humidity of the nine stations for which hourly averages are given Another interesting fact revealed by the new data is that at Eskdalemuir in the southern uplands of Scotland, the diurnal range of vapour pressure is substantially greater than at Kew in summer months It is impossible in this article to enter upon any general discussion of the data but it is clear that this publication contains sufficient information to meet the needs of most inquirers

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* Averages of Humidity for the British Isles M O 421 (London H.M Stationery Office) 9d net.

[1] Stacey W F, Distribution of Relative Humidity in England and Wales *Quart J Roy Met Soc* 41 45 (1915)

[2] The Book of Normals M O 236 Sec VI Normals of Relative Humidity (London H.M Stationery Office 1928)

[3] Bilham E G The Climate of the British Isles (Macmillan and Co 1938)

[4] Scheel and Heuse *Ann Phys* 1909 and 1910

Reclamation of Tidal Lands

IN the *Journal of the Royal Society of Arts* of July 15, 1938, there is published the paper read before a meeting of the Society on February 23 by Mr. Oscar Borer, chief engineer of the River Ouse Catchment Board, in which he gave a survey of the reclamation of tidal lands which has been proceeding on both sides of the North Sea. In a brief note on the geological history of this sea, the author shows that, whether it be accounted for by one theory or another, its water holds in suspension a fine sand or silt which was ground to its present state during the glacial period. This silt only settles in quiet protective bays where the flood water can come to rest; the aim of the work of reclamation is therefore to create those favourable conditions requisite for the extension of the land from the enormous stock of silt provided by Nature. Nature not only provides the material but also constitutes the agency by which the main operations are carried out. Here the engineer exercises his highest function in studying the methods of Nature and in directing them so that they benefit mankind

'If the natural process of accretion be not assisted by artificial means it becomes stationary after reaching a certain distance from the shore, because beyond that distance the movement of the flow and ebb of the tide does not admit of the quiet conditions favourable for deposit. When a sea marsh is enclosed by a bank, the movement of the water is restricted, and, outside the bank, accretion takes place rapidly, so that in a few months the sand becomes covered with warp This is followed by a growth of samphire, which is, in turn, succeeded by grass, so that eventually the surface consists of a fine mass of warp mixed with roots of grass and decaying vegetable matter. In the course of a few years this process results in the production of a highly fertile soil which, however, must not be enclosed until a sufficient number of years have elapsed and the land thus reclaimed has become 'ripe'—a process taking about twenty years Meantime, of course, no accretion beyond this is taking place, so that it will be realized that the work is such as to demand patience, foresight and continuity in its direction.

In the course of the lecture, many details were given of the work carried out since Roman times and of the different methods adopted in the operations at the Wash, in the Netherlands and on the German North Sea coast, at each of which the necessary favourable conditions exist. Mr. Borer also mentioned the various plants and grasses which assist the work and the order in which they appear.

Science News a Century Ago

British Association at Newcastle-upon-Tyne

ON taking the chair of Section A (Mathematical and Physical Science) of the British Association, on Monday, August 20, 1838, Sir John Herschel said that the Committee had decided on the order of proceedings for the Section, but it had been found difficult to arrange matters, as although notices of abundance of communications had been received, few papers had come to hand and it was almost impossible to get in touch with contributors owing to a lack of knowledge of their addresses. The part of the proceedings he considered most valuable and important was the opportunity to ask questions. In exercising this privilege members, however, would do well to condense their remarks.

Importance of Meteorological Data

AMONG the contributions to Section A of the B.A. at Newcastle-upon-Tyne was "A Report explaining the Progress towards developing the Laws of Storms" by Lieut.-Colonel W. Reid, R.E. His attention, he said, had been first directed to the subject in 1831 when he was on military service in Barbadoes. A hurricane had occurred just before he arrived in the colony and for two years and a half he had been employed among the buildings which had been ruined In the course of his paper he referred to the observations of Benjamin Franklin and of Col. Capper of the East India Company, the writings of W. C. Redfield of New York, the anemometers of Whewell and Osler, and he pointed out the desirability of preserving the logs of ships, and of inducing the several maritime nations to establish registers at their lighthouses, and mutually to communicate their observations

Waves and Water Resistance

To Section A and also to Section G (Mechanical Science), John Scott Russell contributed papers on waves and the resistance of water He and Sir John Robison, he said, had been constituted a committee to prosecute the investigation of the motion of waves and other problems in hydrodynamics. As to the general problem of the resistance of a fluid to a floating solid, this was a department of science of which we were avowedly ignorant; so much so that some of our best vessels were acknowledged to be constructed by rule of thumb The question of resistance resolved itself into that of the motion of waves. Waves were of various kinds The laws of the great primary wave had been laid down in previous communications. Its velocity depended simply on the depth of the fluid The old law of resistance, as the square of the velocity, was too small so long as the velocity of the solid was less than that of the wave, but too great so soon as the velocity of the solid becomes greater than that of the wave.

Structure of Teeth

THE most important paper before Section E (Medical Science) was that on the structure of teeth and the resemblance of ivory to bone, as illustrated by microscopical examination of the teeth of man, and of various existing and extinct animals, read by Richard Owen, then Hunterian professor and joint conservator of the Hunterian Museum. Until recently, Owen said, the analogy of tooth to bone was supposed to extend no farther than related to the chemical composition of the hardening material, while the arrangement of this earthy constituent, as well as its mode of deposition during the growth of the entire tooth, were considered to be wholly different from those of bone, and to agree with the mode of growth of hair and other so-called extra-vascular parts, with which the teeth undoubtedly closely correspond in the genera vital properties. Owen referred at length to the work of Prof. Retzius of Sweden, and explained the views he himself held on the analogy subsisting between tooth and bone, illustrating his observations by description of teeth of both living and extinct species. Through the endless diversity which the teeth of different animals present, he said, the general law of the tubular structure could be unequivocably traced.

Societies and Academies

Paris

Academy of Sciences, June 27 (*C R* 206 1933–2038)

R Esnault Pelterie The yield of thermal machines

Charles Achard Augustin Boutaric and Mme Madeleine Roy Researches on the optical activity of the seric proteins

Marc Krasner A generalization of the local theory of bodies of classes Generalization of Hasse s symbol and the law of isomorphism for Galoisian extensions Local analogue of Tschebotarow s law of densities

Zeev Nehari A theorem on functions a mean value of which is limited

Stefan Bergmann Meromorph functions of two complex variables

Roger Serville The passage from the viscous regime to the hydraulic regime for the translation of a solid in water The existence of five regimes of flow

Jean Dufay The structure of the violet cyanogen bands in the spectra of comets

Willy Benedictus Dirac s equations in a space with Riemannian metrics

Félix Jean Taboury The application of the properties of polished electrodes to the study of zone of passage Beilby layer electrolyte

Raymond Chevallier and Mlle Suzanne Mathieu The spontaneous evolution of the magnetic properties of ferric hydroxide By carrying out the magnetic measurement in the tube in which the ferric hydroxide is precipitated the changes can be followed starting with the third minute after precipitation The increase in the coefficient of magnetization is more rapid as the medium in which the precipitate is formed is more basic

Maurice Billy and Alain Berton The absorption spectra by reflection of solid substances in the visible and ultra violet regions Value of the method

Pierre Jacquinot The exactitude of the linear law in the simple cases of Zeeman effects

Jean Thibaud and Paul Comparat The stimulation of nitrogen nuclei by rapid neutrons passing through paraffin

Mlle Marie Louise Delwaulle The application of the Raman effect to the identification of a mercuric chlorobromide

François Bourion and Emile Rouyer The determination of the total hydration of the ions of barium nitrate

(To be continued)

Calcutta

National Institute of Sciences of India

Symposium on 'Weather Prediction at Poona July 25–26

[illegible] **R Savur** : Seasonal forecasting in India

[illegible] **Basu** Franz Baur s forecasts for 10 day periods.

[illegible] **N Sen** Air mass analysis and short period weather forecasting

S. K Pramanik Application of air mass analysis to the problem of the forecasting of nor westers in Bengal

K. R Ramanathan : Upper air data and weather forecasts.

N K Sur Latent instability in the atmosphere, and its consequences

S P Venkiteswaran Rainfall due to the winter disturbances and the associated upper air temperatures over Agra

S K Pramanik Upper air data and weather forecasts

P R Krishna Rao Weather forecasting for aviation with special reference to local forecasts

S K Banerji Kinematical methods in weather forecasting

Rome

National Academy of the Lincei (*Atti* 27 145 188 1938)

E Marcus Geometrical interpretation of the equation $\frac{\delta^2 \log \beta\gamma}{\delta\mu\ \delta\nu} + \beta\gamma$ 0 and some properties of congruences of straight lines of the canonical assemblage

G D Mattioli Reduction of degree of systems of Pfaff

C Pauc (1) Extension of some properties of surfaces and of V_3^2 varieties to non holonomous V_n^{n-1} varieties (2) Images of ordered ensembles Polygons Curves

G Colonetti The second principle of reciprocity and its applications to the calculation of permanent deformations (2)

C Jacob Generalization of a formula of Cisotti and its application to the study of slow motions of a compressible fluid

L Sona Some rigid configurations of vortex filaments perpendicular to one plane (2)

T Perri Researches on a cycle of histological modifications of the thyroid of the male albino rat

Tokyo

Imperial Academy (*Proc* 14 No 5 May 1938)

Akira Kobori The multivalence of a group of analytical functions

Yukiyosi Kawada On Riemann surface algebraical functions

Chuji Tsuboi Gravity anomalies and the corresponding subterranean mass distributions

Takesi Nagata Magnetic anomalies and the corresponding subterranean structure

Kyosuke Tsuda and Seikichi Kitagawa Dehydration of triterpene alcohols by means of finely divided copper

Teiichi Kobayashi and Masaru Katayama Further evidence concerning the chronological determination of so called Rhæto Liassic floras, with a description of *Minetrigonia* a new subgenus of *Trigonia*

Taturo Matumoto A biostratigraphic study of the Cretaceous deposits of the Naibuti Valley, South Karahuto The association and the order of occurrence of genera and species in this region are not always parallel to those of the equivalent forms in Europe and other regions Thus the so called standard scale of Europe must not be applied directly to the stratigraphy of the North Pacific region

Yoshiki Mikami Experiments on the formation of free lenses in *Triturus pyrrhogaster*, with special reference to Harrison s experimental results in *Amblystoma*

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (CAMBRIDGE MEETING)

Monday, August 22

At 10 a m —Dr H B G Casimir Dr J F Allen Prof J H Van Vleck Dr F Simon Sir J J Thomson Low temperature Physics with special reference to Helium II (Symposium Section A)

Prof W Cramp C F Webb D C Gall Dr L G A Sims and J Spinks J Greig and J E Parton and E V D Glazier and J E Parton Magnetic Measurements with special reference to Incremental Conditions (Joint Discussion Sections A and G)

Prof E K Rideal F R S Prof W L Bragg F R S Dr G Nagelschmidt Clays (Discussion Section B)

Prof H H Swinnerton Development and Evolution (Presidential Address Section C)

Dr J S Huxley F R S Dr H B Cott D Lack I H Burkill Sense Perception and the Evolution of Colour and Pattern (Symposium Section D)

Prof V Gordon Childe The Orient and Europe (Presidential Address Section H)

Dr A S Watt Dr H M Steven R Ross The Ecological Aspects of Afforestation (Joint Discussion K and K*)

J Paley Yorke Dr W A Richardson F Pick Prof Winifred Cullis Education for a Changing Society (Discussion (continued) Section L)

J A McMillan Prof F L Engledow C T Gimingham Sir John Russell F R S The Practical Problems of Crop Production (Discussion Section M)

At 10 45 a m —F H W Green A E Stephens G Hayes and Miss M Chriss W G East O Borer English Ports and Estuaries in their Geographical Setting (Section E)

At 11 15 a m —Dr H von Eckermann Lieut Colonel W Campbell Smith S I Tomkeieff and Prof C E Tilley F R S The Origin of Carbonate Rocks Associated with Alkali rich Intrusions (Discussion Section C)

At 2 15 p m —H C Gilson Lake Titicaca (Semi popular Lecture Section D)

At 3 15 p m —Exhibition of Biological Films (Section D)

At 8 30 p m —Prof M L E Oliphant F R S The Contribution of the Electrical Engineer to Modern Physics (Evening Discourse)

Tuesday August 23

At 9 45 a m —Sir F Gowland Hopkins F R S Prof E C Dodds Prof L Ruzicka Dr A S Parkes Prof J W Cook F R S Dr T Reichstein Prof A R Todd Repercussions of Synthetic Organic Chemistry on Biology and Medicine (Discussion Section B)

At 10 a m —Dr F J W Whipple J S Hughes and Miss E F Bellamy Prof O T Jones F R S Miss I Lehmann, Dr D W Phillips T F Gaskill Dr H Jeffreys F.R S, Dr R Stoneley F R S Prof J D Bernal F R S Seismology and presentation of report of the Seismological Committee (Symposium Section A)

Prof J Gray F R S J E Harris and Dr Lissmann Dr F S J Hollick, C Horton Smith The Rôle of the Environment in Animal Locomotion (Symposium Section D)

Dr S W Wooldridge Dr R E Dickinson R O Buchanan Miss H G Wanklyn Prof C Daryll Forde Some Aspects of the Regional Concept (Discussion Section E)

Prof C E Inglis F R S Dr F H Todd Major B C Carter Vibration (Symposium Section G)

Dr K M Smith F R S and W D MacClement, Dr R N Salaman F R S F C Bawden Dr R W G Dennis Present Aspects of Plant Virus Research' (Discussion Section K)

Prof R Rae Prof F A E Crew Dr E L Taylor Dr J Hammond F R S The Practical Problems of Animal Husbandry (Discussion Section M)

At 11 a m —R C Steel Dr P B Ballard Dr S J F Philpott and Miss L M Holt The Educational Significance of the Cinema and Wireless (Joint Discussion Sections J and L)

At 2 p m —A M Hocart Mrs N K Chadwick Prof S H Hooke and Prof H J Rose Ritual (Symposium Section H)

At 8 30 p m —The Scientific Delegation to India 1937 38 Short lectures by delegates

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Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

LECTURER IN PRACTICAL MATHEMATICS AND PHYSICS in the Heanor Mining and Technical School—Mr H C Preston 30 Mansfield Road Heanor (August 22)

INSTRUCTOR IN HORTICULTURE in the University of Leeds—The Registrar (August 31)

LECTURER IN MECHANICAL ENGINEERING in the Rutherford Technical College—The Director of Education City Education Office Northumberland Road Newcastle upon Tyne 2 (September 2)

SCIENTIFIC OFFICERS and JUNIOR SCIENTIFIC OFFICERS in the Admiralty Scientific Pool—The Secretary of the Admiralty (C E Branch) (Sept 2 Quote Ref *C E* 6509/38)

TWO NATURALISTS in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary 10 Whitehall Place S W 1 (September 5)

SENIOR PROFESSIONAL OFFICERS (1) PHYSIOLOGY (2) BIOCHEMISTRY in the Department of Agriculture and Forestry of the Union of South Africa—*The High Commissioner,* South Africa House Trafalgar Square London W C 2 (September 12)

UNIVERSITY PROFESSOR OF RADIOLOGY at the Royal Cancer Hospital—The Academic Registrar University of London Senate House W C 1 (September 20)

LECTURER IN PSYCHOLOGY in the University of Glasgow—The Secretary of the University Court

READER IN THEORETICAL PHYSICS in the University of Liverpool—The Registrar

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Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Regulations for Earthing Electrical Installations to Metal Water Pipes and Water Mains Pp 6 (London Institution of Civil Engineers) *6d* [38

City of Leicester Museum and Art Gallery Thirty fourth Report to the City Council 1st April 1937 to 31st March 1938 Pp 32+4 plates (Leicester Museum and Art Gallery) [38

Family Allowances By Marjorie E Green Pp 32 (London Family Endowment Society) *6d* [38

Other Countries

Sveriges Geologiska Undersökning Ser C, No 408 Sjösediment från Rogenområdet i Härjedalen Av G Lundquist Pp 90+4 plates 2 00 kr Ser C, No 409 Kvartsiter sandstenar och tektonik inom Sunneområdet i Jämtland. Av Per Thorslund Pp 30 0 50 kr Ser C No 410 Über die regionale Limnologie von Südschweden Von Sven Thunmark Pp 160 3 00 kr Ser C No 411 Die Svinesund Kosterfjord Überschiebung ein Beitrag zur postgranitischen tektonischen Geschichte des nördlichen Bohuslän. Von Walter Larsson Pp 32 1 00 kr Ser C No 412 Upplysningar till en karta över den gotländska åkerjordens fosfathalt. Av O Arrhenius Pp 15 2 00 kr Ser C, No 413 Über Sedimentgesteine in der Leptitformation Mittelschwedens, die sogenannte Larsboserie" Von Sven Hjelmquist. Pp 39 1 00 kr Ser C No 414 Klotentjärnarnas Sediment Av G Lundquist. Pp 49 1 00 kr Årsberättelse för år 1937 Pp 9 0 50 kr (Stockholm P A Norstedt and Söner) [267

Annuario della Reale Accademia d'Italia, 1934–1937 Pp 648 (Roma Reale Accademia d Italia.) [267

State of Connecticut. Public Document No 24 Sixtieth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1936 Pp. xii+954+16 (New Haven Conn Agricultural Experiment Station.) [36

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The Progress of Science in India

IT is one hundred and three years since Macaulay wrote his famous minute on education in India, in which he stated that it was impossible, with the limited means available, to attempt to educate the body of the people This century has seen an amazing development in all directions Politically, self-government has been largely achieved and this has been rendered possible by the adoption, as advocated by Macaulay, of English as the medium of education English has become the *lingua franca* of the Peninsula, and the mass of the discussions in the legislative councils is conducted in that language. But there has occurred another, if less dramatic, change. An educational ladder has been provided which has opened a clear road from the village primary school to the university In the space of a century, India has passed from a social state with an aristocracy as strongly marked as in the Norman period, with a priestly hierarchy as dominant as in the palmy days of the monasteries and with the mass of the people in a state of serfdom equally reminiscent of those early English days, to a state with all the democratic institutions of modern England and with an industrial development of no mean proportion if, as yet, small when judged by the percentage of population so engaged.

In this movement science, both pure and in its application, has received its full share of attention Science, in its modern sense, found its first footing in India in 1784 with the foundation by Sir William Jones of the Asiatick Society; now known as the Royal Asiatic Society of Bengal, and that footing was extended and fortified by other societies of which the best known is the Bombay Natural History Society founded in 1883. These were unofficial ventures. Officialdom took longer to recognize the status of science. In those early days, certain services clearly lay beyond the capacity of the civil administration as established by the East India Company For these, special services had to be instituted, a medical service, first established as distinct from the Army medical service in 1763, and a trigonometrical survey in 1800, which were staffed from the only technical source available, namely, the Army.

With a growing recognition of the need for specialized knowledge in other fields, it was only natural that the civil authorities should turn to the same source to find the cadre Thus, to mention one sphere only, botanical work was entrusted to men of the medical services who, as such names as Roxburgh, Royle, Wallich, Prain and Watt testify, laid a solid foundation for later building, while, to mention the other service as well as to sound a personal note, an Army engineer, an uncle of the present writer, became controller of the mint

But science was moving fast, particularly in its application to the everyday facts of life It was also becoming more specialized, and something more than diversion of the talent existing in these established services was required India is an agricultural country still, and was even more so at the end of the last century, when great strides were being made in the application of science to agriculture in temperate countries. To Sir Edward Buck falls the credit of realizing the need for investigating the fundamental problems of Indian agriculture and the special nature of these problems Thus came to be employed a group of specialists—Leather, Barber, Butler and Maxwell Lefroy are names that will be recalled—later, in 1903, to be incorporated into one service, the Indian Agricultural Service, with its imperial branch at Pusa and a provincial branch in each province.

Two motives can be traced in the above noted developments The first of these is that general thirst for knowledge which at first finding outlet in private directions afterwards became translated into official action Thus the Botanic Gardens of Calcutta founded in 1788 became the centre of the Botanical Survey of India in 1889 an Archæological Department was established in 1862 while the foundation of the Indian Museum in 1866 provided a centre for this and for the study of natural history The second was the growing economic importance of many sciences The Geological Survey was established in 1851 the Indian Marine Survey Department in 1871 a Fisheries Department in 1870 and a centralized Meteorological Department in 1872

In all these movements it was the British who provided the impetus Here and there Indians played their part Ram Mohan Roy who so early as 1816 took a prominent part in founding a Vidyalaya afterwards to become the Hindu College and later the Presidency College Calcutta Sir Ashutosh Mookerjee Sir Jagadis Bose and P N Bose The reason for this is to be traced to the lack of facilities for and the inadequate organization of higher education the potentialities of the Indian for advanced studies had not yet been appreciated Though universities had been established at Calcutta Bombay and Madras in 1857 at Lahore in 1882 and at Allahabad in 1887 these remained examining bodies and teaching was relegated to the affiliated colleges where facilities were inadequate for original work even by the staff whose time was absorbed in teaching and still less for postgraduate work It remained for the Universities Commission of 1902 to transform the universities into teaching bodies with the allocation of large grants for higher education a policy further implemented by the establishment of a separate Department of Education in 1913

Thus the beginning of the century marks an epoch and the progress made since then has been remarkable No adequate presentation could be given in a brief article such a presentation is contained in the volume of nearly eight hundred pages* recently published It requires no detailed turning of these pages to realize from the names of those whose work is quoted how quick the Indian has been to take advantage of the facilities thus newly thrown open to him The volume has been produced to celebrate the silver jubilee of the Indian Science Congress Association which held its first meeting under the presidency of Sir Ashutosh Mukhopadhyaya (Mookerjee) in the spring of 1914 This Association owes its origin to a realization of the growing need for some means of bringing together the increasing number of workers in the various scientific fields and it adopted as its fundamental plan and conception the principles of the British Association

India is a large country and the danger of isolation is greater there than in relatively small England The need for some means of co ordination early became apparent The Board of Agriculture with its annual and later biennial meetings served that function for the newly instituted agricultural services though owing to its official status and its reviews of programmes of work it ran grave risk of adopting a dictorial attitude Since 1929 its functions have largely devolved on the Imperial Council of Agricultural Research In 1902 a Board of Scientific Advice was established but suspended in 1924 and in 1911 the Indian Research Fund Association was founded mainly to co ordinate research on the causation mode of spread and prevention of disease

It was to provide a field in which a co operative spirit rooted in personal contacts rather than in co ordination a word which savours of officialdom and dictation that constituted the primary objective of the Association—a field free from official dictation but having the official blessing That it has gone a long way to achieve its purpose is undoubted but that it has not entirely succeeded —is any human institution an unqualified success ? —its foremost advocates would be the first to admit The concept of the British Association has perhaps been too closely followed This Association serves two functions it forms a common ground on which scientific men may meet and so counteract the dangers of specialization and it has the further objective of the dissemination of scientific thought among a wider public That latter objective is perhaps the dominant one but, in India the public which can be so influenced is small The feeling of incompleteness whatever its cause is there and has found expression in the institution of supplementary societies the Academy of Sciences United Provinces founded at Allahabad in 1930 the Indian Academy of Sciences founded at Bangalore in 1934 and the National Institute of Sciences of India founded at Calcutta in 1935 Scientific organization thus is proceeding in India centrifugally Instead of a central body arising as a coping stone, around this earlier central body are coming into existence a number of loosely linked associations each with its local sphere This difference has significance.

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* Indian Science Congress Association Silver Jubilee 1938 The Progress of Science in India during the past Twenty five Years Edited by Dr B Prashad Pp lvi+767 (Calcutta Indian Science Congress Association 1938) 5 rupees

India has demonstrated that it is capable of producing men with a scientific ability which would do credit to any country, but the very speed with which it has attained this position has its dangers. If, in conclusion, these are briefly indicated, it is in the spirit of the friendly criticism of one who remembers many happy years spent among its peoples It appears to such a writer that the major danger arises from the entry of India into the scientific field at a time when the application of science to economic problems had proceeded far It was this pressure that provided openings for a livelihood in scientific work and it was the Government that mainly created those openings. Science may easily, in these circumstances, lack the stabilizing effect of a nucleus of disinterested men studying for studies' sake, and tend to become merely a means of earning a living; and it is difficult to regard a potential competitor for a post with true scientific detachment It is a danger from which Great Britain is not free but one which is emphasized in a country where university education is primarily sought as a qualification for employment and where pre-university education remains in many respects defective These are, however, growing pains; with ability undoubtedly present, with the will to develop the true scientific spirit which clearly exists, who can doubt the future of science in India?

H. M. L.

The Credo of an Anthropologist

Apes, Men and Morons

By Prof. Earnest Albert Hooton Pp. ix + 307 (London: George Allen and Unwin, Ltd, 1938) 10*s*. 6*d* net

IF a credo is to have value, it must be enunciated by one who has several outstanding qualifications. In the first place, it must be based on a prolonged personal experience of a particular branch of knowledge. Prof Hooton has this qualification; he has been teaching physical anthropology to the students of Harvard University for more than a quarter of a century In his earlier years he made a detailed report on the bones and culture of the peoples who had inhabited the Canary Islands; later he did the same for Pueblo Indians. In more recent years he has devoted himself to a physical and social study of his fellow countrymen. Of these about 6,000 had been isolated in penal institutions; his "controls" were taken from those "not yet apprehended" The full results of ten years spent in a "statistical purgatory" have not yet been published but in this book he gives in the midst of his general discourse a summary of his chief conclusions. He has found that those within the walls of penal institutions are inferior in body and in mind to those who live outside, and that already in the United States of America the population is becoming differentiated into local types.

Prof. Hooton has the knowledge, but knowledge alone is not sufficient to make a credo worth listening to. Knowledge must be linked to a sound judgment, and ultimate beliefs must be uttered with a resolution which is fearless of popular opinion It needs as much courage to run counter to the prejudices of a democracy as to face the wrath of an autocracy "For myself," Prof. Hooton has written, "I prefer to be the target of rotten eggs rather than to be suspected as a purveyor of that odoriferous commodity" He refuses to "side-step the issues which are vital and dangerous" and seeing that he discusses the problems of 'race', religion and sex, a less courageous man would have been tempted to "side-step" at every turn. Prof Hooton, too, has the saving grace of humour; his pages scintillate

A book which is made up, like the present one, of lectures and articles, is apt to be disjointed and over-lapping. There is no trace of these faults in the present work Its pages discuss in sequence the various phases in man's ascent from the jungle. Especially is its author concerned with the impact of his science on the community His attitude will be conveyed by an extract from his final chapter entitled: "What must we do to be Saved"?

> "We must either do some biological house-cleaning or delude ourselves with the futile hope that a government of the unfit, for the unfit, and by the unfit will not perish from the earth.
>
> "We must, in some way or other, encourage a sit-down reproductive strike of the busy breeders among the morons, criminals and social ineffectuals of our population. . . We must inculcate into the rising generation a code of biological ethics . . . The emergency demands a surgical operation."

I, for one, refuse to take Prof. Hooton's "obstinate pessimism" in all its implications; nevertheless, his is a vigorous and timely call to action —on the part of everyone.

A. K.

A Highway Code for Vitamin Workers

The Biological Standardisation of the Vitamins By Dr Katharine H Coward Pp viii + 227 + 7 plates (London Baillière Tindall and Cox 1938) 12*s* 6*d*

INTERNATIONAL standards for certain vitamins have been in existence since 1931 The experience of the last few years has shown that while they have been accepted readily throughout the world a number of workers have either failed to make proper use of them or have not interpreted the results correctly The errors are of commission as well as omission and a rooted dislike and fear of the mathematical unknown lying beyond a simple average—usually drawn from too few animals—seems to be the most common sin

Dr Coward and her colleagues of the Pharmaceutical Society have for some time been leading a courageous missionary campaign among the unbelievers and have published many papers mostly in the *Biochemical Journal* describing how to carry out vitamin assays and how to make proper use of animals and of mathematics These papers form the basis of Dr Coward s book Much new information has been added and the author must be heartily congratulated on this timely collation

The book is in two parts of which the first is self contained and describes the practical aspects of vitamin estimation The reader can make use of this part without first having to master the second which deals with statistical methods of interpretation Nevertheless the second part is extremely simply written and as the author points out in her preface it is to be hoped that workers who have been accustomed to fight shy of statistical methods will be encouraged to take the plunge

Part 1 opens with a very concise account of the general principles of biological assay and of the selection and care of experimental animals The following chapters deal separately with methods for the estimation of vitamins A B_1 C and D that is of all the vitamins for which international standards have been adopted The final chapter of Part 1 describes the way in which certain vitamins affect the estimation of other vitamins

Part 2 outlines the rudiments of the statistical methods which are necessary for biological estimation It then deals with the application of these methods separately to each of the vitamins Copious numerical illustrations are worked out in full in each case The factors governing the standard of accuracy are explained and the way in which an experiment has to be designed and the number of animals chosen to attain a given standard of accuracy is most happily described

Dr Coward writes almost entirely from first hand knowledge and thus imparts to the book a pleasing vitality and directness of style She is a recognized master in the field of vitamin research and few authors have had her opportunities of trying out most methods selecting a few and testing them over a period of years on a large number of animals Her vast experience enables Dr Coward to give the reader invaluable practical hints as to what should be done in the general planning of biological assay Perhaps more important still is what she has to say about things which should not be done

The book does not aim as many compilations do at giving a glossary of all existing methods indeed the author only rarely cites methods not in regular use in her own laboratory and then only on the best authority As she wisely points out a technique of assay found successful in one laboratory often fails in another The principles of interpretation remain however unchanged In working out the technique best suited to his own laboratory and in interpreting his results the reader could not do better than follow the advice contained in Dr Coward s book

Like every piece of pioneering work the book is not faultless but its merits heavily outweigh its few shortcomings In fact it is so good that it will doubtless become a standard book of reference

Owing possibly to the method of presentation the book contains a certain amount of repetition which a specialist might feel inclined to delete but which will be welcomed by the reader approaching the subject for the first time Some pruning should however be possible without loss to the latter for example it is scarcely necessary to give on pages 27 125 and again on page 134 the detailed composition of the same salt mixture

The statistical part of the book is so lucid and is likely to be used as a model by so many readers that it is a pity that the author has not mentioned the refinements introduced by Student since

1908 "Student" showed that the limits of accuracy calculated by the older formulæ (which are those used by Dr. Coward) are always somewhat too optimistic, the more so the smaller the number of animals used. In the case of an estimation of vitamin B_1, with only five or six animals per group, Dr. Coward's formulæ would lead to a considerable over-estimate of the standard of accuracy The correct result can be found by entering the t-table (Fisher, "Statistical Methods for Research Workers", fifth edition, 1934, p 158) in place of the table quoted by Dr. Coward on page 150 of the book under review

Of serious errors there are few, and only two are likely to mislead the reader. on page 156, the three square-root signs should be deleted, and on page 162, σ in the text, the figure and the title to the figure should in each case read ϵ By an obvious slip the word "ingestation" is consistently used for "gestation" on page 9 *et seq* On page 21 in the equation of the straight line the second y should be $\bar{y}$ On page 29, line 20, "uncertain" should read "certain"; page 37, line 14, "cod liver oil" should read "test substance", page 48, line 17, "603" should read "606"; page 148, line 24 would be clearer if the second "of" were replaced by "in"; and on page 157, μ^4 of the fifth equation should be μ_4 and μ^3 of the sixth equation should be μ_3 In a few cases authors' names are given in the text, but not in the bibliography, for example, Peters on page 67, and Phillips (1934) on page 143.

Dr Coward writes so clearly and has succeeded so well in giving a presentation of 'statistics without tears' that the few passages of her book which are less clear may be pointed out in the hope that she will find it possible to revise them for the next edition Thus on page 16 the paragraph on the potency of cod liver oil in different solvents will puzzle the reader who may not yet realize that the differences lie within the limits of biological accuracy The paragraph beginning at the bottom of page 46 may also present difficulties The author has set herself too hard a task in attempting to explain Gaddum's statistical procedure to the non-mathematical reader in the brief compass of pages 177–179 The first part of section E on correlation coefficients (page 202) has also suffered from the need of compression

These few errors of a first edition can easily be corrected They do not affect the fundamentally sound structure of the work

The book is eminently readable and should prove extremely popular One finishes its pages impressed and grateful, and one wishes that it were possible for the centres distributing the international vitamin standards to send to each new recipient a copy of this "Highway Code for Vitamin Workers"

S K KON.
P WHITE

Iraquian Hydrology

The Régime of the Rivers Euphrates and Tigris: a General Hydraulic Survey of their Basins, including the River Karun, having particular reference to their Lower Reaches within Iraq, with Information for the Use of Irrigation Engineers, etc By M. G. Ionides. Pp. vii + 278 + 1 plate (London: E. and F. N. Spon, Ltd, New York. Chemical Publishing Co., 1937) 32*s*.

AMONG the great rivers of the world, the Euphrates and the Tigris stand out with peculiar prominence, not that they are of unrivalled length—there are at least a score of rivers of greater or equal magnitude and mileage—but because they are intimately associated with the infancy of the human race. The earliest written records of humanity are linked with Mesopotamia, now absorbed in the country of Iraq, and from the beginning of history the Euphrates was "the great river" (Genesis xv, 18). The closely adjacent basins of the Euphrates and the Tigris were, in fact, the home of the Sumerians, the race to which is credited the oldest form of connected script, the cuneiform.

There is a special interest, then, attaching to a volume which sets out to put on record, for the first time in systematic form, observations of the hydraulic characteristics of these two rivers, and Mr Ionides is to be complimented on the painstaking care with which he has assembled his material and collated his data He acknowledges in the preface that his readings cover a comparatively short space of time and that a long term of records is very desirable This is undoubtedly true, since the characteristics of most rivers cannot be accurately and fully delineated from short-period observations, but still a beginning has to be made, and though for engineers the present study must be considered as provisional and likely to be outdated, yet the information it contains will always have permanent value as a contribution to the fuller knowledge of the future. Mr Ionides expresses his indebtedness for advice and assistance to Mr W Allard who was director of the Irrigation Department of Iraq from 1928 until 1933 and attributes to him the existence of records in a statistical form amenable to analysis Mr Allard is now serving the Ministry of Health in Great Britain and has been lent to the Inland Water Survey which at the present time seems to be scarcely so far advanced as that of Iraq

The drainage system of the Euphrates and Tigris is bounded on the northern and eastern sides by ranges of mountains which form a consecutive series of catchment areas with outlets facing south to south west The south western side of the basin lies on the edge of the Syrian desert and slopes gently inwards towards the Persian Gulf It is to be noted that there is a pronounced difference in the physical conformation of the courses of the two rivers The catchment area of the Euphrates is fairly compact and below its confluence with the Khabur the river traverses arid and desert country for more than 700 miles without receiving any influents except insignificant storm water drainage The catchment area of the Tigris on the other hand is feather like and the river receives numerous tributaries exclusively however along its eastern bank Although the basin lies within four countries Turkey Syria Iran (Persia) and Iraq it is to the last named which includes the territory formerly known as Mesopotamia that the river discharge is of chief value and indeed of vital importance

The cultivated area of Iraq comprises two zones the rainfall zone and the irrigation zone In the latter there are about 51 000 square kilometres (20 400 square miles) capable of cultivation of which 40 490 square kilometres (16 200 square miles) are actually cultivated while the river supply is probably sufficient to irrigate annually about 30 000 square kilometres (12 000 square miles)

The foregoing facts are of interest but they are merely introductory to the main theme of the volume Chapter ii describes processes of observation and presentation of data by methods more or less generally in vogue The gauges employed are of two types one a post marked with a graduated scale and the other a set of masonry or concrete steps to which scales are affixed The question of the datum is as yet a little indeterminate There is the G T S or Great Trigonometrical Survey datum but in out of the way places where precise levelling has not yet been done an arbitrary datum is adopted Most of the gauges are read once a day a few more frequently and a few once a week Chapter iii deals with the climate which on the whole is sub tropical and arid Nowhere in the basin is the rainfall heavy while on the plain it is very scanty Temperatures on the plains range from a cool winter to a very hot summer Frosts in winter are fairly common July and August are the hottest months with a mean daily temperature of about 95° F (between 111° F and 79° F) Records of rainfall except at Basrah and Bagdad do not cover a period of more than a dozen years and (up to 1934) yield local averages varying from 49 mm to 607 mm (2 in to 24 in)

Four subsequent chapters constitute a series of detail studies dividing each river into two sections the Euphrates from its source to the Hindiyah Barrage and thence to the Shatt El Arab or combined stream and the Tigris from its source to Bagdad and thence to the Persian Gulf Thereafter follows an examination of three features of river hydrology river bed instability and silt forecasting and floods The underlying principles of river bed instability are discussed and figures are given of general and cross sectional instability coefficients the latter of which reach a maximum at Bagdad and Kut of ±1 1 metre (3 5 feet) Forecasting is an uncertain function in the present state of knowledge and the need for trustworthy seasonal predictions of water supplies available for distribution can only be met by more extended observations in the respective catchment areas The two rivers have their source on opposite sides of the same watershed but owing to the longer course of the Euphrates before reaching the plain danger region the Tigris flood peak tends to arrive about a week earlier

In the chapter on floods the author emphasizes the difficult nature of forecasts and affirms that he has not hesitated to give estimates in which imponderable experience (to wit local knowledge and hearsay) plays a large part He follows Hazen s method in computing per cent chances and his nomenclature and tabular statistics are given on these lines Notable occurrences include the 1929 flood on the Euphrates estimated to be the highest for a period of thirty six years when the maximum discharge was 5 300 cubic metres per second (187 000 cusecs) and the 1935 discharge of the Tigris at Mosul estimated at 7 000 cubic metres per second (247 000 cusecs) These may be compared with the Thames record flood of 37 000 cusecs in 1894

There are a useful bibliography a coloured map, and an index The book is well printed and the diagrams seventy nine in number are clear Altogether the volume will be of undoubted service to geographers hydrologists and other geophysicists and pre eminently to river control and irrigation engineers especially naturally to those engaged in the region of Iraq

BRYSSON CUNNINGHAM

An Encyclopædia of the Air

The Air and Its Mysteries
By C. M. Botley. Pp. xv+296+16 plates. (London: G. Bell and Sons, Ltd., 1938.) 8s. 6d. net.

IF Miss Botley had reverted to the old custom of using sub-titles when she christened her substantial volume, recently published, she could have hit on none more appropriate than "Inquire Within upon Everything connected with the Atmosphere". Meteorologists are perhaps somewhat prone to regard the earth's mantle of gases as the joint province of their own and the aviation fraternities: this book comes as a salutary reminder of the important part played by the air in almost every ramification of human activity. Here is matter that concerns physicians, physicists, psychologists, geographers, astronomers, seismologists, archæologists, photographers, botanists, ornithologists, entomologists, chemists of both the organic and the inorganic variety, radio workers, business men, shipmasters, with, of course, meteorologists and airmen, and, last but not least, lovers of the beautiful in Nature. To each and every one of these the author offers food for thought, supplemented in several cases by suggestions for mutual co-operation or original investigation.

In so doing, the author displays a range of knowledge that is rare in these days of specialization. So encyclopædic is the array of information set forth in her 290 pages of text that it may be doubted whether even the most omniscient reader of NATURE could go through Miss Botley's book without adding something to his stock of wisdom. For he who understands the muscular structure of birds and bats, and who knows that the house-fly moves its wings more than 300 times in a second, may well have neglected to inform himself of the maximum possible size of raindrops, and of the fact that the earth's atmosphere is at least 625 miles thick.

The author has the gift of a pleasant, lucid style, coupled with no small literary grace, evidently resulting from wide and well-chosen reading outside, as well as inside, the realms of science. On one point Miss Botley gives a more accurate statement of the truth than Prof. D. Brunt in his book "Weather Science for Everybody". According to the latter authority, there are "zones of silence" around the seat of *any* great explosion: Miss Botley rightly tells us that this does not happen in the case of an extremely violent explosion, such as the eruption of Krakatoa on August 26–28, 1883, when the detonations were heard at all distances up to about 3,000 miles.

It would really need a corps of reviewers to deal adequately with the multitude of aerial subjects discussed in this volume. So far as the meteorological sections are concerned, there is not much to criticize. An understatement appears on p. 111, where it is implied that the annual average of 143 thunderstorms at Leon, Mexico, is not known to be equalled or exceeded elsewhere on earth. We have the good authority of Dr. C. E. P. Brooks ("Climate", Ernest Benn, 1929, p. 126) for pointing out that Buitenzorg, Java, ordinarily suffers such storms on as many as 322 days in the year. To redress the balance, p. 183 of Miss Botley's book contains what must surely be an overstatement: "On the eastern side of Hudson Bay . . . so cold are the conditions that, in an area five times the size of England, there is not a single tree, only creeping willow".

Attention has recently been directed to a strange lack of unanimity in regard to the world's recorded extremes of low temperature. For the absolute surface minimum at Verkhoiansk (Siberia) Miss Botley, following the *Meteorological Glossary* (M.O. 225, ii), gives − 93·6° F., on January 3, 1885. In various authoritative works the figure is cited as − 90° F. Doubt exists also as to the date of the occurrence, February 1892 being adopted by some Soviet writers, who ought to know. The absolute upper-air minimum, over Java, is said by Sir Napier Shaw to be − 135° F. McAdie, however, puts it at − 133° F., the *Meteorological Glossary* at − 131·6° F., and Miss Botley at − 131° F. How, therefore, has all this promiscuity arisen?

The work under review is well worthy of the high company with which it rubs shoulders in Bell's Popular Science Books. Mention should be made of the fine series of photographic illustrations, outstanding among which are Plates II, X, XIII and XIV, representing respectively a sandstorm over the Pyramids, an example of ball-lightning, the 'banner' cloud on the Matterhorn, and a Fulmar petrel in process of 'banking'. Incidentally, the position of Plate V (an infra-red photograph of the coasts of south-east England and northern France taken from the air) is wrongly given in a reference on p. 202.

E. L. HAWKE.

Essai sur les fondements de la géométrie Euclidienne

Par *Julien Malengreau* Pp *311* (*Lausanne et Genève* Payot et Cie 1938) 8 francs

M MALENGREAU conceives the object of a geometrical treatise to be that of investigating the point aggregates of a space which has been generated by the help of appropriate postulates In the present essay, he has set himself the task of generating the most elementary space which can be the object of Euclidean geometry, where Euclidean space is understood as that space which corresponds to the conditions of our environment according to such immediate verifications as we possess The method whereby M Malengreau obtains this elementary Euclidean space is based upon the generation of aggregates containing an indefinite number of points from those containing only a definite number Such a process necessitates the consideration of all those intermediary aggregates which are of use in classifying the new points as they are obtained But M Malengreau is careful to introduce as few new definitions as possible although he invents several new terms to apply to aggregates which are termed differently in classical geometry and in some cases uses the familiar terms in a different sense from that of classical geometry

From the outset, his method differs radically from that of classical geometry the definitions postulates and theorems being introduced in logical order according to the indispensability of the ideas which they define and explain and then only to the extent necessary to enable them to generate a new fundamental aggregate But M Malengreau points out that it is not possible to pass from an aggregate of lower to one of higher order until the extensions of the members of the former in order and magnitude have been determined

M Malengreau maintains that the elementary space generated by his method is equal in experimental value to the general Euclidean space of classical geometry and his treatment is original enough for one to anticipate with interest the general treatise on geometry which he is planning and to which this essay serves as an introduction

Hydrophobic Colloids

Symposium on the Dynamics of Hydrophobic Suspensions and Emulsions held at Utrecht on the 5th and 6th November 1937 under the auspices of the Colloidchemistry Section of the Nederlandsche Chemische Vereeniging Pp 181 (Amsterdam D B Centen s Uitgevers Maatschappij, 1938) 4 florins

THIS book forms a testimonial to the work of the Dutch school on hydrophobic colloidal solutions It contains a number of papers on the electrical double layer, including one of special importance by H C Hamaker, who discusses stability in terms of potential curves Ionic exchange is then discussed and the book ends with two papers on emulsions It should be read by all workers on colloids, but with certain reservations The best comment is provided by Prof Kruyt at the end of his introduction He says To-day colloid chemistry floats in water ! All our results are confined to an ionising intermicellar liquid and I can scarcely think of any satisfactory way of extending these discussions to non aqueous systems But why try ? It must be realized that colloidal solutions fall into two main classes First there are those the stability of which is due to an ionized surface layer, which may be formed by adsorption of ions as in hydrophobic sols or which may be due to the presence in the particles of ionizable groups The particle may be a polymer molecule or a micelle for example, proteins and soaps Secondly there is the rapidly growing class of substances which form stable solutions because they are soluble in the solvent and which are colloidal because of their large molecular weights for example rubber and the polymers generally There is no reason why this dualism should be more disturbing in two dimensional chemistry than in ordinary three dimensional chemistry It is not a bar to progress, but a clear indication of how far a particular line of attack can be followed profitably

A S C L

Discarnate Influence in Human Life

a Review of the Case for Spirit Intervention By Ernesto Bozzano Translated by Isabel Emerson (Library of the International Institute for Psychical Research, Vol 1) Pp xiv + 274 (London International Institute for Psychical Research , John M Watkins n d) 8*s* 6*d*

IN this volume Signor Bozzano, one of the most prolific of Italian writers on psychical research sums up the conclusions to which he has been led in the course of many years of attention to this subject The book will be of some considerable interest to spiritualists since it attempts to deal in detail with the difficulty of combining in one so called explanation, phenomena where resort to a spiritistic hypothesis is clearly unnecessary, and other manifestations where the influence of the discarnate might to some minds be considered obvious

Signor Bozzano advances the view that it is not a situation where the choice is between what he calls animism and spiritualism but that it is one where the two are combined and interlinked to such an extent that it may be said that animism proves spiritualism The subliminal processes are, to Signor Bozzano the senses of the spirit still incarnate, which are only later to emerge and function in the environment proper to them Thus instead of being an all sufficient explanation of psychic phenomena they can be regarded as pointers to the only true explanation, namely, the activity of spirits still incarnate which, when released from the body at death, fulfil their destiny in spiritual realms

Although the theory will scarcely be considered by those to whom the existence of psychic phenomena is still in doubt, it will certainly be discussed at length by psychical researchers generally, to whom this book, so well translated by Isabel Emerson, can therefore be commended

The Pleistocene Anthropoid Apes of South Africa

By Dr. R. Broom, F.R.S., Transvaal Museum, Pretoria, South Africa

DART'S discovery in 1924 of the fossil ape of Taungs, which he named *Australopithecus africanus*, opened a new chapter in the history of the origin of man The type skull, which unfortunately is the only one known from that locality, is that of a five-year-old child, and though there seems little doubt that Dart was right in regarding it as an ape much nearer to man than either the chimpanzee or the gorilla, some European men of science still seem to believe that it is a variety of chimpanzee or a dwarf gorilla, in spite of the fact that the milk teeth are entirely different in structure from those of the living anthropoids, and closely similar to those of man

In 1936 I discovered, at Sterkfontein, much of an adult skull which I described as *Australopithecus transvaalensis* It is clearly allied to the Taungs ape, but there are few points in which a comparison can be made between the two, and I provisionally placed it in the same genus In the last two years almost continuous exploration has been going on at Sterkfontein, and many interesting further remains have been found, notices of some of which have been published in NATURE

Until this year, nothing was known of the lower jaw except a beautifully preserved 3rd molar We still do not know much of the mandible, but we now have a well-preserved 2nd premolar, much of what I regard as a female canine, and the incisor portion of the jaw of a young male, corresponding to a human boy of nine years, with the perfectly preserved crown of an unworn canine This canine is unlike that of any ape at present known, but there seems little doubt that it is rightly identified as that of the male *A. transvaalensis*, from the resemblance it bears in a number of respects to the canine, which I regard as the lower canine of the female. Though little more than the incisor portion of the symphysis is preserved, it shows the sockets of the incisors, and reveals the interesting fact that the lateral incisors are considerably larger than the central ones. The shape of the symphysis is so different from that of the Taungs ape that it seems advisable to place *A transvaalensis* in a distinct genus, for which the name *Plesianthropus* is proposed.

In June of this year a most important new discovery was made. A schoolboy, Gert Terblanche, found in an outcrop of bone breccia near the top of a hill, a couple of miles from the Sterkfontein caves, much of the skull and lower jaw of a new type of anthropoid. Not realizing the value of the find, he damaged the specimen considerably in hammering it out of the rock The palate with one molar tooth he gave to Mr Barlow at Sterkfontein, from whom I obtained it Recognizing that some of the teeth had recently been broken off, and that there must be other parts of the skull where the palate was found, I had to hunt up the schoolboy I went to his home two miles off and found that he was at school another two miles away, and his mother told me that he had four beautiful teeth with him I naturally went to the school, and found the boy with four of what are perhaps the most valuable teeth in the world in his trouser pocket He told me that there were more bits of the skull on the hillside. After school he took me to the place and I gathered every scrap I could find; and when these were later examined and cleaned and joined up, I found I had not only the nearly perfect palate with most of the teeth, but also practically the whole of the left side of the lower half of the skull and the nearly complete right lower jaw. The only missing parts

Fig 1

PALATAL VIEW OF SKULL OF *Paranthropus robustus* BROOM, ABOUT ½ NATURAL SIZE THE TEETH OF THE LEFT SIDE HAVE BEEN WEATHERED OFF, BUT ARE REPLACED IN WHAT MUST HAVE BEEN NEARLY THEIR ORIGINAL POSITION PART OF THE SOCKET OF LEFT m^3 IS PRESERVED of importance are the halves of two molars, the crown of the left 1st upper premolar and the crown of the right lower canine. Those I still hope to discover. As, however, we have impressions in the matrix of some of the missing teeth and parts, we know nearly the complete dentition

The skull is that of a large ape, larger than most male chimpanzees and nearly as large as most female gorillas, but it differs very greatly from both the living African anthropoids. Much of the palate is preserved in perfect condition The whole of the left side of the sphenoid bone is also preserved; while the zygomatic arch is nearly complete The glenoid cavity and the tympanic bone are in perfect preservation, and much of the mastoid region, and part of the occiput with a portion of the left condyle

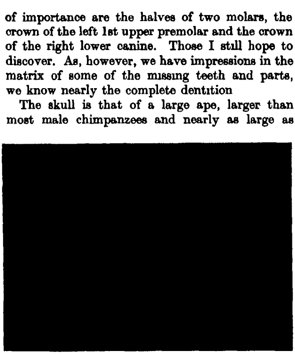

Fig 2

Side view of skull of *Paranthropus robustus* Broom. About ½ natural size.

The glenoid cavity and the relations to the tympanic bone are of exceptional interest. In the gorilla, the chimpanzee, the orang and the gibbon, the outer part of the tympanic is situated behind the posterior glenoid process In man, the tympanic is situated mainly below the glenoid process, and even at its outer part it forms the posterior non-articular part of the glenoid cavity In the new fossil ape, the condition of the glenoid and tympanic is almost exactly as in man, though the parts are very much larger.

The occipital condyle is in practically the same plane as the external auditory meatus and thus farther forward than in the gorilla and the chimpanzee; which appears to indicate that the ape walked somewhat more erect than the living anthropoids.

From the portion of the brain case preserved, I estimate the volume of the brain to have been about 600 c.c. The face is remarkably flat and much shorter than in the gorilla. A curious bony ridge runs down from the inner border of the large infraorbital foramen

The molar teeth, as will be seen from the illustrations, differ considerably in shape from those in *Plesianthropus transvaalensis*, and the 2nd premolar is about half as large again as in the Sterkfontein ape The upper canine had been lost before fossilization, but it must have been relatively remarkably small, and the incisors, of which we have much of the sockets preserved, were also relatively small. The palate is relatively short and broad, and owing to the small size of the incisors and canines the anterior part is narrowed, and the teeth are arranged more as in man than in any of the living anthropoids. The anterior two-thirds of the right mandible are satisfactorily preserved. The symphyseal region has been broken off behind the canine before fossilization and slightly displaced. The incisors which are lost have been relatively very small, and the lateral ones are scarcely larger than the central. The canine crown is lost, but the impression of its outer side is preserved in the matrix. It is quite a small tooth, and remarkably human in shape. It is clearly very unlike the canine of *Plesianthropus transvaalensis* The premolars have rounded crowns without any high well-developed cusps as in the living anthropoids, and are thus fairly similar to those of man, but about twice as large The 2nd premolar differs very markedly from that of *Plesianthropus transvaalensis*, and we may thus confidently place the new skull in a new genus and species.

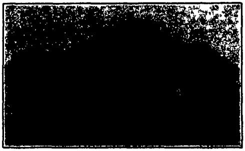

Fig 3

Occlusal view of molars, with roots of premolars, of right mandible of *Paranthropus robustus* Broom.

The deposit in which the skull was found is the floor of an old cave the walls of which have probably been weathered away thousands of years ago. We may therefore suspect that the deposit is very much older than that in the Sterkfontein caves, and this is confirmed by the associated fauna. It contains a jackal, a baboon, a horse and a hyrax, which are all of different species from those at Sterkfontein, and are most probably all older.

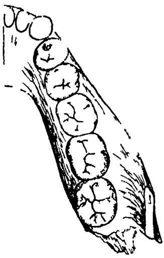

Fig 4

OCCLUSAL VIEW OF RIGHT MANDIBLE OF *Paranthropus robustus* BROOM ½ NATURAL SIZE THE PORTION OF THE JAW WITH CANINE AND INCISOR SOCKETS WAS DETACHED AND IS PLACED IN WHAT WAS PROBABLY ITS ACTUAL RELATIONSHIP

The skull may be referred to as the Kromdraai (pronounced Kromdry) skull and may be given the name *Paranthropus robustus*

It seems probable that the Sterkfontein skull is of Upper Pleistocene age the Kromdraai skull of Middle Pleistocene and the Taungs skull probably of Lower Pleistocene though of course more work will have to be done before the geological ages of any of these skulls can be determined with more than probability

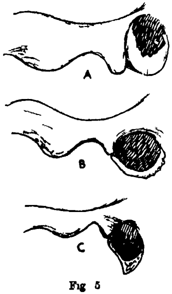

Fig 5

THE GLENOID AND THE EXTERNAL AUDITORY MEATUS IN (*A*) A LARGE MALE GORILLA (*B*) *Paranthropus robustus* AND (*C*) A LARGE KORANA MALE ½ NATURAL SIZE

Clearly during the Pleistocene there lived in South Africa a number of large brained anthropoids which resemble man in the shape of their premolars and in having relatively small canines and in having the glenoid region in at least some forms remarkably human in structure These Pleistocene apes are probably the modified descendants of forms that may have been widely distributed over Africa in Pliocene times and it is probably from one of the Pliocene members of the group that man arose

Quite certainly the conditions in Pleistocene times in South Africa were not unlike those of to day The apes lived on the plains and among the rocky krantzes At Taungs most probably the apes lived in the caves The associated animal remains seem to be the kitchen midden of *Australopithecus*

At Sterkfontein and Kromdraai the larger bones in the caves seem all to have been introduced by carnivorous animals and the small bones by owls Nearly every bone of the larger animals has been broken in pieces No perfect limb bone has been found and most teeth are detached from the jaws and many of the teeth have also been broken before fossilization

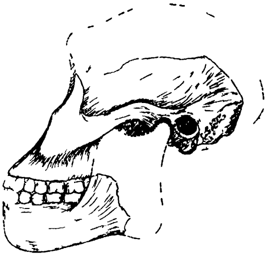

Fig 6

SIDE VIEW OF SKULL OF *Paranthropus robustus* BROOM ⅓ NATURAL SIZE RESTORED THE PARTS IN LINE ARE KNOWN

We have now a fairly good knowledge of the faunas associated with the apes We know about a dozen fossil mammals from the Taungs caves all extinct about thirty mammals from Sterkfontein nearly all extinct and we know about a dozen from Kromdraai all extinct except one—the living porcupine

Social and International Relations of Science

THE growing feeling among scientific workers that they have a definite part to play in the promotion of social well-being and in international affairs found expression in a discussion in NATURE of April 23. The outcome was a suggestion that the British Association should take up the matter, and the Council of the Association put forward a proposal for the establishment of a new Division for the Social and International Relations of Science. The proposal was agreed to by a meeting at Cambridge of the General Committee on August 17. We print below the memorandum prepared for the General Committee.

At the present time a strong feeling exists that the social relations of science demand close and objective study. The question has been dealt with recently in the Press and elsewhere. At an informal meeting of persons specially interested, it was stated that there is nothing in the constitution of the British Association to prevent the establishment of machinery within that organization for the purpose desired. A resolution was thereupon addressed from this meeting to the Council of the Association, inviting the Association to establish a special department which would consider the social and international relations of science, by means of inquiry, publication, and the holding of meetings not necessarily confined to the annual meetings of the Association.

International relations were specified in this resolution primarily because of the deep interest of the American Association for the Advancement of Science in the subject. Discussion is expected to take place between officers of the two Associations, during the present summer, on the best means for international co-operation.

The Council supported the proposal to establish an organization for these purposes within the Association. They appointed a Committee to formulate a scheme for the working of such an organization, to be presented to the General Committee at the Cambridge Meeting. It is thought that the organization should work on lines in some respects different from those of a Section, and should not bear that title. The term 'Division' is therefore recommended.

The purpose of the Division would be to further the objective study of the social relations of science. The problems with which it would deal would be concerned with the effects of advances in science on the well-being of the community, and, reciprocally, the effects of social conditions upon advances in science.

The Division would be worked by a Committee, nominated annually by the Council and appointed by the General Committee. The Council should have power to appoint additional members of the Committee during the year.

The Committee should embody the existing British Science Guild Committee of the Association, inasmuch as the Norman Lockyer, Alexander Pedler, and Radford Mather Lectures, now administered by that Committee, would appropriately come within the purview of the Division.

The President of the Association and the General Officers should be *ex-officio* members of the Committee. A chairman of the Committee should be appointed for a fixed period of office. A fixed proportion of the ordinary members of the Committee should retire annually (as in the case of the Council) and should not be eligible for immediate re-election.

The functions of the Committee would be:

(*a*) To arrange meetings of the Division both at the time and place of the Annual Meetings of the Association, and elsewhere at other times, as invited or otherwise arranged; to appoint speakers and to accept or reject communications offered to the Division.

(*b*) To furnish material for the information of the public.

(*c*) To co-ordinate work dealing with the social relations of science, both at home and abroad.

(*d*) To be prepared to act in a consultative capacity and to supply information, and to that end to establish relations with organizations and persons engaged in practical administration.

(For the furtherance of the above objects, the Committee, immediately upon the establishment of the Division, should issue an announcement thereof, together with a reasoned statement of its aims, to institutions and other organizations and individuals known or likely to be interested in its work.)

(*e*) To set up sub-committees for executive purposes, or for research, inquiry, or co-ordination. If any such sub-committee should require a grant of money for its work, the Committee should be empowered to apply for such grant to the General Committee or the Council in accordance with the usual procedure relating to research committees.

(*f*) To maintain close relations with the Sections of the Association and their Organizing

Committees In particular, there may be imagined subjects which two or more Sections might be disposed to recommend to the Division for discussion, in lieu of arranging joint meetings of the Sections. The Committee of the Division, on its part, should be enabled to invite the advice of the sectional organizations on all appropriate questions The Organizing Sectional Committees should be kept regularly informed of the activities of the Division

The Committee should meet regularly throughout the year, at intervals determined by itself, and in particular it should hold a meeting at or near the time of the joint meetings of Organizing Sectional Committees in January, in order to assure the relations with the Sections referred to above.

The Committee should report to the Council as and when necessary, and annually through the Council to the General Committee.

Logic and Probability in Physics*

By Dr. C. G. Darwin, F.R.S.

IN choosing a theme for my address I was in some difficulty The main subjects of present interest in physics, the nucleus of the atom, cosmic rays, and the phenomena at deep temperatures, are being dealt with in the discussions of our Section, so that they would be excluded even apart from the fact that I cannot speak on them with authority It would have been possible for me to choose a narrower subject, but I could not feel that this would have possessed the general interest that such an occasion demands, and so with some trepidation I am venturing on an even wider theme and am going to touch on the philosophy of our subject This is a dangerous thing to do for one who has never made more than the most superficial study of pure philosophy, but still I do not apologize for it, because it appears to me that recent scientific history has revealed a deep schism between the professional philosophers and the scientists, and this schism is worthy of examination

General philosophy claims to be the critical subject which lays down for all of us what we may be allowed to think, and yet it has played no part whatever in the great revolutions of human thought of the present century—those connected with relativity and the quantum theory It might have been expected that the scientists would have been constantly consulting the philosophers as to the legitimacy of their various speculations, but nothing of the kind has happened Since no one can dispense with some sort of metaphysic, each scientist has made one for himself, and no doubt they contain many crudities, but it would seem that a deep interest in metaphysic is a disadvantage rather than an advantage to the physicist—at least I have the impression that those of my friends who are most inclined to speculate on the ultimate things appear to be the ones whose scientific work is most hampered by doing so Now I propose to risk a similar indiscretion I want to embody in it the practical philosophy of a physicist, and I do not mean it as an attack on the pure philosophers, who are very reasonable people, only chargeable with the minor offence of not having made me want to read their books!

I had better begin by stating shortly the ideas I intend to discuss. There is a notable contrast between the way we think about things and the way we think we ought to think about them We have set up as an ideal form of reasoning the formal logic which has held the field since the days of Aristotle We rarely conform to this ideal, but instead we usually make use of arguments having no accurate axiomatic basis, which compel belief because of some large accumulation of favourable evidence I intend to develop the idea that the old logic was devised for a world that was thought to have hard outlines, and that, now that the new mechanics has shown that the outlines are not hard, the method of reasoning must be changed. The key to the modification has already long been in our hands in the principle of probability, but whereas in the past constant attempts were made to fit this into the old system, the new mechanics suggests the possibility of a different synthesis Though I hope this subject will be found interesting in itself, I would not have ventured to bring it forward if I had not also a very practical purpose in doing so, and that is to urge that our mathematical education both at school and university has been gravely deficient in that it has put all the emphasis on matters susceptible of rigorous proof, while it has very completely neglected the equally important subjects of statistics and probability. I shall enter into these matters at the end of my address.

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* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Cambridge on August 19.

If we examine various examples of theories and why we believe in them, we conclude that an axiomatic basis, of the kind demanded for the operations of formal logic, is too narrow for the understanding of the physical world Something wider is needed. Now for more than a century there has been growing up the recognition that probability plays a part in much reasoning, and that there must exist a wider system of logic which has probability as one of its features. Attempts have been made, and are still being made, to bring probability back into the narrow fold of the old logic It appears to me that these attempts are hopeless, but before approaching the question directly I want to develop an analogy which seems to me important Like everyone else I *feel* the compelling power of the old logic, and I cannot *feel* how when we try to go beyond it we can get the same compulsive force. But on the other hand, I *know* of a case where our thoughts are driven in one direction by a force which seems to have the same psychological compulsion as does formal logic, and yet where the result is undoubtedly wrong

To anyone who has thought at all seriously about the world, or at any rate to anyone who has made an elementary study of mechanics, I suppose there is nothing more absolute than the law of causality By this I mean that the future is completely contained in the present Passing over obvious examples where this is true, like the path of a projectile or the orbit of a planet, we may take an extreme case where we might expect our faith in the principle would be most severely tried. Take the typical case of chanciness, the tossing of a coin We know that in a general way there is an even chance of heads or tails, even though we sometimes hear of gifted individuals with muscles so delicately adjusted that they can control the event. But in the ordinary way the tossing of a coin is complicated by being produced by a living organism, so let us simplify the problem by designing a catapult of some kind to project it. Which of us does not believe the coin would fall the same way every time if such a mechanism could be made with really complete precision ? When the machine fails to make it do so, we say it is because there may have been a speck of dirt in the lubricant or something like that. In other words, we do not feel that the fall of the coin is determined by chance, but we regard the uncertainty we observe as due to our ignorance of all the detailed causes. Ignorance is a confession of incompetence, and so we regard the existence of chance as a blemish in our otherwise admirable characters. This feeling goes very deep, since we are prevented by it from having the complete control of our surroundings that we somehow think should be our due. We start prejudiced against probability and in favour of causality.

So much for what we *feel* about causality , and about thirty years ago this feeling would have been regarded as a piece of inescapable reasoning, with the same kind of compelling power as a logical syllogism We still have the feeling, but now we know it is wrong, and what is more, we know that it is wrong for a reason we never thought of. To understand this oversight we must review the recent history of atomic theory.

[There follows a review of the history of the quantum theory with special reference to the way in which it disposes of the difficulty of causality]

The history of the quantum theory serves as an analogy to the deeper question of what is wrong with the old logical processes. Just as we used to feel the all-pervading compulsive force of causality, so we feel the all-pervading force of pure logic. Just as we felt that classical mechanics provided no room for anything beyond itself, so we feel that the old logic is the only admissible kind of reasoning We knew that certain things led to the Old Quantum Theory and obstinately refused to fit into mechanics, and we know that the principle of probability can cover many things outside the old logic. Many men tried to force the quantum into the classical system, and many are still trying to bring probability within the fold of the old logic I do not believe it can be done. This is not the occasion, nor have I the capacity, for a deep argument on the place of probability in logic, but one of the most convincing ways of seeing it may be found in the consideration of another branch of physical theory, the kinetic theory of gases.

The greatest contribution to the subject was that of Gibbs, who recognized that there had to be a big assumption somewhere and made it quite frankly and without attempt at justification. The works of Gibbs are not easy reading , in both his great works he attends to every detail with a particularity that is really rather tedious, whereas his basic ideas are thrown at the reader almost without explanation. The idea of a canonical ensemble is a really beautiful idea once you understand it, but where does it come from ? An ensemble is an idea which will be unfamiliar to many, so I had better explain it. We want to know something about the behaviour of a complicated system composed of a great many parts ; say we want to know the pressure of the gas in some vessel. Gibbs considers a very large number of possible states of motion of the set of molecules, which have some character in common such as their total energy, but which are otherwise unrelated. Though each specimen of the motions is quite independent of all the others, he looks at them all together; this explains the word *ensemble*—I do not know why he had to take a French word—and makes the assumption that the pressure of the gas is correctly given by the average of all the specimens. The actual gas in the vessel at any instant is one of the specimens, in its motion it passes into configurations corresponding to others, but only after a fantastically long time would it go through even a perceptible fraction of the whole ensemble. Gibbs is assuming that the behaviour of the actual gas will be determined by the average of the uncountable millions of specimens in the ensemble.

With the old mechanics all this involved ideas which for many readers were distinctly hard to accept. The principle of probability, embodied in the averaging over the ensemble, was frankly laid on top of the logical principles of Newtonian mechanics, and to anyone believing that probability would ultimately be brought down to the old logic the association was most repellent But we can now see that Gibbs was a prophet far ahead of his time—and indeed, to be frank, far ahead of his own knowledge—for the new mechanics accommodates the ensemble very much more easily than did the old The new mechanics has shown us that it is impossible to know how the individual molecules are moving, because when one undertakes an experiment to see, that experiment automatically alters the condition of the gas and so fails to tell what was wanted, the state of the molecules without the experiment.

In the old days one used to feel that the validity of Gibbs's idea would be spoilt by some skilful experimenter who would really observe the motions of the individual molecules and would therefore rule out the legitimacy of averaging over the *whole* ensemble, but we now know that there is no danger of this. The real gas in the vessel is not merely one specimen of the ensemble, unrecognizable only because of our clumsiness, it is itself the whole of the ensemble. We used to think of the gas as *either* in the state *A*, *or* in the state *B*, *or* in *C*, but according to the new physics we have to think of it as in *all* the states *A and B and C*. The distinction is typical of the change we must make in our habits of thought, and most of us resist this change strongly, for we find we can scarcely help asking: 'But which state was it really in?' As I have said, we used to be ashamed of ignorance, but we must now realize that *this* ignorance is one of the things that makes the world possible. The principle of probability, which used to be loosely superposed on the old logical principle, is now with the new mechanics fully united with it in a higher synthesis.

Before leaving Gibbs I would like to refer to one thing in his book, where I think he has not even yet come into his own He considers various types of ensemble of increasing generality. In the micro-canonical the members all have the same energy Now we never know the exact energy of the gas in a vessel, so that a better idea is the wider one of a gas at a given temperature which therefore has a certain range of admissible energies. This is represented by Gibbs's canonical ensemble, and it is the main one that he uses In both these the number of atoms in the ensemble is constant But in the last chapter of his book Gibbs introduces a still wider ensemble He calls the ones with a constant number of atoms *petits ensembes*, which I shall translate as petty ensembles, and regards them as parts of a grand ensemble in which the total number of atoms is not fixed. He uses the idea to some extent in connexion with semi-permeable membranes, but on the whole does not get far with it

As in much of Gibbs's work, it is the idea itself, rather than what he does with it, that is important This idea of the grand ensemble is not yet incorporated in the new physics. In the quantum theory we take a number of electrons and nuclei, and, allowing for their interactions, we construct something that is practically the canonical ensemble But we take fixed numbers of them—this is partly reflected in the technical process of using normalized wave-functions Now in an experiment dealing with a large number of particles we are never really sure exactly how many there are, and to assume this number is much like assuming a constant energy for them If the canonical ensemble is a better idea than the micro-canonical, then the grand ensemble is superior to the petty ensemble In the new mechanics nobody has yet succeeded in making anything of it, or has made any proposal how to do so, but I will venture the forecast that when some of our present difficulties in the quantum theory are cleared up, it will be found that we shall be using the grand ensemble with its indefinite number of atoms

Reverting to my main theme, what is the moral of all this? It is that the new physics has definitely shown that Nature has no sharp edges, and if there is a slight fuzziness inherent in absolutely all the facts of the world, then we must be wrong if we attempt to draw a picture in hard outline. In the old days it looked as if the world had hard outlines, and the old logic was the appropriate machinery for its discussion Things went wrong when it was found necessary to call in the help of the principle of probability; this appeared first as an alien, but there was hope in the old days that the alien might be naturalized. It has resisted the process and we now recognize that it cannot be assimilated, because it provides the necessary step to a wider reason, that of the new fuzzy world of the quantum theory, a world which is not contained in the old. How far it will be possible to make a full synthesis of the new and the old I do not know, but I like to think there is something in my analogy from the history of the quantum theory, and to suppose that we are still in the condition corresponding to the Old Quantum Theory, and that some day a real synthesis will be made like that of the New Quantum Theory, so that there will be only one thing in the world that has not indefinite outlines, and that will be a new reformed principle of reasoning

There may be a feeling among some that the very general suggestions I have been making are open to every sort of criticism Perhaps they are right; as I have said, it is part of my doctrine that the details of a physicist's philosophy do not matter much But whether it is wrong or right, my next point is one on which I do very much hope that there may be a consensus of agreement This is that the subject of probability ought to play an enormously greater part in our mathematical-physical education I do not merely mean that everyone should attend a course on the subject at the university, but that it should be made to permeate the whole of the mathematical and scientific teaching not only at the university but also at school To the best of my recollection, in my own education I first met the subject of probability at about thirteen years of age in connexion with the problems of drawing black and white balls out of bags, and my next encounter was not until the age of twenty-three, when I read a book—I think it was on the advice of Rutherford—on the kinetic theory of gases Things are better now, but mathematicians are still so interested in the study of rigorous proof, that all the emphasis goes against the study of probability.

This is not the place to describe a revised scheme of education I would only say that it is not special new courses that are needed, but rather a change in the spirit of our old courses. When a boy learns about the weighing machine, emphasize its sensitivity, and consider the length of time that must be taken for the weighing. When he has a problem on projectiles, make him consider the zone of danger and not merely the point of fall At a rather higher level, but still I should hope at school, introduce the idea of a distribution law; for example, in doing central orbits work out Rutherford's law of scattering Calculate the fluctuations of density of a gas, or the groupings in time of the scintillations of α-particles. All these things ought to be examples of a familiar train of thought, and not merely a highly specialized side-branch of mathematics first met at the university. It is the incorporation of probability in the other subjects on which I want to insist, but there will of course remain some higher aspects—things like least squares or significance tests—which are still to be treated in separate university courses Even these I should hope would come to be recognized as subjects of central interest and not, as they are at present, relegated to a remote corner of specialized study.

If these reforms are carried out. I shall hope that generations will grow up which have a facility that few of us at present possess in thinking about the world in the way which the quantum theory has shown to be the true one The inaccuracies and uncertainties of the world will be recognized as one of its essential features. Inaccuracy in the world will not be associated with inaccuracy of thought, and the result will be not only a more sensible view about the things of ordinary life, but ultimately, as I hope, a fuller and better understanding of the basis of natural philosophy.

Obituary Notices

Sir John Snell, G.B.E.

BY the death of Sir John Francis Cleverton Snell, the electrical profession has lost an inspiring leader, and all who knew him mourn the loss of a great-hearted and much-loved friend.

The son of Commander Snell, he was born in 1869, at Saltash, Cornwall, the county which produced Trevethick, Humphry Davy and other pioneers. Being unable to enter the Navy through defective eyesight, he decided to adopt an engineering career. He became a student of King's College, London (of which, in later years, he was elected a fellow), and after gaining valuable experience with Woodhouse and Rawson, and Crompton and Company (for whom he laid a complete system of underground mains in Stockholm), he became chief assistant to the late General Webber, and in 1893 became resident engineer to the Vestry of St. Pancras. From 1896 until 1906 he was borough electrical and tramways engineer of Sunderland, where he designed a new, and the main, power station and a complete system of electrical tramways.

In addition, Snell found time to publish in 1906 a work on the "Distribution of Electrical Energy", to be followed later by a complementary work on "Power House Design", which for many years were regarded as standard works.

All this time, Snell's virile brain envisaged a much wider sphere of activity, and as his advice on technical problems was sought with increasing frequency he took the plunge and established himself as a consultant in Westminster. His practice rapidly increased, and also his reputation as an expert witness, and as an authority on the rating of electricity undertakings. In 1910, he amalgamated his practice with that of Messrs. Preece and Cardew, the new firm being known as Preece, Cardew and Snell.

Perhaps Snell's outstanding achievement in these years was in connexion with the acquisition by the State of the telephone service He was the principal technical witness for the Crown in the arbitration proceedings, and was in the witness-box for thirteen days. His case was prepared with that meticulous care and accuracy which distinguished him throughout his career, and as a result, he was largely instrumental in saving the country more than £8,000,000

Snell received the honour of knighthood in 1914, and later, as a reward for further public services, he was created a G.B.E. in 1925. He was retained as electrical adviser to the Board of Trade on matters such as the regulations for the safety of the public Owing to the growing importance of electric supply as a public utility, the Government of the day passed the Electricity (Supply) Act, 1919, for the reorganization of the industry, and placed the control in the hands of an independent body of experts known as the Electricity Commission. Snell was persuaded to accept the office of chairman (though at a considerable financial loss to himself), a position which he adorned until his retirement in January last

In 1925, Snell was chief technical adviser to the Weir Committee, the recommendations of which were embodied in the Electricity (Supply) Act, 1926, which provided for the re-organization and co-ordination of electrical generation on national lines, under the direction of a new body, the Central Electricity Board, a function of which was to interconnect by means of the 'Grid' the most efficient power stations and close down the smaller and less efficient plants The generating side of the industry being thus placed on a soundly organized basis, he turned his attention to the reorganization of the distribution side, envisaging the reduction of more than six hundred separate undertakings, which had grown up in somewhat haphazard fashion, to a much smaller number, by means of amalgamation or acquisition on fair terms. He was a member of the McGowan Committee which reported its conclusions to the Government in 1936. The Government has announced its intention of promoting legislation to this end

The outstanding achievements of 'Snell's career may be summarized as (1) his work for the country in connexion with the acquisition of the telephones; (2) the reorganization of generation into one orderly whole and the establishment of the 'Grid'; (3) the unification of the frequency throughout the country to a standard of 50 cycles in place of various frequencies ranging from 25 to 100 cycles; (4) the encouragement of a standard of A C voltage of 400/230 which, though not yet universal, is making encouraging progress; and (5) the encouragement to electrical undertakers to take long views—especially with reference to rural electrification.

Sir John Snell was president of the Institution of Electrical Engineers in 1914–15, and was awarded the Faraday Medal in March last, in recognition of his distinguished services to electrical science: vice-president of the Institution of Civil Engineers in 1926–31 and only ill-health prevented his accepting the presidency: past-president of the Incorporated Municipal Electrical Association in 1902–3: past-president of the British Electrical and Allied Industries Research Association in 1928–29: president of Section G (Engineering) of the British Association in 1926 (Oxford meeting)

Though it will be obvious that Snell's opportunities for recreation were scanty, he was keenly interested in the petrological study of rocks, particularly those of igneous and metamorphic origin In late years he made a special study of the contact minerals associated with the aureole of metamorphism surrounding the Cornish granites. He was always a great bird lover, and in his younger days he used to tame various wild birds to come to the hand.

The present writer, who enjoyed his friendship for more than forty years, and who for a decade was in almost daily touch with him, would give the following impression of Sir John's character. He had the judicial mind to a marked degree In his conduct as chairman of conferences and inquiries, he was always dignified, always fair, and those to whom he had to announce an adverse decision never doubted his integrity and impartiality To all who came in contact with him, whatever their station in life, he showed a fine old-world courtesy

T P WILMSHURST.

Mr. E. M. Nelson

BY the death of Edward Milles Nelson on July 20, at the ripe age of eighty-seven years, a great microscopist has passed away He was the son of a doctor, and after a brief period of study at Corpus Christi College, Cambridge, he entered the service of a telegraph company and was for a time engaged in laying submarine cables along the coast of South America, and between the Shetlands and the mainland Even at this period, he was never so happy as when testing the performance and optical qualities of a telescope, sextant or other optical instrument

Nelson afterwards settled in London, and in 1876 joined the Quekett Microscopical Club, of which he later became president for three successive years (1893–95), and contributed a number of papers to its *Journal*. He now devoted himself more and more to work with the microscope, being much more interested in the theory, construction and use of the optical parts of the instrument than in the objects examined. He had an acute controversy with Abbe respecting the proper conditions for obtaining the best performance of microscope objectives of high numerical aperture. Abbe maintained that a small (pin-hole) stop in the substage condenser was the proper combination, whereas Nelson held that a large aplanatic cone is essential, and this was afterwards proved to be correct His views on this subject were contributed in a paper to the *Journal of the Quekett Microscopical Club* (4, Ser. 2, 116; 1890).

Nelson was also a fellow of the Royal Microscopical Society, to the *Journal* of which he communicated some two hundred papers and notes between 1881 and 1914 He was likewise president of this Society for three years (1897–99).

Possessed of very keen eyesight and unlimited patience, Nelson by his method of 'critical illumination' demonstrated many structural details previously unknown in diatoms and other microscopic forms of life, and in 1882 exhibited at the Royal Microscopical Society. Nobert's 19th band resolved for the first time in England He also devoted much time to photomicrography with conspicuous success, and contributed the fine series of photomicrographs which illustrate the 1891 edition of "Carpenter on the Microscope", edited by Dallinger.

Nelson was also interested in the telescope, upon which he had privately published a little book in 1893, and he aroused the interest of Col. Gifford in this instrument, who, guided by Nelson, computed apochromatic telescope object glasses with very perfect corrections. The designing of mathematical scales and rules and the calculation of mathematical tables, with special reference to optics, were other subjects at which he worked. Nelson was also interested in ancient stone circles and made a considerable study of them, resulting in the publication of a small book on the subject, "The Cult of the Circle Builders".

In private life, Nelson was deeply religious and an admirer of classical culture in its proper sphere. He will be greatly missed by microscopists, for he was always ready to place his unrivalled knowledge and technique at the disposal of all—and they were many—who sought his help. R. T Hewlett.

News and Views

Sir Albert Seward, F.R.S.

By the election of Sir Albert Seward as president of the British Association for the meeting to be held in Dundee next year, botany again assumes the presidential dignity after a comparatively short interval, since Prof F. O Bower was president of the Bristol meeting in 1930 Sir Albert's work and influence have been, and still are, very widespread in scientific research and in guiding the destinies of science and academic administration. For thirty years (1906–36), he held the chair of botany at Cambridge, which, since his retirement, is being filled by one of his former students, Prof. F. T. Brooks. For some years before Sir Albert's election to the chair at Cambridge, he had been fellow and tutor at Emmanuel College, and for sixteen years, University lecturer in botany; so his connexion with Cambridge has been a very long one. During 1915–36, he was Master of Downing College, and in 1924–26 Vice-Chancellor of the University. Thus has he been able to play a large part in academic administration at Cambridge for which his scientific attainments and personal qualities were admirably suited. He is a fluent speaker with an exceptional fund of sharp humour. Most of Sir Albert's scientific work has been associated with palæobotany, and his name is joined by botanists with those pioneers who were responsible for lifting botany from the stagnant condition in which it was in Great Britain several decades ago, to the very live condition in which it finds itself to-day.

Sir Albert's palæobotanical work has proved of inestimable value to present-day concepts of plant evolution and the distribution of plants in geological time. These researches have been published over a long period of years, and still continue. His more general works include the "Wealden Flora" and the "Jurassic Flora", both in the British Museum Catalogue series, and "Fossil Plants and Tests of Climate". Students of botany and geology have for long been indebted to him for his "Fossil Plants for Students of Botany and Geology" in four volumes, while his more recent book "Plant Life Through the Ages" is a pattern of conciseness and clarity of style. His particular scientific interest in recent years has been the study of plants in past geological ages with particular reference to their distribution over the world and the indications they give of climate in geological time. But he has always fostered the study of botany in all its aspects and not merely as regards his own special interest. In more general fields, Sir Albert's influence has been even more profound. He was president of the International Botanical Congress held at Cambridge in 1930; president of the Geological Society of London in 1930, and president of Section K (Botany) of the British Association in 1903 and again in 1929. He has served on the Council of the British Association and was one of the local secretaries for the very successful Cambridge meeting of 1904. He was a vice-president of the recent Cambridge meeting. Since 1934 he has been foreign secretary and a vice-president of the Royal Society. During his academic career, and since his retirement, his work has received well-merited recognition from many sources. He is honorary member of most national academies and societies and was awarded a Royal Medal of the Royal Society in 1925, the Wollaston Medal of the Geological Society in 1930 and the Darwin Medal of the Royal Society in 1934. His influence and advice have not passed with his resignation, for he is now a trustee of the British Museum and a member of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research. With the British Association, he has visited Canada, Australia and South Africa, and is otherwise widely travelled. Sir Albert's election to the presidency of the British Association will be welcomed by all men of science, especially botanists and geologists.

Cambridge Meeting of the British Association

THE meeting of the British Association which has just closed will long be remembered by all who attended it. At the first meeting of the General Committee, it was agreed to form a Division for Social and International Relations of Science (see p 380), which may well prove a vital step in the history of the Association Lord Rayleigh's address was received with much enthusiasm, and a specially warm welcome was given to Sir J. J. Thomson, who moved a vote of thanks to the president for his address, and also to Dr. G. D Birkhoff, past president of the American Association for the Advancement of Science, who, as spokesman of the delegation from his Association, expressed his desire to see active co-operation between the British and American Associations in the cause of international friendship The customary announcement at the close of the inaugural meeting, made by Dr. O. J. R. Howarth in the absence of the general treasurer, Lord Stamp, of the number of tickets issued for the meeting, showed that the attendance, 2,795, while not a record, was highly satisfactory The services of broadcasting were utilized to bring the Association's activities before a wider audience in Great Britain and also in the United States. Prof Allan Ferguson broadcast an account of the opening meeting through the B B.C., while on August 19, Lord Rayleigh and Sir Richard Gregory were 'interviewed' before the microphone by Mr. Watson Davis, director of Science Service, and the 'interview' broadcast in America

THE setting at Cambridge for the meeting was of course ideal, and the University and individual colleges showed their traditional hospitality. In addition to the discussions and papers before the several sections, members had an opportunity of inspecting an exhibition of old and historic scientific instruments, which appropriately included apparatus used by Sir J. J. Thomson and by Lord Rutherford, of seeing demonstrations and exhibits of gold films produced by Prof. C S. Gibson and his collaborators, and other more 'sectional' exhibitions The officers of the Association who have been elected for 1939 are as follows : *President*, Sir Albert Seward ; *General Treasurer*, Prof. P. G. H. Boswell ; *General Secretaries*, Prof. F. T. Brooks and Prof Allan Ferguson , *New Members of Council*, R. W. Allan, Prof. F. E Fritsch, Sir Richard Gregory, Prof. C. Spearman and Dr. C R. Fay. Future places of meeting of the Association will be Dundee (1939), Newcastle-on-Tyne (1940), Belfast (1941) and Birmingham (1942).

Impressions of Cambridge

A CORRESPONDENT writes : "Cambridge is the best of all places for the British Association to meet. There was an air of activity and exhilaration throughout the week, and the organization was carried out with extraordinary smoothness There were almost too many receptions, dinners and garden parties ; perhaps one could wish for a little more time for those discussions behind the scenes which are the most valuable feature of these gatherings. The great novelty of the meeting was, of course, the formation of the Division for the Social and International Relations of Science It was astonishing and encouraging to find the project so enthusiastically received by the widest variety of scientific workers It has lit up many people's imaginations, and given them a chance to devote themselves intelligently to something which offers a hint of usefulness in an increasingly lunatic world. Perhaps the shadow of the world outside has never hung so menacingly over a scientific meeting , many there felt that all they cared for intellectually might have vanished before long. It was noticeable that the most eager supporters of the new Division were often those whose own research happened to be particularly 'pure'. Those who complained in private that the cobbler ought to stick to his last usually turned out to be engaged on semi-applied research. It is, for example, interesting that the more abstract kind of physicists tend to be far more socially interested than people busy with traditional chemistry."

"DARWIN'S was easily the most exciting presidential address, and a model which other sections might usefully study It had the great advantage that the intelligent layman could listen to it and not waste his time , and yet it also contained ideas enough to set professional scientists and philosophers arguing for weeks Childe's and Southwell's were also nice pieces of work, and Griffith Taylor's highly entertaining For pure science, Blackett's Saturday morning talk on cosmic rays was unsurpassed. The trouble is, one wants to go to so many lectures that are taking place simultaneously But still, an energetic person could have heard something from Wells, Bohr, Darwin, Keynes, Blackett, Shapley and Huxley—which is not such a bad bag for a week's holiday "

Art at the British Association

A COLLECTION of photographs taken by members of the scientific delegation from Great Britain to the Indian Science Congress Association's jubilee meeting in January of this year was exhibited in the reception room of the British Association at Cambridge. Some of the photographs were of scientific personalities, others of Indian scenes and inhabitants, whereas several gave beautiful impressions of certain well-known Indian buildings at night, flood-lit and illuminated. A very pleasing innovation at this year's meeting, too, was the exhibition of works of art by members of the Association, which demonstrated very clearly that genius is not confined to a single avenue of interest. Many outstanding men of science are known to be accomplished in one or other of the arts, especially music, but this exhibition must have proved a pleasant surprise to many. Well over a hundred examples were exhibited, the chief among them being oil and water colour paintings, though examples also of ware, metal-work and hand-printing and weaving were on view. The arrangement of the exhibition would have reflected credit on the Royal Academy itself. All three members of the Bragg family have clearly found the painter's palette a valuable means of utilizing the little leisure at their command. Sir William Bragg, president of the Royal Society, showed an attractive study of aloes, while landscapes were also exhibited by his son, Prof. W. L. Bragg, Cavendish professor of physics in the University of Cambridge, and by his daughter, Mrs. Carol

Major C. E. S. Phillips, secretary of the Royal Institution, and Mrs Phillips, are known by many to be artists of considerable taste. Between them they showed six of their many paintings, one of them being "On the Purbeck Hills", by Major Phillips, which was exhibited in this year's exhibition at the Royal Academy. A beautiful interior of the Cathedral Church of Christ, Oxford, was exhibited by Emily Vaughan Jenkins One of the most interesting exhibits was a portrait of a spinster by Joyce Gardiner. The slightly embittered and very grim expression made the portrait live, and the title "Frustration" made the picture itself. Three landscapes by the late Dr. William Bateson, president of the British Association in 1914, and two by Mrs. Bateson showed an obvious love of rugged scenery. Three very beautiful paintings executed by the late Lady Robertson during the meeting of the British Association in Canada in 1924 were exhibited by Sir Robert Robertson, formerly Government Chemist E. N. Willmer, lecturer in physiology in the University of Cambridge, is known to spend much of his holiday periods painting landscapes; here he showed three examples of what is clearly a successful and enchanting hobby. There is also a good portrait of Dr. F F. Blackman, emeritus reader in botany in the University of Cambridge, by one of his colleagues, G. E. Briggs. Another by Briggs—"Cineraria"—besides being a poem of colour, also brings out the plant physiologist in the painter. The wilting of the leaves and the florets is strikingly natural

Fossil Anthropoids in South Africa

Further discoveries of the fossilized remains of anthropoids in South Africa, which were announced on behalf of Dr. Robert Broom of the Transvaal Museum during the meeting at Cambridge of the British Association (see p 377 of this issue of Nature), constitute an addition of the first importance to the evidence relating to the early history of man and his precursors which has been accumulating in South Africa since the discovery of Rhodesian man in 1921 and the later discovery in 1925 by Prof. Raymond Dart of the Taungs skull, *Australopithecus africanus*. The doubts which had been expressed whether the latter might not be a young chimpanzee or gorilla, and not, as Prof Dart maintained, more closely related to the human stem than any fossil anthropoid then known, may be regarded as having been finally resolved by Dr. Broom's discovery of the Sterkfontein skull two years ago, to which he gave the name of *Australopithecus transvaalensis*, but for which his later discoveries now recorded lead him to adopt the significant nomenclature of *Plesianthropus*, expressing not only its generic difference from *Australopithecus*, but also its even closer relationship to man in the scale of development. This, however, does not close the tale of remarkable additions to our knowledge for which we are indebted to Dr. Broom. The story of how he rescued from the dangers of oblivion the fragments of still another and even more important relic, will command a tribute of admiration from all for his acumen and persistent energy in the pursuit of scientific discovery. He has been rewarded by the acquisition of what must be regarded as the most important piece of evidence now in existence relating to the evolution of man's ancestry. From fragmentary bones of the skull, the teeth, and the reconstruction of missing parts from the matrix, Dr. Broom has been able to reconstruct the Kromdraai skull, now classified as a new genus, *Paranthropus robustus*, and not merely coming closer in certain details to man than any previously known fossil anthropoid, but actually in line with man Equally important is Dr. Broom's conclusion as to its dating, for he is now able to say, subject to further geological investigation, that while *Australopithecus* is regarded as probably Lower Pleistocene, the Kromdraai skull is Middle, and the Sterkfontein skull Upper Pleistocene.

Russian Astronomers

The Polish journal *Acta Astronomica*, in its July issue, states that the following members of the staff of the Pulkovo Observatory have been imprisoned: I. A Balanovsky, N. I. Dneprovsky, B. P. Gerasimovič (director), P. I. Iaschnoff, B. W. Noumeroff (director of the Astronomical Institute at Leningrad, who is believed to have been shot), N. W. Zimmermann. The Editor of *Acta Astronomica* states that it would give him great pleasure to be able to refute this statement, a sentiment which we are sure scientific workers everywhere will echo.

Backward Peoples: a Proposal from Holland

The Netherlands Commissie voor Internationale Natuurbescherming (Netherlands Committee for the International Protection of Nature) has prepared through its recently constituted Committee for the Preservation of Primitive Races a general statement of the problem with special reference to the primitive peoples of the Dutch possessions in New Guinea. To this are added some suggestions as to how best to deal with the difficulties which will arise, or have already arisen, if and when peoples living in the stone age, who in some instances previously were not even aware of the existence of the white man, are suddenly brought into contact with the blessings (aeroplanes, motor-cars, radio) and the curses (alcohol and venereal disease) of Western civilization. A useful point is made, frequently overlooked, that an even greater danger than the white man in the matter of exploitation is the neighbouring native people of slightly higher culture which has assimilated or acquired some of the elements of white civilization. This statement of the problem is restrained, but well informed. Its details will be familiar to those who have studied the effects of contact between primitive and Western culture and the irreparable disasters which have followed upon such contacts in the last hundred years.

In putting forward certain suggestions as to how best to deal with the situation in areas in which the natives are at present virtually untouched, such as parts of New Guinea, the islands of New Britain, and the Congo, two principles are enunciated, one ethical, namely, that the ruling power must not restrict the natives' opportunities of ordered cultural development, the second that in the interests of science opportunity should be preserved for study of native cultures before they are hopelessly corrupted by unregulated contact with the worse elements in Western civilization Accepting the view that the interests of the native should be the first consideration, since commerce and industry may be trusted to look after themselves, the committee suggests that reserves should be created, not for the preservation of native tribes and cultures as museum pieces, but in order that these backward peoples may be led to develop gradually under supervision and strict regulation of contacts, cultural and other, in a slow but healthy upward progression, in which the elements of their own culture will be assimilated in higher forms of civilization. It will be seen that the ideal formulated by the Dutch Committee is sufficiently in accord with the views of those in Great Britain, who press for a scientific approach to the problem of the future of backward peoples, to warrant co-operation in the attainment of what is the common end. In any event, they will agree with the committee that the problem is urgent and immediate.

Jubilee of the American Mathematical Society

The fiftieth anniversary of the founding of the American Mathematical Society, which is being celebrated early in September at Columbia University, New York City, in connexion with the annual summer meeting of the Society, is unusual among jubilees of learned societies in that the principal founder of the organization in 1888 is serving as chairman of the committee in charge of the jubilee celebrations Prof. Thomas Scott Fiske, now emeritus professor of mathematics in Columbia University, took the initiative in bringing together six mathematicians fifty years ago to establish the New York Mathematical Society, having received his inspiration to do this from his attendance at meetings of the London Mathematical Society while a student at Cambridge the preceding year. Dr Fiske, as secretary of the young society, was indefatigable in his efforts to increase its membership, and succeeded so well that in 1891 the Society was strong enough to begin publication of the *Bulletin of the New York Mathematical Society*, which has been continued to the present time as the official organ of the Society, its name, of course, having been changed to correspond to the change in name of the Society to American Mathematical Society in 1894.

In 1900, the journal entitled *Transactions of the American Mathematical Society* was established by the Society for the publication of research papers. In the course of time the service of the Society to its membership in the promotion of mathematical research has come to include also an annual course of lectures on recent advances in some specific field of mathematics, and the publication of these in a series of Colloquium Publications, now numbering twenty-four volumes, the Josiah Willard Gibbs lectureship on applied mathematics, the maintenance of a library especially strong in relatively obscure journals, the award from time to time of several endowed prizes and the holding of ten or more meetings annually for the communication of approximately five hundred research papers. For many years Columbia University has provided office space for the Society, and more than half the regular meetings of the Society have been held in the University

The Centro Volpi di Elettrologia

Count Volpi di Misurata, whose name is associated with many important Italian electric companies, has decided, in the interests of science, to create an institution in Italy to promote the knowledge of, and research in, electrical science. He has presented the magnificent Vendramin-Calergi Palace in Venice to serve as a home for the new institution which will be known as the Centro Volpi di Elettrologia after its founder It is so arranged that it works in harmony with other existing Italian scientific societies. Its principal object is the improvement of electrical knowledge by means of new cultural exchanges between Italian and foreign scientists. Its main activities will be to publish a bulletin giving summaries of recent Italian researches, translated into various languages in different editions for distribution abroad It will also promote international congresses and meetings of men of science in the quiet Venetian palace so that they may advance electrical knowledge by exchanging ideas on specific scientific questions.

We have received a copy of the first bulletin of the Centro Volpi di Elettrologia in English. It illustrates briefly the activities of and the schemes initiated by the Centro Volpi It reports in the form of short abstracts all Italian publications dealing with electrical subjects. Great pains have been taken with the documentation of the bulletin. Each abstract is of such a size that it can be cut and gummed on an international card in accordance with the resolutions and recommendations of the World Congress of Documentation Later on, should some article appear which is important either on account of new ideas or results, or because it serves as a basis for cultural exchanges, an amplified summary will be given in addition to the usual notice. In this bulletin an interesting article on "Acoustical Research in Italy" is given The plans and sections of the new acoustic laboratory in the national electrotechnical institute 'G Ferraris' in Turin is described. At present the laboratory has in use four reverberating rooms and two sound-absorbing rooms. When completed it will have a sound-proof room for microphonic calibrations and acoustimetric experiments.

Safety in the Chemical Industry

IN 1928, the council of the Association of British Chemical Manufacturers decided to prepare and issue to its members for their guidance a set of model safety rules for use in chemical works These rules were based on the Factory and Workshop Act, the Chemical Works Regulations, the Electricity Regulations and similar statutory provisions, together with other precautions suggested from experience, and they represented the first attempt to draw up a comprehensive safety code for the chemical industry The first part of the model rules, consisting of the proposed safety rules in concise form, was completed and issued in provisional form early in 1929 Various amendments and additions have been suggested in the light of the experience gained during the past nine years, and this part has now been issued in final form covering the provisions of the new Factories Act, 1937 It is in the nature of an introduction to Part 2, the first section of which was also issued in 1929, and it is hoped to revise and complete it also for issue at an early date The model rules, Part 1 consist of eight sections, the first being a general section The following sections deal with rules for the design and operation of plant with fire and explosive risks, for plant involving risks from gas, vapour, fume or dust, for plant involving dangers from contact with corrosive or deleterious substances and for plant involving other risks The last three sections deal with fire protection, first aid, and with welfare The publication is a part of the services provided for by the Association for its members, but so much importance is attached to dissemination of safety information that the Association is prepared to supply copies to firms outside its own membership on special request

Malaria-Therapy by Means of Infected Mosquitos

TREATMENT of general paralysis of the insane by means of induced malaria, commenced in 1917 has been adopted everywhere In the early days of malaria therapy, the fever was induced by the injection of the infected blood of a malaria patient, and this is still occasionally done , but generally the fever is now transmitted through the bites of infected mosquitos This has been rendered possible by the establishment of a mosquito farm at the Horton Mental Hospital Full details respecting this mosquito farm', and of the methods employed for breeding, infecting and transmission are given in a recently issued report by Lieut Colonel J A Sinton ('A Report on the Provision and Distribution of Infective Material for the Practice of Malaria Therapy in England and Wales *Reports on Pub Health and Med Subjects*, No 84 London H M Stationery Office 6*d* net) At Horton, in a special insectary, an indigenous species of mosquito, *Anopheles maculipennis*, var *atroparvus*, is bred throughout the year, freshly hatched females are collected and are stored in cages in an outhouse, being allowed to feed on a rabbit at appropriate intervals When required for transmission work, the insects are placed in a special hot room for 48 hours, and are then allowed to feed upon a suitable patient with malaria in the wards of the hospital A special Madagascar strain of benign tertian malaria parasite, *P vivax*, is that used A batch of 100–200 mosquitos are allowed to feed on the selected case, the insects being placed in jars and applied to the thigh of the patient When most of the mosquitos seem to have fed, the jars are removed and the insects are then released into a storage cage, which is kept in a hot room maintained at about 75° F , and are fed every second day on a rabbit After 10 days or so, when parasites are found in the salivary glands of the insects, the mosquitos are ready for use for transmission , they remain active for about a month For the transmission to a patient for the cure , about 15–20 infected insects are placed in jars and are taken to the hospital where the patient is The mosquitos are then given an opportunity of biting by applying the gauze covered end of the feeding jar to the external surface of the patient s thigh

Mining and Fuel Technology at Sheffield

THE University of Sheffield s report on research work carried out in the Departments of Mining and Fuel Technology during the session 1936–37, recently published gives a particularly lucid summary of progress made in the work undertaken by those two Departments Within the confines of its twenty pages it is not possible to include a comprehensive account of every phase of the research, nor to publish many of the valuable results obtained Nevertheless it can be amplified by reference to the technical papers cited in the appendix or by direct appeal to the university authorities The Department of Mining has been concerned chiefly with the problem of provision in advance of ventilating schemes for projected workings, and it is hoped to publish tables from which it will be possible to calculate roadway sizes required to provide adequate ventilation under varying conditions Problems of deterioration in efficiency of high candle power electric lamps, resistance of different types of trailing cables to mechanical damage, influence of design and material on chain coal cutter picks and investigations into the nature and conditioning of washery water, have received careful consideration by the Department, and valuable data have been adduced in these connexions The Department of Fuel Technology has been concerned during the period with the compilation of a revised method of classification of coal with the view of ultimate definition of the relationship between compositions and properties of different coals This work has been facilitated by the discovery of differences in behaviour between the younger and older coals which afford a useful basis of classification of coals of varying geological age.

Earthquake of August 16

AN earthquake of 'destructive' intensity was recorded on seismographs in Great Britain in the early hours of Tuesday, August 16 The epicentre of the shock is calculated to be about 5,500 miles away, possibly in the plains of Central Asia A message from the seismological station at Hamburg, Germany, states that the primary waves arrived at $4^h\ 38^m\ 55^s$, and the secondary waves at $4^h\ 47^m\ 54^s$, giving the distance of the epicentre from Hamburg at 7,600 km. As the region of the supposed epicentre is sparsely populated, it will be some while before direct information is available

The Science Museum: Recent Acquisitions

A LARGE collection of astrolabes, portable sundials, clocks and other scientific instruments, mainly of the sixteenth and seventeenth centuries, has been presented to the Science Museum by Mr. W E. Miller and has now been placed on exhibition The astrolabes are particularly fine examples; they include a fifteenth-century specimen from Germany and a sixteenth-century Flemish instrument, probably by Arsenius, one of the leading makers of his era. Among the sundials are several unusually large and fine ivory tablet dials by well-known south German makers of the early seventeenth century, as well as an interesting series of pocket dials of various types, many of them indicating time on the old Italian system in which the day-and-night period was divided into twenty-four equal hours, starting from zero at sunset and counting from 1 up to 24 The clocks have small projections opposite the hour numbers on the dial, so that the time can be found by touch during the night.

The Night Sky in September

THE sun crosses the celestial equator at the autumnal equinox (or First Point of Libra) on September 23 at 17^h U T. The moon is full on September 9 at $20{\cdot}1^h$ and new on September 23 at $20{\cdot}6^h$. For a few days near full phase, the moon rises only 21–23 minutes later on successive evenings instead of the normal 50 minutes in these latitudes—hence the Harvest Moon. The moon occults two naked-eye stars during the month, namely: (1) δ Piscium (mag 4·6) on September 11, when its reappearance from behind the moon's disk, as seen from Greenwich, takes place at $22^h\ 40{\cdot}6^m$ U.T. at position angle 238° from the north point; (2) ε Tauri (mag. 3·6) on September 15, the disappearance taking place at $22^h\ 32{\cdot}2^m$ at 131° and the reappearance at $23^h\ 07{\cdot}5^m$ at 211°. The respective times and position angles as seen from Edinburgh are $22^h\ 35{\cdot}4^m$ (118°) and $23^h\ 18{\cdot}9^m$ (224°). Lunar conjunctions with the planets occur as follows: with Jupiter on September 8 at 7^h; with Saturn on September 12 at 8^h; with Mars on September 22 at 14^h and with Venus on September 27 at 9^h. Mars, a morning star difficult to see, is in conjunction with Mercury on September 4 at 20^h and September 16 at 15^h; on September 5, Mars is near the first magnitude star Regulus. Jupiter is a bright object rather low in the night sky and southing at about 22^h in mid-September. The various phenomena of the satellites may be followed with the aid of the tables and diagram given on pp. 616–617 of the *Nautical Almanac* for 1938. The four bright inner satellites, visible with binoculars, are most closely grouped near the planet at $22^h\ 15^m$ on September 1, 7 (all eastwards), 8, 10 (one satellite occulted), 17 (the same satellite again occulted by Jupiter), 18, 25 and 26 Saturn, which is now visible throughout the night, souths at about $1^h\ 30^m$ in the middle of the month. The diameter of the minor axis of the ring system is about 8″. At 22^h on September 15, Arcturus is setting in the north-west; Aldebaran is rising in the north-east, preceded by the beautiful cluster of the Pleiades.

Announcements

MR R. W. HAMILTON has been appointed to succeed Mr E. T. Richmond as director of the Palestine Department of Antiquities Mr. Hamilton has been acting director since the retirement of Mr Richmond a year ago, and joined the staff of the Department as inspector in 1931 after experience with the British School of Archæology in Palestine.

IN NATURE of May 7, p 823, concern was expressed over the geophysical observatory at Zi-Ka-Wei. A correspondent informs us that he has just received a parcel of seismograms from the observatory. Thus in spite of the troubled times around Shanghai, the observatory is apparently carrying on its work.

THE Rockefeller Foundation has offered and the London County Council has accepted the sum of £2,500 for the assistance of psychiatric research at the Maudsley Hospital

THE twenty-fifth French Congress of Medicine will be held at Marseilles under the presidency of Prof. Olmer on September 26–28 Further information can be obtained from Prof Roger, 66 Boulevard Notre-Dame, Marseilles.

THE second International Spa Federation Congress will be held in Berlin during the second half of September and will consist of five sections devoted respectively to the economic, legal, medical, and technical aspects, and tourism and propaganda. Further information can be obtained from Reichsfremdenverkehrsbund, Potzdamer Platz 1, Berlin.

WE have received a copy of "Spectrochemical Abstracts, 1933–1937", by F Twyman (London: Adam Hilger, Ltd., 3*s* 10*d*, including postage 4*s*). This is a 52-page bibliography with abstracts of 228 papers on spectro-chemical analysis which have appeared in the period stated The references to the literature are grouped in an author index, to which references are made in the subject-matter, which is conveniently divided into topics under materials. There is also a list of recent books on the subject. The work, which is bound in limp covers, will be welcomed in scientific and technical laboratories.

REFERRING to the letter by E V. Newnham entitled "Effects of Floods in East Norfolk", published in NATURE of August 6, p. 257, Dr. Margaret Jepps writes: "Late in July one still passed (at Horsey, Norfolk) suddenly from a green landscape in high summer dress to a wintry scene with bare hedges and leafless woods between the brown wastes where in places the frost yet appeared to lie, since there had been too little rain to wash away the salt left by the receding seas."

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 400.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Capture Cross-sections for 220 Kev. Neutrons

THE selectivities (in Z) observed in the activation of nuclei by capture of slow neutrons are explained by differences of the energy (E) of the lowest neutron resonance level in different nuclei · the contribution of one level to the capture cross-section for thermal neutrons is proportional to $1/E^2$, while the cross-section at resonance is proportional to $1/\sqrt{E}$, the measured values of E lie between 1 and 200 volts The application of the one-level formula[1,2] to the experimental results yields some evidence on the neutron width Γ_n and the radiation width Γ_r of the best-known resonance levels. Some experimental evidence on the total widths has also been obtained[3,4,5]

Little or no direct evidence exists concerning the distance of the neutron levels for the excitation energies given by the mass defect of the captured neutron. The kinetic energies for which slow neutrons are selectively captured should lie between 0 and the distance of the levels Statistical considerations seem to be scarcely applicable, since of course the lowest resonance energies are the easiest to observe and in the case of some nuclei the capture cross-section of which is very small and where no pronounced level has been found yet, the first resonance level for slow neutron capture may be situated rather high Bethe and Placzek[2] have suggested the study of neutron capture under special conditions : for a neutron source emitting a spectral band broad enough to cover several resonance levels and the lower energy limit of which is high compared with the level distance, they derive the cross-section formula

$$\sigma = \pi^2 ƛ^2 \cdot \frac{\Gamma_n \Gamma_r}{(\Gamma_n + \Gamma_r)D},$$

D being the averaged distance between levels and $ƛ$ the wave-length of the neutrons divided by 2π. This formula is obtained by summing the one-level formula over an interval containing many levels The factor $\frac{\Gamma_n \Gamma_r}{(\Gamma_n+\Gamma_r)D}$ tends to become 1 when $ƛ$ becomes comparable with the distances existing between single particles within the capturing nucleus, that is for neutron energies of some million electron volts ; for lower energies the factor would in any event be smaller than 1. On the basis of the nuclear compound model one should expect it to be of the same order of magnitude for nuclei of similar mass and for equal excitation energy.

Activations with high-energy neutron beams considered free of slow neutrons have already been carried through with D + D neutrons of some 2·5 Mev.[7] We made some measurements with a source of photo-neutrons produced by the γ-rays of thorium C″ in heavy water This source gives neutrons of an average energy of 220 Kev. which in consequence of the conservation of momentum are distributed on a 40 Kev.-wide band The source (5 c c. D_2O with the γ-ray source in the centre, suspended far away from diffusing walls) was surrounded by cylinders of the elements investigated. Only nuclei for which a neutron-capture period is known were resorted to ; the activities were measured by means of a Geiger-Muller counter which fitted inside the cylinders. In order to obtain the absolute cross-sections, the number of neutrons emitted by the source was determined after the method of Amaldi and Fermi[3,6] A determination of the thickness responsible for the emission of one half of the observed β-rays was also carried through. The following cross-sections were obtained :

	^{27}Al	^{51}V	^{55}Mn	^{58}Ni	^{63}Cu	^{75}As	Se	^{79}Br	^{81}Br	^{108}Pd
σ (in 10^{-26} cm^2)	8	9	9	< 9	≈ 9	83	< 3	160	< 30	250

	^{107}Ag	^{109}Ag	^{121}Sb	Te	^{127}I	^{138}Ba	^{164}Dy	W	^{197}Au	Tl
σ	300	460	110	< 10	175	< 2	< 70	26	230	≈ 10

The factor $\Gamma_n\Gamma_r/\{(\Gamma_n+\Gamma_r)D\}$ being equal to σ divided by $\pi^2ƛ^2 = 0\cdot 94 \times 10^{-22}$ cm^2, its values in 10^{-4} units are represented by approximately the same numbers.

The results show considerable variations even for neighbouring nuclei, the nuclei showing biggest cross-sections being identical with those showing big cross-sections for *slow* neutron capture A careful search was therefore carried through in order to make sure that the source does not produce slow neutrons, which might account for the observed selectivities in Z. Any influence of outside diffusing substances such as the floor could be excluded ; in order to avoid the slowing down of neutrons, the cylinders were never touched by hand during activation A process of slowing down by collisions in the heavy water could be ruled out, since additivity was observed when smaller amounts of heavy water were used instead of the total 5 c c. The influence of (unknown) γ-rays of meso-thorium producing slower neutrons could be excluded by neutron absorption measurements in silver, using a silver detector.

The observed differences in the capture cross-sections are, therefore, real unless we assume the existence of a hitherto unknown isomer (difficult to observe because its period is too long or too short) in each case of seemingly low cross-section.

The coincidence that the same compound nuclei which show pronounced resonance levels at very slow neutron energies, show the big values for $\frac{\Gamma_n\Gamma_r}{(\Gamma_n+\Gamma_r)D}$ observed here, would imply the fact that the average distance of levels at the excitation energy given by the mass defect of the neutron is especially low for these nuclei. The table shows also that the nuclei with big capture cross-sections have mostly odd proton numbers and even neutron numbers.

A detailed account of these results will appear soon in the *Journal de Physique* We are indebted to Dr G Placzek for many valuable discussions

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July 14

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[1] Breit and Wigner *Phys Rev* **49** 519 (1936)
[2] Bethe and Placzek *Phys Rev* **51** 450 (1937)
[3] Amaldi and Fermi *Phys Rev* **50** 899 (1936)
[4] von Halban and Preiswerk *J de Phys et Rad* **8** 29 (193)
[5] von Halban and Paxton NATURE **141** 116 (1938)
[6] Booth and Hurst *Proc Roy Soc* A **161** 248 (1937)
[7] Reddeman *Naturwiss* **26** 124 (1938)
[8] Amaldi Hafstad and Tuve *Phys Rev* **51** 896 (1937)

Hyperfine Structure Perturbations in Iodine due to Nuclear Quadrupole Moment

MURAKAWA[1] has recently published a more extended multiplet classification of the lines of the first spark spectrum of iodine, which differs in a number of respects from that given by Lacroute[2] and used by me in analysing the hyperfine structures The line multiplets which have been arranged are in both cases similar, but the term allocations differ Since, however, Murakawa retains almost all the J values found by Lacroute, the hyperfine structure analysis is only affected in the very few cases where the proposed J values are not in agreement

The evidence from hyperfine structure strongly favours the classification of Murakawa For example the identification of the sp^6 levels removes the anomaly which was previously reported[3] for the interval factor of the term given by Lacroute as $(^4S)5d\ ^3D_2$ Also the hyperfine structures of the newly classified lines, where known, fit perfectly into the analysis now given Further, a number of minor difficulties encountered in a recent more detailed analysis of the hyperfine structures[4] are removed by the use of the new classification

From Murakawa s results the classifications are now known for a number of lines the hyperfine structures of which I have already measured From these, ten new interval factors have now been derived, the details of which will be given elsewhere A very exact analysis has been made from which it is evident that at least seven terms exhibit perturbation, the interval rule breaking down The frequency of this indicates that it must arise from the existence of a nuclear quadrupole moment However, the interaction energy for each perturbed level does *not* obey the $\cos^2$ law found to hold in other cases by Schüler[5] Instead a cubic law is necessary to account for the observations This can be written as

$$E = a_0 + \frac{a}{2}\ C + b\,C\,(C+1) + c\,C^2\,(C+1),$$

where

$$C = F(F+1) - I(I+1) - J(J+1)$$

The perturbation constants for the eight terms not obeying the interval rule are shown in the following table (The units are $\text{cm}^{-1} \times 10^{-3}$)

For terms with $J = 1$ the constant c is arbitrary and has no precise meaning since there are only three fine structure levels which can always be adjusted to fit an equation with three constants

The ratio of c to b is so high that the contribution of the cubic term becomes of great importance This cubic term appears to be too large to be accounted for by assuming it to be a second order term in the accepted theory of quadrupole moment perturbation

Term	a_0	a	b	c
$(^2D)\ 6s\ \ ^3D_2$	502	65 5	0 44	− 0 015
$(^2D)\ 6p\ \ ^3F_2$	345	41	0 19	+ 0 009
$(^2D)\ 6s\ \ D_2$	454	72	+ 0 11	− 0 012
$(^4S)\ 5s\ 5p^6\ ^3P_2$	1030	∽ 152	∽ + 0 2	—
$(^4S)\ 5s\ 5p^6\ ^3P_1$	600 5	176 1	+ 0 38	
$(^2D)\ 6p\ \ ^3D_1$	344 8	107 1	+ 0 72	
$(^2D)\ 6p\ \ I$	100 8	18 4	0 87	
$(^4S)\ 5d\ \ ^3D_1$	1 9 3	40 8	0 39	

If this is indeed the case then the constant c must involve some nuclear physical property other than electrical quadrupole moment There is strong evidence for assuming that the effect is due to a new phenomenon, namely nuclear *magnetic* quadrupole moment

A detailed report will appear elsewhere

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July 4

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[1] Murakawa K *Z Phys* **109** 162 (1938)
[2] Lacroute P Thesis Univ Paris (Nov 1934)
[3] Tolansky S *Proc Phys Soc* **48** 49 (1935)
[4] Tolansky S and Forester G O in the Press
[5] Schüler H and Schmidt H *Z Phys* **89** 239 (1935)

Quantum Theory and Relativity

STARTING from the assumption that the possibilities of defining and measuring high relative impulses are limited in a new way, because of the nature of β ray forces (with participation of neutrinos) and because of the appearance of explosion showers in the high energy collisions, an attempt is made to solve the convergence difficulties of quantum theory The proposed solution is based on a new kind of algebra of quantum states and observables, and on the assumption of the existence of a new kind of indetermination arising from the interaction of high energy particles with the measuring apparatus

In every measurement there is always a part of the measuring apparatus which constitutes the reference frame So for example, in the γ ray microscope, it is the diaphragm which limits the angular aperture and produces the characteristic diffraction phenomena Considering all observables referred to such a reference frame, we assume that the new phenomena responsible for the supplementary indeterminacy in the region of high relative impulses have a universal character that is, they appear in the collision of all kinds of particles The assumptions referring to this indetermination can be formulated in the following manner Let us consider an assembly of particles in a *Hohlraum*, and adopt as basic states the eigenstates of the momenta From the point of view of the present quantum theory, the number of states in the interval $(p, p + dp)$ is given asymptotically by $dz = \frac{8\pi}{c^3} V p^2\, dp$ In this formula we introduce a converging factor $G(p)$ in such a way that the number of new quantum states which can be defined relatively to the *Hohlraum* is: $dz^1 = \frac{8\pi}{c^3} V.G(p)\,p^2\,dp$, where $G(p) \sim 1$ if $p < b$, and $G(p) \to 0$ if $p \to \infty$, and $b = h/r_0$ is a critical value of the impulse. It means that a Lorentz observer has no possibility of distinguishing between states belonging to an assembly of $n(p) = G^1(p)$ neighbouring states. (A discussion of the measure of p by means of the Compton effect shows that the possibilities offered by this measure are not incompatible with the existence of the indeterminacy here examined.) For example, if a particle with $p > b$ produces showers by collision with the walls, the usual eigenstates become energetically connected and consequently indistinguishable. Considering the correlation between the quantum states and the cells of volume h^3 in the phase-space, we can say that it is impossible to distinguish experimentally elements of an assembly of $n(p)$ neighbouring cells, and thus it is necessary to consider such an assembly as constituting a unique quantum cell in the new theory. We assume, therefore, that the observables, impulse p_x and co-ordinate x, relative to a reference frame individualized by the measuring apparatus, satisfy the commutation relation of the type.

$$\Delta p_x\,\Delta x \gtrsim h \cdot f(p_x),$$

where $f(p_x) \sim 1$ if $|p_x| < b$ and $f(p_x) \to \infty$ if $|p_x| \to \infty$

Recently I have shown that it is possible to build an example of representatives of these new states and observables satisfying the following rules: the number of states for a unit impulse interval has a maximum for $p \sim b$; the total number of states is finite, the representatives of the states corresponding to the impulse-operator are not orthogonal; the *orthogonality is approximately satisfied only for* eigen values $p < b$.

In order to satisfy the claim of relativistic invariance, it is possible to substitute systematically for the impulses the modulus of the difference between two 4-vectors p_ν referred to an initial and a final state respectively. The consideration of the reference frame individualized by the measuring apparatus in this formulation of the theory gives results of great importance.

The most important consequences of the modified algebra of states and observables will be discussed in detail elsewhere. Let us confine ourselves to some remarks regarding the possible origin of Heisenberg's explosion-showers. According to the present quantum theory, the simultaneous production of many particles in a single quantum process is very improbable because it corresponds to a high-order process of the perturbation theory. In a first order transition the selection rules, derived in the case of photons from the orthogonality and peculiar properties of the eigenfunctions of a harmonic oscillator, forbid transitions with emission and absorption of more than one photon. The representatives of the new quantum states corresponding to $p > b$ are not orthogonal and differ sensibly from the usual representatives. Therefore the first order process with simultaneous emission of many particles becomes probable, with the same order of probability as the single particle transition.

A more detailed discussion shows that in the barycentric *frame of two colliding* particles the impulses of secondaries have their probable values $\sim b$ because the great majority of quantum states is condensed in the region $p \sim b$. In another reference frame, in which the barycentre is moving with an ultra-relativistic velocity, nearly all secondaries are projected, with $p \gg b$, within a small solid angle (as in the hard showers of Bothe). The existence of a lower limit of measurable lengths follows also from the assumption discussed above.

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April 30

Indeterminacy and Electron Spin

SINCE a dipole of magnetic moment M in a magnetic field of intensity H has a potential energy $-M.H$, two free electrons in magnetized iron with magnetic axes respectively parallel and anti-parallel to the direction of magnetization should differ in potential energy by $Heh/2\pi mc$, where H is the effective field intensity acting on a free electron in the iron. It may be of some interest to see whether this difference in energy could be detected in an ideal experiment, for example, by a splitting under magnetization of the photo-electric threshold of iron, or whether the quantum indeterminacy prevents the resolution, as Bohr has shown it must in a Stern-Gerlach experiment on a beam of free electrons[1].

Let the field be assumed parallel to a boundary of the iron. At the photo-electric threshold those electrons will just escape which reach the boundary with a velocity v normal to the surface, the work function being given by

$$W = \tfrac{1}{2} mv^2$$

The path of these electrons in the iron will be an arc in a plane normal to the direction of magnetization and having a radius given by

$$\rho = mvc/He.$$

They must therefore have received the kinetic energy W at some point on a semi-circle in the iron, and their initial angular position is thus determined within the angle π. Canonically conjugate with the angular co-ordinate is the angular momentum given by

$$mv\rho = m^2v^2c/eH = W \cdot 2mc/eH.$$

The indeterminacy in the angular co-ordinate being π, we have

$$\pi \cdot \Delta(mv\rho) > h$$

whence

$$\Delta W > Heh/2\pi mc.$$

But this is just the difference in energy that was to be resolved, and the resolution is thus impossible.

If the direction of magnetization is normal to the boundary, the conclusion is the same. The argument in this case resembles that for the Stern-Gerlach experiment in that it depends on the divergence equation of the magnetic field.

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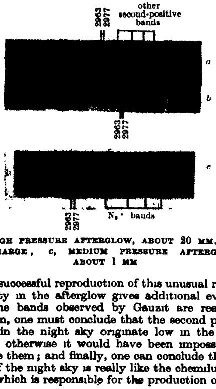
[1] See Mott, N. F., *Proc. Roy. Soc.*, A, 124, 425 (1929).

Existence of the Bands 2963, 2977 in Night Sky Spectra

THE list of wave-lengths in the light of the night sky, which was reported by Gauzit[1] two years ago, includes the two second positive bands of nitrogen 2963 and 2977 with an intensity ratio of 2 to 1 Since those bands lie in the region of the great Hartley absorption band of ozone, the reality of those observations could readily be open to question The importance of additional evidence concerning this problem is understood when it is pointed out that the shortest auroral radiation which has been reported is the second positive band at 3110

If the 2963 band has really been observed by Gauzit, it would mean that this radiation originates lower in the atmosphere than most auroral displays. Recent afterglow pictures, taken at very high pressures, show these two bands and the remaining band of the sequence, with about the same relative intensity as that reported by Gauzit, and not at all like the intensity distribution in the electrical discharge in which 2977 is at least as intense as 2963. These are shown in the accompanying figure



a, HIGH PRESSURE AFTERGLOW, ABOUT 20 MM., *b*, DISCHARGE, *c*, MEDIUM PRESSURE AFTERGLOW, ABOUT 1 MM

The successful reproduction of this unusual relative intensity in the afterglow gives additional evidence that the bands observed by Gauzit are real. In addition, one must conclude that the second positive bands in the night sky originate low in the atmosphere, otherwise it would have been impossible to observe them; and finally, one can conclude that the light of the night sky is really like the chemiluminescence which is responsible for the production of these afterglows.

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An Anomalous Change in the Electric Resistance of Iron-Silicon Alloys with a Longitudinal Magnetic Field at Various Temperatures

THE electric resistance of Fe-Si alloys was measured in a longitudinal magnetic field at various temperatures. The specimens were annealed at 1000° C. for one hour and re-annealed at 850° for one hour after setting them on the measuring apparatus.

The relation between the changes in resistance and temperatures at a constant field of 1,500 oersteds for 1·66 per cent and 9·43 per cent silicon alloys was obtained as shown in the following table.

1·66 per cent silicon		9·43 per cent silicon	
t (° C.)	$R/R \times 10^2$	t (° C.)	$R/R \times 10^2$
− 195	− 0·055	− 195	− 0·135
− 95	− 0·025	− 95	− 0·133
10	0·010	10	− 0·103
100	0·040	100	− 0·076
201	0·075	200	− 0·059
300	0·075	300	− 0·024
402	0·070	401	− 0·011
505	0·065	499	0·001
592	0·048	599	− 0·010
703	0·019	643	− 0·050
745	− 0·022	650	− 0·080
776	− 0·116	660	− 0·142
789	− 0·177	670	− 0·029
801	− 0·020	690	− 0·010
820	0·000	720	− 0·003

From this table, we see that the resistance decreases with the longitudinal magnetic field at temperatures other than in the vicinity of the Curie point, which phenomenon was not observed in the alloys of Ni-Cu[1], Ni-Co[2] and Fe-Ni[3] previously investigated. The decrease of resistance in solid solution alloys is a very interesting fact, which has not heretofore been observed by investigators. This phenomenon has been also observed in Fe-Al alloys. The complete report of the present investigation will shortly be made in the Science Reports of the Tôhoku Imperial University.

In conclusion, I wish to express my cordial thanks to Prof K Honda, president of the Tôhoku Imperial University, and to Prof H Masumoto, under whose kind guidance the present investigation has been carried out

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Gamma to Alpha Transformation in Iron Alloyed with Palladium

THE gamma to alpha transformation of iron is of fundamental importance in the heat treatment of steels. The face-centred-cubic gamma form, stable at high temperatures, transforms so rapidly to the body-centred-cubic alpha form below 906° C. that it cannot be preserved by quenching Various alloying elements stabilize the gamma phase so that it may be obtained at room temperature as a stable or metastable form

Carbon is of predominating importance among these elements. It is soluble to a considerable extent in gamma iron, being dissolved interstitially, but is almost insoluble in alpha iron. Consequently, austenite (gamma iron containing dissolved carbon) tends to decompose below the transformation temperature into alpha iron plus a carbon-rich phase which is cementite, Fe_3C, or graphite. For low carbon contents, this reaction takes place too rapidly to follow, but above 0·7 weight per cent carbon (3·2 atomic per cent), it may be arrested by a sufficiently rapid quench. Quenched samples are found to consist of austenite plus martensite.

Martensite is considered to be an intermediate phase in the decomposition of austenite into alpha iron plus cementite at sub-critical temperatures It is body-centred, like alpha iron, but the cubic symmetry is distorted into tetragonal by lengthening of the c axis. The c/a ratio decreases linearly with decreasing carbon content If this trend is extrapolated, c/a would apparently be close to one at zero per cent carbon. Thus, martensite resembles a supersaturated solution of carbon in alpha iron, with the symmetry distorted by the carbon.

This suggests that with a suitable quench the first step in the decomposition of austenite is a rearrangement of atoms into a body-centred form. Further annealing will result in the expulsion of carbon in a carbon-rich phase. Although a large number of papers have been written on this subject, the mechanism of this transformation is still disputed

In an X-ray examination of the iron-palladium system, we found an intermediate stage in the decomposition of the gamma form which resembles martensite in several respects.

Palladium, which is miscible in all proportions with gamma iron, is only slightly soluble in alpha iron There is a wide two-phase region between alpha and gamma extending at low temperatures from 1 or 2 atomic per cent palladium to about 42 atomic per cent.

However, samples containing 5·5, 10 and 20 atomic per cent palladium showed only a single body-centred-cubic phase when quenched from the gamma range The lattice constants of this phase increased linearly with the palladium content, as shown in the accompanying table. Since all the lattice constants are greater than that of a saturated solution of palladium in alpha iron, it is assumed that the palladium is in supersaturated solution.

LATTICE CONSTANTS OF SUPERSATURATED SOLUTIONS OF PALLADIUM IN ALPHA IRON

Atomic per cent palladium	Lattice constant
0	2·86
Saturated at 740° C	2·87
5·5	2·89
10·0	2·91
20·0	2·96

Hence, under the quenching conditions, the decomposition of the gamma phase takes place in at least two steps. First, the atoms rearrange themselves into a body-centred form, then palladium is precipitated out in a face-centred palladium-rich phase.

The resemblance to martensite is obvious, but there are several differences which should be noted First, palladium is dissolved in a substitutional rather than an interstitial solid solution. Second, only one phase is present in the quenched sample, while in the iron-carbon system austenite accompanies martensite. Third, the intermediate phase is cubic, rather than tetragonal.

The quench by which the intermediate phase is obtained need not be drastic. Lines are fairly sharp, except for those near back-reflection, which are diffuse. Two other samples, containing 34·4 and 39·5 atomic per cent palladium, respectively, retained the gamma phase on quenching.

We expect to publish our work on the complete iron-palladium system later. We are indebted to Dr A B. Greninger and Mr. A. R. Troiano for illuminating discussions of the martensite problem.

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Adsorption Potentials and Ageing Liquids

Messrs Craxford and Gatty and Lord Rothschild[1] have recently commented on our letter[2] on "oil-potentials", that is, the E M F of cells of, for example, the type ·

Calomel electrode	Electrolyte BA in water C_1	Oil' (= water-immiscible organic liquid)	Electrolyte BA in water C_2	Calomel electrode

Everyone must admit that the processes in such an 'oil-cell' are very complicated. If we wish to understand them, we have to idealize in some way or other (which, of course, means a loss of exactness). Previous investigators have tried the ideal "Partition equilibrium at the interfaces, steady diffusion between them". Finding this theory inconsistent, we have suggested that another ideal, "Adsorption equilibrium, negligible diffusion", will in certain systems give a better qualitative and even quantitative agreement with facts

Now Craxford, Gatty and Rothschild state that there must still be a certain diffusion of ions through the interfaces. This we have not denied. But we cannot understand their argument: "the cells examined by Ehrensvärd and Sillén take up definite potentials", they say, but if "the interphase contains a boundary across which no charged particle can pass", "it has no definite potential of its own" Now a palmitic acid monolayer between water and air should suit the above description, as it is very hard to imagine a diffusion of ions from water to air. But it still has a definite potential of its own according to work of Rideal, Schulmann[3], *et al.*

Craxford, Gatty and Rothschild quote the well known modernized form of Henderson's integra formula for diffusion potentials[4] and also give a few reasons why it is useless in this case. There are other reasons for this too. For example, we have to do not only with the two ions of the salt, but also with the ions of water and whatever charged particles may transport electricity inside the oil. The transport number, t_i, for each kind of charged particle will therefore be a hopelessly complicated function of the concentrations and mobilities of all sorts of particles present. Moreover, this function should be integrated

Instead of leaving the question at that point, we have tried to find a practical method of attacking the problem. Especially we hope that the adsorption point of view will prove useful for understanding rapidly changing biological systems, where diffusion will have very little time to develop.

One complication we met in our experiments at first greatly confused us. There is a remarkable difference between the E.M.F's of a certain oil-cell if the organic liquid is freshy distilled, and on the other hand if it has been kept in a glass bottle for some time after the last distillation (of course, the cells are prepared in exactly the same way). After a few hours or days in the glass bottle, the process of 'ageing' seems to be terminated After that, the oil will give the same E.M F. in a certain cell whenever it is taken from the bottle A difference is also found between newly prepared and aged oil-mixtures, for example, of nitrobenzene and benzene Dr. Y. Björnståhl, Uppsala, has told us that he has found similar ageing effects with the magneto-optic properties of nitrobenzene and some other liquids.

What has happened inside the oil? Dr F. C. Frank, of Oxford (at present of Berlin), has suggested to us that the ions of the glass may have slowly dissolved into it. We are rather inclined to think that it is a question of molecular re-association We have read the long discussion of Baker, Smits[5] and others without being much wiser. If anyone could give us a hint, we should be grateful for any communication, public or private, as we have very little time left for a special investigation of this question. So far we have mostly studied 'old' liquids, as giving more constant values.

Our work is still proceeding. By experiments on the short-circuiting of oil-cells and cataphoresis of oil droplets, we are now investigating the diffusion rate and the surface charge of the interfaces. Until this work is completed we intend to publish no more about oil-potentials. But we shall be very glad to have personal communication with Messrs Craxford and Gatty and Lord Rothschild.

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Mode of Action of Visual Purple

FOR the chemical theory of excitation of nerve cells, the following observations as to how the retinal rods are stimulated by the substance visual purple would seem to be of general interest Their understanding requires knowledge of the fact that after a preceding period of adaptation to sunlight the size of the electrical response of the eye to a constant test light reproduces the curve of regeneration of visual purple (see, for example, [1,2,3]). When the quantity of visual purple, obtainable from an eye after increasingly longer periods of dark adaptation, increases, the size of the electrical response (its *b*-wave) likewise increases owing—one would have thought—directly to the larger amount of cell stimulant available.

Actually, however, parallel measurements of visual purple densities and size of the electrical response in dark-adapted excised frogs' eyes under strictly identical conditions show that, after 5–10 minutes of adaptation to the moderately strong monochromatic stimuli from a spectral source, the electrical response may be greatly reduced without any parallel diminution of the concentration of visual purple. With test lights from the short wave-lengths 0·500–0·430 μ, and adapting lights 0·450 and 0·580 or 0·560 μ, it is found that the long wave-lengths may cause a reduction of the electrical response by some 40–50 per cent and that, contrary to expectation, the short adapting wave-lengths have a much smaller effect on the response to the test light, sometimes even causing it to increase[4] The total quantity of visual purple obtained from eyes in which the electrical response has been reduced by 1/3–1/4 by adaptation (digitonin extracts tested photo electrically) is neither influenced by the adapting wave-length used, nor is it reduced compared with the amount of visual purple of completely dark-adapted control eyes Our technique of measuring the density of visual purple of single retinas gives averages identical to within 7 per cent Therefore less than 7 per cent of the total visual purple is *active* in mediating maximal electrical responses in dark-adapted eyes The rest is a store of photosensitive material which is *inactive* from the point of view of excitation of the cell. However, this store must be large in order to enable the eye to react maximally[1,2,3]

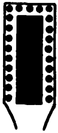

DIAGRAM ILLUSTRATING OUTER LIMB OF ROD WITH ACTIVE STIMULATING VISUAL PURPLE (FILLED CIRCLES) AND INACTIVE NON-STIMULATING STORE OF VISUAL PURPLE INSIDE THE CELL

These facts are simply accounted for on the hypothesis (see the tentative scheme of the accompanying figure) that the active visual purple is active because of its particular manner of distribution, say, at the surface of the outer limb of the rod cell, but that a high concentration of the non-stimulating store of inactive material inside the cell is necessary for keeping up the charge at the surface Illumination may then be assumed to lead to a depolarization of the surface spreading electrotonically and giving rise to the *b*-wave of the electrical response of the retina

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Synthesis of Growth Factors by *Rhizobium trifolii*

A STUDY of the growth factor requirements of *Rhizobium trifolii* has indicated that, under suitable conditions, the organisms are able to synthesize all the organic substances essential for growth from a synthetic carbohydrate - mineral salts medium of known composition. Although various extracts of plants and micro-organisms contain a heat-stable factor *stimulative* to growth, it is not required for successful continuous transfer of the organism in synthetic media. A base medium, claimed by Allison and Hoover[1] to be incapable of supporting continued growth of the nodule organism in the absence of extracts of *Azotobacter* or other substances (termed 'coenzyme *R*'), was found to be satisfactory after adjusting the oxidation-reduction potential and adding iron. Although the growth was not profuse in comparison with media which contain plant extracts, continuous transfer was possible

Further experimentation indicated that continuous transfer of *Rhizobium trifolii* in the purified base medium is dependent upon a highly active factor, synthesized by the growing culture and transferred in sufficient amount with a loop inoculum (0·005 ml.) to enable initiation of growth in the new medium Inoculations made with cells removed from the medium in which they had grown, and washed free of the metabolic products, caused little or no growth in the synthetic modified medium, whereas those not so treated grew well This separation of the cells from their essential factor can be accomplished by aseptic centrifugation of a fluid culture or by mere suspension of a small amount of growth from an agar slope in fresh medium Addition of so little as 0·01 per cent filtrate from a culture of *Rhizobium* (grown in the synthetic medium) or the autolysate of a culture permits 'washed' inocula to grow normally.

From various chemical and biological properties, to be described in detail elsewhere, two components of the *Rhizobium* factor have been identified as vitamin B_1 (thiamin) and riboflavin, which occur in the culture autolysates as heat-labile complexes. A method developed by West and Wilson[2] for the determination of vitamin B_1 has indicated that *Rhizobium trifolii* synthesizes 19·6 micrograms of vitamin B_1 per gm., an amount closely approximating that found in yeasts. Moreover, analyses for riboflavin likewise reveal a high content (0·3 microgram per milligram) of this vitamin. Although these substances are more active in combination, either one alone is capable of replacing the activity of the culture filtrate. Both thiamin and flavin, but especially the latter, have a very narrow range of activity; slight increases in concentration beyond the optimum result in lessened stimulation.

As previously pointed out by Laird and West[3], when inocula carrying metabolic products from the previous culture are employed, only a slight stimulation of growth is to be observed in the presence of thiamin. Later studies have shown the same to be true of riboflavin. In view of the recent report by Nilsson *et al.*[4] concerning stimulation of *Rhizobium* by thiamin, it was considered desirable to summarize the data obtained in these laboratories concerning the role of the B vitamins and other growth factors in the nutrition of the nodule bacteria.

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Inhibition of Adventitious Bud Initiation in Hypocotyls of Flax by Indole-3-Acetic Acid and Flax Extract

Hypocotyls of intact flax plants (*Linum usitatissimum* L) rarely develop buds. If decapitated, the young hypocotyl initiates adventitious buds some of which develop into flowering shoots[1]. The result is the same if both the cotyledonary buds and the epicotyl are removed, but the cotyledons are allowed to remain. Hypocotyls of plants with cotyledons and the young epicotyl enclosed in a plaster cast remain budless. Segments of hypocotyls[2] and of internodes occasionally initiate buds. These findings suggested that bud initiation is under hormonal control which is disturbed by partial or complete isolation

Since each hypocotyledonary bud is initiated by division of a single epidermal cell[3] without immediately precedent enlargement, these findings suggested flax for study of the influence of its auxins and of indole-3-acetic acid upon the sequence of the cellular events which initiates an hypocotyledonary bud in flax.

Ether extracts of upper portions of plants severed in the hypocotyl were mixed in equal parts by weight with lanolin and applied daily for a week to cut surfaces of hypocotyls. Hypocotyls, cut and (*a*) treated and (*b*) not treated with lanolin, served as controls. Concurrently hypocotyls were treated with applications of indole-3-acetic acid in lanolin in concentrations ranging from 3 to 0·000056 per cent The flax extract significantly decreased both rate and frequency of bud initiation. Indole-3-acetic acid in concentrations ranging from $1·7 \times 10^{-2}$ to $7·5 \times 10^{-4}$ molar completely inhibited bud initiation but induced apical tumours, while the other concentrations, ranging from $3·7 \times 10^{-4}$ to $2·7 \times 10^{-6}$ molar, retarded and diminished it with progressively decreasing tumour formation Because of variability of material and growing conditions we have not been able to determine the end-point of deleterious effect for indole-3-acetic acid, or whether the lowest concentrations used ($5·5 \times 10^{-6}$ and $2·7 \times 10^{-6}$ molar) favour bud initiation as reported by Greenleaf[4], Beal[5] and Goldberg[6] for high concentrations when applied to tobacco, lily and cabbage.

Our findings add inhibition of hypocotyledonary bud formation to the long list of secondary effects produced in plants by native auxins (autoauxins) and by indole-3-acetic acid (one of the heteroauxins). Since in flax this bud formation is initiated by cell divisions which are not immediately preceded by cell enlargement, the results suggest that a cell-division substance (possibly a complex of substances) is a constituent of the causal complex which brings about these bud-initiating cell divisions. Probably these or other cell-division substances play their part in initiation and maintenance of the other meristems. Laibach's[7] term 'meristins' is suggested for this type of cytomerisone[8], which appears distinct from traumatin[9] and other wound hormones.

Went[10,11] has advanced a hypothesis of specific growth substances additional to auxins. In terms of this hypothesis the results here reported, in conjunction with those of others, indicate that auxin gradients influence meristins in such manner that the latter become effective in regions of relatively high auxin concentrations. In addition to influencing the transport and activity of meristins, auxins, through their influence on cell metabolism, also are factors in the production of cell-division substances. If it should develop that the substance (or substance complex) which initiates the cell divisions of a bud meristem and of its products (growing point and leaf primordia) is not only a cell division substance but also specifically a bud forming substance then it should be designated blastocaline to distinguish it from Went s rhizocaline[11], which forms roots If a specific meristin is involved in leaf bud and another in flower bud initiation, then a more specific term will have to be used for each

Conceivably the substances which specifically affect or effect the basic growth events of cells—increase in protoplasm cell size, cell number and cell complexity—are regulated in each plant by other specific substances in such manner that the various kinds of cells, tissues and organs of the plant are initiated and developed If this proves to be the situation, then the division substance indicated by our experiments cannot be designated blastocaline Probably internal factors other than specific chemical agents are also decisive factors in conditioning the kind, place, moment intensity and duration of the basic growth events of cells in such manner that the specific cells tissues and organs of each plant are initiated and developed

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A Simple Conversion of *Trans*-Dehydro-Androsterone into Pregnane Derivatives

ABOUT a year ago, we published a method whereby it was possible to carry out a practically quantitative addition of acetylene to *trans* dehydro androsterone[1] We have in the meantime ascertained that the thereby easily obtained 17 ethinyl 3 *trans*,17 dioxy androstene (5), [*A*], in glacial acetic acid in the presence of acetic anhydride and mercuric oxide together with the boro fluoride ether catalyst[2] readily adds on acetic acid to the triple bond and gives rise to 20-acetoxy 3 *trans* 17 dioxy pregnadiene (5, 20), [*B*], m p 175–177° (corr); CH-determinations agree with $C_{23}H_{34}O_4$ The 3 monoacetate of [*A*] also adds on acetic acid with the formation of 3 *trans*, 20-diacetoxy 17 oxy pregnadiene-(5,20), [*C*], m p 191–192° (corr), CH determinations agree with $C_{25}H_{36}O_5$

By alkaline hydrolysis of [*B*] or [*C*] 3 *trans*,17 dioxy pregnen (5) one (20) is formed in good yield m p 275–277° (corr) $[\alpha]_D -78°$ (dioxan), CH determinations agree with $C_{21}H_{32}O_3$, oxime m p 245–247° (corr), CH and N determinations agree with $C_{21}H_{33}O_3N$ 3 monoacetate prepared by treatment with acetic anhydride and pyridine in the cold, m p 270–272° (corr) CH determinations agree with $C_{23}H_{34}O_4$

Further conversion products of these new compounds specially the preparation of 17 oxy progesterone and certain compounds in the corticosterone series[3] will be described later

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[3] In collaboration with Prof Reichstein

Use of Amino Acids containing Deuterium to follow Protein Production in the Organism

WHEN α amino acids are heated to 100–170° with heavy water and strong acids or bases, heavy hydrogen (D) is introduced in a stable or practically stable position in the amino acid molecule[1, 2] The position into which D is introduced seems to be the C–H linkage at the α C atom and further into the ring of some of the aromatic and the heterocyclic amino acids

It was suggested[2] that amino acids prepared in this way could be used to follow the fate of amino acids in the organism The following experiment was made A rat starved for 48 hours, was given a food consisting of equal parts of dried milk whole rye flour and butter For every gram of protein was added 0 5 gm casein hydrolysate containing heavy hydrogen (dry and practically free from inorganic ions) This food was given for three days In all 3 5 gm protein and 1 75 gm hydrolysate was eaten by the rat Then the animal was killed (weight 150 gm) and single organs dried and extracted with acetone and petrol ether The casein hydrolysate used was prepared by heating 3 gm casein with 14 c c 50 per cent deuterium and 3 c c sulphuric acid (conc) in a sealed pyrex tube to 170° for 24 hours Sulphuric acid was removed quantitatively the water distilled off and the residue dissolved in ordinary water and dried again twice to remove the non stable deuterium By complete ignition this hydrolysate would give water containing 6 per cent D_2O The combined food protein and hydrolysate would give an amino acid mixture yielding water containing 2 per cent D_2O Assuming that only the *l* series of amino acids could be used by the organism for building up protein (the hydrolysate being a racemic mixture of both series), the concentration of D_2O formed by ignition of newly formed protein would be at most 1 per cent, and in reality somewhat lower on account of the differences as regards the relative amounts of the amino-acids in the food and the organs of the rat.

On determining the D_2O content of combustion water from liver protein, 0·1 per cent D_2O was found, which means that at least 10 per cent of the liver protein present after the experiment is newly formed from the food absorbed in the course of the three days of experimental feeding. In the muscle the concentration of deuterium was less, indicating that about 2·5 per cent of the protein was newly formed.

The water distilled off from the organs showed a D_2O concentration of 30 mgm. per cent, which shows that most of the ingested protein has been broken down in the organism. This experiment supports the well-known view that the liver functions as a protein depot[3], but experiments have to be done under varied conditions before definitive conclusions can be drawn

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July 4.

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[1] Günther, G , Diss Leipzig (1937)

[2] Krogh, A , and Ussing, H H , *C R Lab Carlsberg*, Ser chim , **22**, 282–287 (1938)

[3] Addis, T , Poo, L J , and Lew, W , *J Biol Chem* , **115**, 11, 117 (1936)

Chemical Studies on the Adreno-Genital Syndrome

IN a recent issue of the *Journal of Biological Chemistry* we published a paper[1] entitled "Chemical Studies on the Adreno-Genital Syndrome. (1) The isolation of 3(α)-hydroxyetiocholane-17-one, 3(β)-hydroxyetioallocholane-17-one (isoandrosterone), and a new triol from the urine of a woman with an adrenal tumor".

We wish to take this early opportunity of pointing out that the word 'hyperplasia' should be substituted for the word 'tumor' in this title. The mistake arose as a result of a slight misunderstanding in our correspondence with Mr L. R Broster, of the Charing Cross Hospital, who very kindly supplied us with the urine upon which these researches were carried out. We wish to add that this unfortunate misunderstanding arose entirely from an oversight on our part, and was in no way the fault of Mr Broster.

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July 12.

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[1] *J Biol Chem* , **124**, 237 (1938)

Points from Foregoing Letters

A TABLE giving the capture cross-section for 220 Kev. electrons, by various elements, is submitted by Dr. H von Halban, jun , and Dr. L Kowarski It shows that the nuclei with big capture cross-sections have mostly odd proton numbers and even neutron numbers.

Seven out of ten interval factors, calculated by Dr. S. Tolansky from the hyperfine structure of the iodine spark spectrum, show perturbations which indicate the existence of a nuclear quadrupole moment The interaction energy for each perturbed level necessitates a cubic law to account for the observed values.

Prof. G. Wataghin makes an attempt to solve the convergence difficulties of the quantum theory and to explain the explosion-showers, starting from the assumption that our ability to measure high relative impulses is limited in a new way. A new algebra of states and observables which corresponds to a supplementary indetermination (due to β-ray forces, neutrinos, showers) by the high-energy collisions is discussed.

Prof. R. T. Cox and Prof. F. E Myers consider that the quantum indeterminacy would prevent the observation of the difference in potential energy between the two free electrons in magnetized iron, which have magnetic axes respectively parallel and anti-parallel to the direction of magnetization

Prof. J Kaplan gives laboratory evidence supporting the reality of the observation by Gauzit of the second positive bands of nitrogen, 2963, 2977, in the light of the night sky Observation of three low wave-lengths is presented as additional evidence for a low origin of the light of the night sky.

X-ray study of the structure of iron-palladium systems shows, according to Dr. R. Hultgren and C. A. Zapffe, that the change from the gamma to the alpha form on cooling takes place in at least two steps : first the atoms rearrange themselves into a body-centred form, then palladium is precipitated out in a face-centred palladium-rich phase.

G. Ehrensvärd and L G Sillén discuss further their hypothesis that potential differences at oil-water interfaces are mostly determined by a state of adsorption equilibrium and negligible diffusion ; they point out, incidentally, that a change in potential difference may be observed between freshly distilled and old organic liquids, which may be due to molecular re-association

From the fact that the electrical response in dark-adapted frog's eyes may be greatly reduced without a parallel diminution of the visual purple pigment, Prof R Granit, T. Holmberg and M. Zewi conclude that the retinal rods contain a store of visual purple, only the surface part of which appears to be active at a given time.

Vitamin B (thiamin) and riboflavin are found by P M West and Prof. P W Wilson to be two components synthesized by growing cultures of *Rhizobium trifolii*, and necessary to it, if it is to be continuously transferred in synthetic media.

Prof. G. K. K Link and Virginia Eggers add one more to the long list of secondary effects of indole-3-acetic acid on plants in reporting that, in concentrations of $1 \cdot 7 \times 10^{-3}$ to $2 \cdot 7 \times 10^{-6}$ molar, this substance inhibits, retards or diminishes initiation of adventitious buds in decapitated hypocotyls of flax. These buds are initiated by division of a single epidermal cell without immediately precedent cell enlargement. It is concluded that the native auxin of flax and also indole-3-acetic acid are effective through influencing a cell-division substance or substance complex, which is designated meristin.

An easy conversion of *trans*-dehydro-androsterone into pregnane derivatives is described by Prof. L. Ruzicka and H. F. Meldahl.

By feeding casein hydrolysate, containing heavy hydrogen atoms, for three days to a rat, and determining the proportion of heavy hydrogen atoms in various organs at the end of that period, H. H. Ussing finds indications that about 2·5 per cent of the protein of the muscle and at least ten per cent of the liver protein was newly formed.

Research Items

Cultural Change in the Assam Hills

Mr Tarar Chandra Das, in the course of investigations carried out in 1931, 1932 and 1934, has made a study of certain cultural changes observed among small tribes in the hills surrounding the valley of Manipur, more particularly of the Chirus, included by some in the Naga group, by others among the Old Kuki (*Anthropos*, 32, 1937) Chiru economic life is based on agriculture, hunting being practised on one occasion only in the year, while fishing, or rather fish taking is merely a by product of irrigation of the paddy fields Trading is not practised as an occupation, but only as a method of disposing of surplus products, excepting only when betel leaves, obtained by exchange from the Kabuis, are sold as a means of raising money for the hut tax Two methods of cultivation are practised, *jhumming* in forest land on the slopes of the neighbouring hills, and by irrigation The latter is possible only on the land at the foot of the hills, and is evidently a recent introduction This is indicated by various features of Chiru economic, social and religious life The people have realized the advantages of this form of cultivation, and are gradually migrating towards the edge of the valley The Chirus are essentially a hill cultivation people The size of their villages is determined by the amount of *jhumming* land available, and increase of population, or even internal friction, readily lead to the founding of new villages The periodical religious rites and ceremonies, which take place on stated occasions in each month throughout the year, are all associated with *jhum* cultivation They are public festivities in which the whole village participates, but the religious festivals associated with wet cultivation in the irrigated fields are few and are entirely a family matter The hill village consists of families, each of which cultivates a patch in the *jhum* land This land belongs to the village, and though a man has a right to his patch when cleared, it is the usufruct only, enduring until the patch is exhausted and a fresh patch has to be cleared The wet cultivation fields, on the other hand, are rented from the Government or a landlord, they belong to the family and may be disposed of by sale, mortgage, or otherwise at such a price as the holder may think fit

Porifera of Krusadai Island

In a report by Dr M Burton, under the title of 'Porifera of Krusadai Island" (*Bull Madras Museum* Supplement to the Littoral Fauna of Krusadai Island in the Gulf of Manaar N S —Natural History Section, Vol 1, No 2, Pt 4, 1937), many species are included, as explained in an appendix, which were not collected in the Gulf of Manaar It is to be regretted that the substance of this important appendix, presumably compiled by the Madras Museum, and containing details of localities of occurrence, and colour in life of species, so far as known, was not included in the body of the report Frequent allusions in the latter to "colour in life", for example, are apparently derived wholly from other sources, and at times in disagreement with that recorded for the material concerned. The scheme of classification is based on the later system of Dendy, with certain modifications, hence, the Hexactinellida being unrepresented with 76 of the 89 species recorded in the report, placed under the order Tetraxonida The remaining 13 species are Keratosa, and seven others, as stated in the appendix, are omitted from the report Under the suborder Astrosclerophora, with 21 species, representing 16 genera, *Ecionema bacillifera* (Carter) is regarded as covering nine other species from the Indo Pacific region, with a table showing details of their differences Under the suborder Sigmatosclerophora, which is not defined, 55 species are recorded, representing 26 genera and 3 families Of the latter, the Desmacidonidæ contains 22 species, the Axinellidæ, though undefined, containing 18 species, and here including the genus *Halichondria* with one species, *H glabrata* Keller The Keratosa appear, through some error, under their two suborders as Dendrokeratida and Dendrokeratina respectively in place of the Dictyokeratida for the former—signifying, that is to say, the dictyal or net like character of the skeleton as compared with its dendritic tendency in the other case But whichever termination of the group name is used, the same in such a case should be retained for both In the second group, a sponge of doubtful position, without skeleton, is referred to the genus *Hexadella* of Topsent

Dermatophyte Fungi

The second fascicle of *Mycopathologia* (1, fasc 2 den Haag Dr W Junk June 1938) a new journal devoted to fungus parasites of man and the higher animals, includes several papers on skin diseases P Negroni describes in detail the cultural and microscopic characteristics of *Actinomyces discofoliatus*, which is concerned in human actinomycosis and lachrymal concretions A new species of *Trichophyton*, named *T immergens*, had been isolated by S Milochevitch, who describes its clinical manifestations, its pathogenicity geographical distribution, and other characters The disease can spread amongst human beings, and is also contracted from cattle It usually attacks bare skin, but can also disfigure the beard The fungus *Oidium albicans* is often associated with superficial diseases of human beings, R Ciferri, P Redaelli, and C Cavallero provide a very detailed summary of the taxonomic position and mycological characters of this species which should contribute materially to its more correct diagnosis It is somewhat surprising, but also sufficiently gratifying, that dermatophyte fungi are not very widespread in Great Britain but the exact results published from time to time in *Mycopathologia* should make the recognition and cure of such attacks as do occur a matter of exact science

Data of Seismology from the Argentine

A most interesting and informative publication has just been received from the Astronomical Observatory of the National University of La Plata in the Argentine Republic It is the "Resultados Sismometricos" for the years 1932, 1933 and 1934, and was published in 1937 at the observatory In it are given readings of the station's seismograms, including component, phase, time of arrival, period, amplitude in mm and absolute amplitude of ground movement, notes on the phases and notes on the character of the *P* wave and the estimated epicentre. Further, there are short notes on most of the seismograms, a list is given of the number of shocks recorded at the observatory month by month, and there is a geographical index of the epicentres of the shocks. The station is equipped with six instruments: a Mainka 450 kgm. arranged to register east-west movements, a similar instrument to register the north-south movements, a Vicentini 105 kgm., with free period 2·4 sec. and amplification 275 to register east-west movement, a similar instrument to register north-south movement, a Vicentini seismograph of 54 kgm. to register vertical displacement, and a Wiechert 80 kgm. to register vertical displacement. Since in the southern hemisphere there are very few seismological stations at all, and in the southern part of South America south of lat. 30° there are only six such stations in more than half a million square miles, these data will be very valuable.

Air Flow at Surfaces

No. 1803 of Reports and Memoranda of the Aeronautics Research Committee (H.M. Stationery Office. 5*s*. 6*d*.) contains a description of a new method devised by Dr. H. C. H. Townend of the National Physical Laboratory for studying the boundary layer flow of air along solid surfaces. If the surface has the end of an electrode flush with it and an electric spark is made to pass to it from a second electrode a short distance from it, the ions along the path of the spark persist for a short time, and if the air is moving parallel to the surface they are carried along with it. If a second spark passes, it follows the path already ionized which has drifted down stream, and so on for successive sparks. As seen or photographed from the side, the successive spark paths give the amount of drift of ions parallel to the surface in the interval between successive sparks, and therefore the velocity at different distances from the surface. For laminar flow the results found by the new method agree with those given by more elaborate methods, but for turbulent flow rather smaller velocities than the older methods.

Isotopic Lead

In a mass-spectrograph study of the isotopes of twelve samples of common lead, A. O. Nier (*J. Amer. Chem. Soc.*, **60**, 1571; 1938) shows that the relative abundances of the isotopes 204, 206, 207, 208 vary considerably in spite of a nearly constant atomic weight. Those samples which contained relatively more 206 also contained more 207 and 208. A tentative explanation for the variations is found if some of the samples are considered to be 'uncontaminated' lead, and the others to be this with the addition of approximately equal quantities of uranium and thorium leads. As the minerals from which the lead was obtained are essentially free from thorium and uranium, such contamination probably occurred before the mineral was formed. A recent attempt has been made to use the constancy of the atomic weight of ordinary lead (and the alleged isotopic constancy) to prove that this lead cannot be a concentration from granitic or basaltic rocks or their respective magmas, but must have its origin in some deeper source in the earth. The present work invalidates this conclusion; it is not inconsistent with the view that ore lead is related to ordinary igneous rocks, provided that the Th/U ratio in such rocks is taken as 4·0 rather than 1·6 to 2·4, as previously assumed. Reasons are given for supposing that the isotopic variations found are not present in the primeval lead itself, and that they are not due to isotopic separation, although it is emphasized that the theory put forward is tentative. A search for the isotopes 203, 205, 209 and 210 showed that, if these exist at all, they must occur with much lower abundance than was at one time supposed.

Rank Correlation

The problem of comparing two different rankings of the same set of persons is of some importance in psychology, and Prof. C. Spearman's coefficient of rank correlation is well known. An alternative method of measuring rank correlation is proposed by M. G. Kendall (*Biometrika*, **30**, 81; 1938), in terms of a new coefficient for which some advantages are claimed. Both coefficients are easy to calculate, and have distributions which tend to normality for a large population, but the distribution of the new coefficient is surprisingly close to normality even for a small population, and its standard error is known for the case where all possible rankings occur equally frequently. The distribution of the old coefficient is not known, but it appears to present some peculiarities, which will be discussed in a further communication to be published shortly. Finally, it is claimed that the new coefficient has a natural and logical significance.

Distribution of Stars in the Zone −40° to −52°

Dr. J. Jackson has recently published a paper entitled "Distribution of Stars in the Cape Astrographic Zone, −40° to −52°" (*Mon. Not. Roy. Astro. Soc.*, **98**, 7; May 1938) in which there is a very full discussion of the distribution of more than 40,000 stars. This zone has been photographed four times with overlapping series of plates, two series being taken round about 1900 with relatively short exposures, the fourth series being taken in 1923–28 for the determination of proper motions in conjunction with the most suitable of the earlier plates. There has been close co-operation with Harvard Observatory in the determination of spectral types, and the spectra of 38,713 stars in the zone were classified by Miss Cannon. Fifteen tables are given in the paper, and these deal with a multitude of subjects, amongst which may be mentioned the number of stars of each spectral type arranged according to galactic latitude and apparent photographic magnitude, separation of stars into dwarfs and giants by means of counts of stars according to magnitude, mean colour indices according to apparent photographic magnitude, percentage of stars in different ranges of proper motions, etc. Table XV shows the density distribution according to spectral type, and it has been computed from assumed absolute photographic magnitudes for stars in the main sequence. Although the table has been extended as far as type G0, the results have little meaning at this stage because many of the stars included do not belong to the main sequence. This table is very interesting, showing the great difference in the number of stars of different spectral type. There is a clear falling off of density in the groups of apparently bright stars, and it is suggested that the effect may not be real but may be due to the presence of distant giant stars in these groups.

Grain Structure of Sand Dunes and its Relation to their Water Content

By Major R. A. Bagnold, Imperial College of Science and Technology

THE stratification of wind accumulated sand beds is well known, and the evidence of it can often be seen on the vertical faces of sand pits Beadnell[1] has shown that the laminar structure of fresh non cohesive dune sand can also be observed, if the dry dune is soaked with water to allow a vertical face to be exposed without collapse The strata he thus exposed dipped at the angle of repose of sand, which experiments show to lie between 30½° and 35½° to the horizontal[2] In this case the succeeding layers have been formed by sand which, having been driven over the surface of the dune, has come to rest temporarily sheltered on the upper part of the slope, and has accumulated there, increasing the angle of the slope until shear occurs An avalanche then takes place down the slope from top to bottom (Fig 1) Fresh sand deposits formed in this way are characterized by their loose packing and by their extreme softness I have called[3] such a mode of deposition encroachment'

Another type of deposition occurs on a smooth sand surface over which sand is being driven by the wind, when, for various reasons previously discussed[3], more grains come to rest on the surface than are picked up from it In this case, which I have called accretion', the packing of the grains is very close and orderly, and the structure is peculiarly firm under normally applied pressure The layers here run parallel to the surface exposed to the wind (The accretion structure very probably corresponds to that of wind packed' snow) If a dune has advanced and grown bigger at the same time, both kinds of structure, encroachment and accretion, are present (Fig 2) This accounts for the alternate patches of firm and yielding sand found on desert dune surfaces

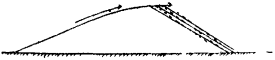

Fig 1

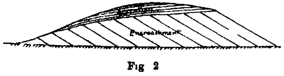

Fig 2

I have recently investigated the structure of a series of desert dunes, during an expedition carried out with the aid of a Government grant allotted to me by the Royal Society When a small quantity of water—half a pint—is allowed to soak gently into a given spot on a dune surface, and the dry sand is scooped away from one side of the wetted area by hand, it is found that the water has travelled farther and faster through some of the layers than through others Parallel wetted layers 1-4 mm thick are left sticking out sideways like wafers between voids a centimetre or more in thickness from which the dry sand has fallen away

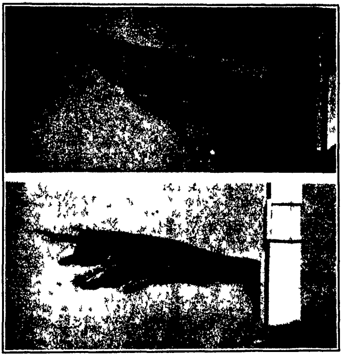

Fig 3

Fig 3 shows photographs of the structures thus exhibited, taken on the same dune surface and at spots a few feet from one another on either side of a boundary, superficially invisible, between very firm and very soft sand The upper photograph shows a firm accretion deposit through which a new top surface has been cut by the wind In the lower photograph a typical soft encroachment deposit has been laid bare by the same denudation and afterwards an accretion deposit has begun to grow on the top of it (In both cases the sand where not wetted appeared merely as a loose structureless mass, and even when wetted showed practically no structure when afterwards cleft down with a knife)

The differential rate of travel of water through sand seems to be due to variations in the effect of surface tension caused by differences in the proportion of fine grains present in succeeding layers It can be verified experimentally that water seeps faster through sand containing fine grains than through sand which does not

In the case of the accretion deposit (Fig 3), I have shown experimentally[4] that the proportion of fine grains in such a deposit is controlled mainly by the composition of the source from which the sand comes. A change of wind direction may therefore alter the fine-grain composition of the deposit, even assuming it to be growing steadily the while In the same paper it was pointed out that the process of denudation tends to concentrate on the surface both extremely coarse and extremely fine grades. There are therefore two possible causes of the variation in texture.

The cause of the laminar structure of encroachment deposits is more interesting. Since the grains reach their final resting place after avalanching down the slope, the structure appears not to be due to direct wind action. From experiments with a mixture of coarse and fine sands, each dyed a different colour, it appears that when a dry sand avalanches down a slope the finer grains become concentrated along the internal surface of shear. When afterwards wetted, the mixture shows just the same structure as the lower photograph in Fig. 3. This phenomenon does not seem to be generally known, and it may have useful applications in experimental soil mechanics.

That desert dunes are able to retain for very long periods the moisture received from rare showers of rain has long been recognized But it has often puzzled me why such patches of moisture should be found beneath the sand surface in some places but not in others nearby The explanation now seems to lie in the different structure of the two kinds of sand structure. When rain falls on an exposed encroachment deposit, the water seeps rapidly downwards along the old shear planes into depths at which it is immune from temperature changes and consequent evaporation. When, on the other hand, it falls on a firm accretion structure, it spreads out laterally along the surface layers of finer grain composition, and is hindered from sinking by the intervening layers of sand which are lacking in fine grains. It therefore remains near the surface and is soon lost by evaporation.

In all cases where I found a moist zone beneath the dry surface, and in most cases where blades of dead grass were still visible on the dunes, the sand when wetted showed the steeply dipping structure of the encroachment formation This is in accord, too, with my experience when motoring over dunes in very arid country, that areas containing occasional dead vegetation are to be avoided owing to their probable softness.

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[1] Beadnell, H J L , *Geog J* , **35**, 387 (1910)
[2] Jenkin, C. F , *Proc Inst Civ. Eng* , **234**, 112 (1933).
[3] Bagnold, R A , *Geog J* , **89**, 432 (1937)
[4] Bagnold, R A , *Proc Roy Soc* , A, **163**, 250–264 (1937).

Researches in Hypnosis

IN a noteworthy article, the first to appear from the recently founded Institute of Experimental Psychology at Oxford, Dr. William Brown discusses "Hypnosis, Suggestibility and Progressive Relaxation" (*Brit J. Psych* , 28, Part 4: April 1938). Originally delivered as a lecture to the British Psychological Society, it was again communicated, in an abridged form, to the Psychology Section of the British Association in 1937. The importance of its content justified this second communication at the Nottingham meeting, when many members of other sections had the opportunity of hearing and discussing it. Dr. Brown has been well advised to have the lecture printed.

Beginning with a brief outline of its history and development from the time of Mesmer, the author even more briefly expounds his own theory of hypnotism and a technique for inducing hypnosis, which may or may not include muscular relaxation. In his therapeutic practice, however, relaxation is always induced, beginning with the small muscles of the extremities, extending to the greater muscle groups of limbs and torso, and ending with all the lesser muscles involved in speech and vision. This process not only secures a calm and tranquil state of body, but also tends to extinguish both inner speech and visual imagery, which might support conscious activity and keep the mind alert. As Jacobson has experimentally shown, progressive relaxation is of the highest importance in many pathological conditions, and of itself may effect their alleviation and even removal. Combined with hypnosis, it secures a passive and receptive state of mind, during which curative suggestions may be given to the patient with every expectation of success. The physician also pays attention to the respiration of his patient, which is normally an autonomic function, in order to induce a slow, regular and rhythmical movement of diaphragm and intracostal muscles, which makes for still greater mental passivity. Though the author does not refer to him, Heyer has pointed out that this, the only autonomic process which is also under conscious control, enables us indirectly to influence the functioning of other autonomic processes. Dr. Brown, however, lays stress upon another way of securing control over the autonomic nervous system, namely, by means of the forming of conditioned reflexes. Hudgins, using Pavlov's method, has shown experimentally that the pupillar reflex can be 'conditioned' to the sound of the word 'contract' when, just after pronouncing it, a bright light is flashed upon the eye. In time, the pupil comes to contract when the subject of the experiment pronounces the word 'contract' himself, or even thinks it, thus enlarging the scope of his volitional control, even if only indirectly. The psychotherapeutic value of this process of conditioning would seem to be evident; since, as Dr Brown points out, a word, or thought, may be associated with the operation of a drug, and in time come to act as a substitute for it

What is, however, of greatest interest in this paper is the account given of the experiments upon the patellar reflex, carried out at the Oxford Institute by Dr Brown himself, by which it was shown that normal sleep and the hypnotic condition can be distinguished by their several effects upon the knee-jerk. The subject was seated in a chair; and every ten seconds a smart tap was given on the patellar tendon by an electrically controlled hammer. The excursion of the reflex movement was recorded upon the smoked paper of a kymograph by a lever which was connected by a thread passing over a pulley to the subject's foot, thus securing a continuous record.

The method followed was to cause the subject to fixate his eyes upon a bright light, and to secure relaxation by suggestions of drowsiness, sleep and rhythmical breathing The subject becomes deeply relaxed, and, though not asleep, his knee jerks are abolished But, when suggestions of a hypnotic kind (for example, that he cannot open his eyes) are given, the reflex manifests itself again

A similar criterion of the distinction between sleep and hypnosis is found in the so called psycho galvanic (or skin constrictor) reflex The more relaxed the subject becomes, the more the body resistance rises, the less there is of 'alertness But, when hypnotic suggestions are given, the resistance falls It would seem that hypnosis is a state of peculiar, though restricted, vigilance, where as lethargy is a blend of hypnosis and drowsiness, or sleep

These and like experiments show the possibility, and indicate the importance, of extending laboratory methods to the investigation of 'abnormal and pathological states

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The Arctic Fauna

GREAT interest in arctic exploration during the last few decades has resulted in a large number of publications on its fauna, mostly descriptive in character and restricted either to certain areas or to groups of animals The only comprehensive work on the subject is the well known Fauna Arctica,' written by numerous contributors under the editorship of Roemer and Schaudinn, which contains extensive lists of animals, mostly devoid of any general information and useful mainly for the statistics of the fauna The questions of the origin and evolution of the arctic fauna have been attacked by some zoogeographers, but their comprehensive treatment from a modern point of view was lacking This gap is now filled by Prof N J Kusnezov, who has succeeded in less than a hundred pages in presenting a remarkably concise and clear survey of the whole problem.*

The term 'arctic', as understood by the author comprises the territories occupied by the tundra proper and by the northernmost marginal belt of the forest zone with its scattered, stunted trees An up to date list of the number of species in each group of animals is given, the total being about 5 500 species The actual number of arctic species is estimated as at least three times as many The number of vertebrates, except birds, is too small to permit reliable zoogeographical conclusions, while birds, although numerous (270 species) are represented almost exclusively by non resident species, which spend in the arctic only a very short breeding period Most of the invertebrates are still insufficiently studied, but insects are represented by an unexpectedly large number of species, particularly of Diptera, Hymenoptera, Coleoptera and Lepidoptera

The existence of the arctic fauna under the peculiar environmental conditions of high latitudes undoubtedly suggests a long period of adaptation Unfortunately, the physiological aspect of this adaptation remains unstudied and is probably not the same in different groups One point, however, appears certain, namely, that the present composition of the arctic fauna is determined not so much by the thermal conditions of the arctic, as by nutritional interrelations of organisms, that is, primarily by plant life, which is mainly dependent on the peculiar seasonal distribution of daylight

As regards the taxonomic composition of the arctic fauna, it proves to be most heterogeneous, including representatives of both primitive and highly specialized groups, while there is no group that may be regarded as specially adapted to arctic conditions This complexity of arctic fauna suggests a very chequered history From a zoogeographer's point of view this history can be best made intelligible by accepting the theory of longitudinal displacements of climatic zones (Koeppen Wegener) causing corresponding migrations of animal population

Among the various historical elements of the arctic fauna an important place belongs to the euarctics, as the author calls endemic species now living only under arctic conditions, although they have no apparent ecological or physiological adaptations The primary origin of the euarctics is obscure, but in Lepidoptera, for example, a taxonomic analysis of euarctic forms points clearly to their origin from the Tertiary fauna of the Angaran continent Moreover, it is highly probable that many of the euarctics should be regarded not as postglacial immigrants into the arctic zone, but as relics of a preglacial fauna This assumption is based on quite legitimate doubts of the severity of conditions during glaciation (which is usually taken for granted) and on the existence of numerous plants and animals under most intense arctic conditions, for example, in Greenland and on arctic islands

The Quaternary glaciations resulted in a southward migration of most arctic organisms which found temporary refuges on the edges of glaciated areas This was followed by return migrations during the inter glacial periods, and these repeated movements led to the great complexity in the composition of the present Arctic population in which, apart from the Angaran elements, those derived from 'refuge areas in western Europe, in the centre and extreme east of Asia, and in the north west of North America, can be distinguished

Incidentally, the analysis of the Arctic fauna throws some light on the similar great heterogeneity of the more southern faunas, namely, the palæarctic and the nearctic, and the author insists very emphatically that the time has come when the current conception of rigidly defined zoogeographical regions should be drastically revised on the basis of modern ecological and geological knowledge and theories

The work of Prof Kusnezov deserves close study not only by those specially interested in the arctic, but also by biologists in general, since it represents a courageous attempt to discuss a wide biogeographical problem from a thoroughly modern point of view and with a healthy critical attitude towards generalizations that are generally accepted merely because they are often repeated

A good bibliography on the arctic fauna (and partly flora) comprising twelve pages concludes this interesting paper

B P. UVAROV.

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* Kusnezov, N J 'The Arctic Fauna of Eurasia and its Origin (In Russian with an English summary) *Trav Inst Zool Acad Sci U.R S S*, 5, Part 1 1938, 85 pp

Vegetable Poisons of Africa

DR. G. CUFODONTIS has reviewed these numerous vegetable poisons of which the native peoples of Africa have made use from time immemorial in war, hunting, fishing and the destruction of fierce and noxious animals (*Scientia*, Ser. 3, 32, 1–5; 1938). Though the use of these poisons by the natives has long been recorded by travellers, owing to lack of botanical and chemical knowledge information is often defective. Native methods of extraction are often not only complicated, but also surrounded by mystery and magical ritual, making observation a matter of difficulty.

Strophanthus, a genus widely spread over the whole of tropical Africa, is the principal source of the most powerful African poisons. Its use was recorded so long ago as 1865 by Livingstone on the Zambezi, though the actual plant used was not identified until long after. As an arrow-poison it is fatal to man and most animals, only such large pachyderms as the elephant and hippopotamus being resistant. In West Africa *S. hispidus* is used, while in Senegal and Guinea its effects have been known to Europeans by fatal experience since the fifteenth century.

The genus *Acocanthera*, of which half a dozen species are found in different parts of tropical Africa, produces a poison which, acting on the nervous system and by vaso-constriction, is even more powerful than strophanthin, an arrow wound causing death in about one hour. *A. ouabaio*, confined to Somaliland, and *A. Schimperi* in Abyssinia, Somaliland, Kenya and Tanganyika, produce a powerful poison, effective, it is said, even in pachyderms which resist strophanthin. The *adeniums*, confined with one exception to Somaliland and the adjacent regions including Socotra, are strongly toxic. They produce a latex which the Somalis use, not for their arrows, but for poisoning bait to kill destructive or dangerous animals near the villages. The active principle is a toxic glucoside which has not yet been analysed. In South Africa a strong arrow poison is extracted from *Toxicophlœa Thunbergii* and also from the bulbs of one of the Amaryllidæ *Buphana disticha*, which contains narcissin, hemanthin and a strongly toxic amorphous alkaloid, buphanin. A large family, very rich in poisons, is the Euphorbiaceæ, which contain five distinct groups of poisons. In Africa the use of poisons extracted from members of this family is confined to the Bushman, Bongos and certain Arabs, while on the east coast at Zanzibar one variety is used in fishing. Few of the leguminous plants are used, and most of these for fishing. It is remarkable that the *Strychnos* group, which in other continents produces such terrible toxic agents as curare in America and the upas poison of Indonesia, in Africa holds a very subordinate position.

Science News a Century Ago

Engineering Education at University College, London

IN the autumn of 1838, courses in civil engineering were arranged at both King's College, and University College, London. An advertisement in the *Athenæum* for September 1, 1838, said "Courses of lectures in aid of the system of instruction pursued in the offices of Civil Engineers, will be given at University College in the course of the ensuing Session.

"Every Saturday evening, from 7 to 9, Mr. De Morgan, Professor of Mathematics, will give Lectures and Praxes, the principal object of which will be to teach the application of Arithmetic to the results of Algebra and Geometry. Mr. Sylvester, Professor of Natural Philosophy, will deliver an Elementary Course principally on the Mechanics of Solid Bodies, and the Doctrine of Heat, and their application to the Steam-engine. The Lectures of Professor Sylvester will be given every Wednesday evening from 8 to 10.

"By attending a Course, or Courses of the Practical Chemistry of Professor Graham, on Monday, Wednesday and Friday from 4 to 5, the Civil Engineer will be exercised in the manipulation of testing and analysing, especially as regards mineral substances used in the arts."

Lyell and the British Association

ON September 1, 1838, Lyell wrote from his father's house at Kinnordy, Forfarshire, to his father-in-law, Leonard Horner, giving an account of his journey to Newcastle for the meeting of the British Association. He had been through Suffolk and Norfolk geologising, and at Norwich had "avoided all but collectors". The journey northward was made in one steamer from Yarmouth to Hull and then by another from Hull to North Shields. From Shields he made a long excursion to Tynemouth along the shore, went by gig to Cullercoats "where the ninety-fathom dike is laid open in the cliffs, the magnesium limestone on one side and the coal on the other", visited a railway cutting and crossed the Tyne to the Marston Rocks, "where there are lofty perpendicular cliffs of magnesium limestone, and small isolated rocks or needles of the same in the sea". At Newcastle Murchison told him he would be president of the geological section. "All that I saw of the government of the Association," he wrote, "gave me a good idea of the spirit, but no wish to consume my time in taking part in it, to which I am invited, I hear, by being put on the council. Sedgwick was so eloquent; his lecture to 3,000 people on the sea-shore made a great impression."

A Uniform System for Railways

IN 1838 Nicolas Wood (1793 ?–1865) published the third and last edition of his "Practical Treatise on Rail-roads and Interior Communication in General, etc." In a review of this edition, *The Civil Engineer and Architects' Journal* in its September number said: "It is now generally admitted that Railways must shortly become the great highways of the kingdom; and it consequently becomes an object of national importance to consider the best modes both of constructing and working them. It appears to us highly desirable that they should all be governed by one law, and all their regulations should be uniform. . . . Regretting, as we do, that the opportunity should have been lost of carrying on the railway system from the first on a uniform and consistent plan, we think that much might yet be accomplished towards this very desirable object. For this end we would recommend as a highly desirable measure, the immediate formation of what might be termed a Railway Congress consisting of one Director and the Engineer of each line. . . . Their decision should be binding on all the companies, and when necessary, they might recommend to Parliament bills for the regulation of railways, which from such a body would come supported by the high authority of extensive and practical experience."

Societies and Academies

Paris*

Academy of Sciences, June 27 (*C R* 206 1933 2038)

Pierre Dubois and **Paul Breton** Study of the ammonium vanadates

Jean Calvet, **Pierre Jacquet** and **André Guinier** The hardening by ageing of an aluminium copper alloy

Denis Duveen An attempt at a partial asymmetric synthesis

Léon Palfray Catalytic hydrogenation in the naphthalene series

Jean Cuvillier Contribution to the study of the Nummulitic of Hadhramaout (Southern Arabia)

Raoul Combes The action of the medium on the nitrogen nutrition of the flower

Mlle Marie Celan The chondriosomes plasts and nuclei in the course of evolution of the cystocarp in *Halopithys pinastroides*

Théodore Solacolu, **Démetre Constantinesco** and **Mme Marguerite Constantinesco** The anatomical and cytological study of the modification provoked by organo formative substances on the decapitated stems of *Vicia Faba*

Mme Lucienne Lavier George Variations in the organization of the leaflets of *Laburnum vulgare*

Charles Chabrolin The germination of the seeds of *Orobanche speciosa*

André Paillot The process of moulting in the middle intestine of the caterpillars of the silkworm

Pierre Carrère Researches on the evolutionary cycle of the trematodes of fishes

Albert Chauchard, **Mme Berthe Chauchard** and **Paul Chauchard** Contribution to the quantitative study of the variations of excitability of the respiratory centre

Henry Bulliard and **Israël Grundland** Experiments relating to the behaviour of the lipoproteic complex

Pierre Girard and **Néda Marinesco** Ultrasound centrifugal machine

Basile Luyet and **Grégoire Thoennes** Demonstration of the isotropic properties of cellular masses vitrified at the temperature of liquid air

Charles Dhéré and **Vero Castelli** The properties of the photoluminescence of synthetic flavin

Mlle Berthe Biecheler The cinetid of the Peridineans

Albert Peyron, **Guy Poumeau Delille** and **Pierre Mercier** The origin and significance of the different varieties of histiocytes observed in inflammatory lesions and in the course of immunity reactions

*Continued from p 367

Moscow

Academy of Sciences (*C R*, 19, No 3, 1938)

L Pontryagin Classification of continuous transformations of a complex into a sphere (1)

A Grošev A theorem of linear systems

P Bažulin Absorption of ultra waves in electrolytes

I I Kornilov Kinetics of the formation of Mg_3Cd and $MgCd_3$ from solid solutions of Mg—Cd alloys

A A Arsenyev Age of the Vitim basalts

N Kogan Stratigraphy of Tertiary formations in the south western part of Soviet Sakhalin

I V Luchizky Ultra basic rocks of Eastern Transbaicalia

V K Monich Average chemical composition of the Cambrian basaltic lavas of West Siberia

P J Schmidt and **G P Platonov** Seasonal character of the response of fishes to low temperature

K A Mikhailova Chromosome morphology of cotton

H F Kushner Blood compositions of yaks, cattle and their hybrids in connexion with the heterosis of hybrids

A Schmuck Chemical nature of substances inducing polyploidy in plants

M Navashin Influence of acenaphthene on the division of cells and nuclei

Dontcho Kostoff Irregularities in the mitosis and polyploidy induced by colchicine and acenaphthene

A I Zuitin New data on the chromosome number in yak (*Poephagus grunniens* L)

V I Rischkov and **F P Gromyko** A new method for the purification of the tobacco mosaic virus

K S Soukov and **A M Vovk** Mosaic disease of oats

N Arkhangelskaya New methods for studying the brown spot disease in potato

L G Dobrounoff Critical periods in the mineral nutrition of plants

M Ch Čajlachjan and **L P Ždanova** Role of growth hormones in form building processes (2) Vernalization and formation of growth hormones

Rome

National Academy of the Lincei (*Atti* 26 433 472 1937)

G Nebbia Lines of the total quantities of motion in permanent liquid currents which vary gradually

F Tricomi Theory of the elastic arc with a circular directrix (2)

L Gialanella New researches on the solar group of stars (1)

P Sconzo Effect of the displacement of continents on the duration of the earth s rotation (1)

A Baroni Action of selenium sulphur protochloride and of sulphur selenium protochloride on ethyl mercaptan and on ethyl selenium mercaptan (2) Selenoglycerines

Atti, 27, 3–36, 1938

O Scarpa Equations for the thermodynamic calculation of the electromotive forces of gas cells

O Scarpa and **C Rossi** Volta effect in solid metallic alloys (1)

T Boggio Curvature of a surface and of a variety

U Salini Assemblage of quadrics defined in one point of a surface

G García General equations of the restricted relativity dynamics

G Lampariello Compounding of motions according to Poincaré

A Corradetti A new classification of *Haemosporidiidea* based on the existence of a schizogonic cycle of the plasmodes in the cells of tissues

A Missiroli Development of malarial parasites

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

ASSISTANT SUPERINTENDENT in the Central Workshops Division Public Works Department, Irrigation Branch of the Government of the Punjab—High Commissioner for India, General Department, India House, Aldwych, W C 2 (August 31)

ASSISTANT LECTURER IN ESTATE MANAGEMENT at the Royal Agricultural College, Cirencester—The Principal (September 1)

JUNIOR SCIENTIFIC OFFICERS at the Road Research Laboratory, Harmondsworth, West Drayton—Establishment Officer (J 38/10), Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (September 13)

SUPERINTENDENT OF THE MARINE DIVISION of the Meteorological Office—Under-Secretary of State (S 2 A), Air Ministry, Adastral House, Kingsway, W C 2 (September 30)

OFFICERS-IN-CHARGE (3 posts) of Electrical, Physical and Metrological Sections of the Australian National Standards Laboratory—Official Secretary, Australia House, Strand, W C 2 (September 30)

LECTURER IN MATHEMATICS AND PHYSICS at the Natal University College, Durban—The Registrar of the College, P O Box 375, Pietermaritzburg (November 1)

ENGINEER for the Posts and Telegraphs Department of Malaya—Crown Agents for the Colonies (M 6330), 4 Millbank, S W 1

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Association of Special Libraries and Information Bureaux Aslib Book-List Vol 3, No 3, July Pp 69 104 (London Association of Special Libraries and Information Bureaux) Free to members, subscription for non-members, 10*s* 6*d* per annum [38

The Board of Greenkeeping Research Report for 1937 and a General Account of the Work in Progress Pp 76 (Bingley St Ives Research Station) 2*s* [58

Technical Publications of the International Tin Research and Development Council Series A, No 77 The Constitution of the Alloys of Tin with Bismuth By A C Davidson Pp 16+4 plates (London International Tin Research and Development Council) Free [58

Philosophical Transactions of the Royal Society of London Series A Mathematical and Physical Sciences Vol 237, No 778 Application of the Phase Integral Method to the Analysis of the Diffraction and Refraction of Wireless Waves round the Earth By T L Eckersley and G Millington Pp 273–310 5*s* Vol 237, No 779 Tides in Oceans bounded by Meridians 3 Ocean bounded by complete Meridian; Semidiurnal Tides By A T Doodson Pp 311–374 8*s* Vol 237, No 780 On Bipartitional Functions By P V Sukhatme Pp 375–410 4*s* (London Cambridge University Press) [98

Department of Scientific and Industrial Research Report by the Director of Fuel Research on a Demonstration of the Freeman Assay for Coal and Carbonaceous Materials, Demonstration witnessed May 1938 Pp iv+5 (London H.M Stationery Office) 3*d* net [98

Experimental Researches and Reports published by Department of Glass Technology, The University, Sheffield Vol 20, 1937 Pp iv+300+30 plates (Sheffield The University) 7*s* 6*d* [98

Nineteenth Annual Report of the Ministry of Health, 1937–38 (Cmd 5801) Pp xi+318 (London H M Stationery Office) 5*s* net [118

Wild Life—and Rare in National Parks and Paradises round the World (Wild-flowers, Trees, Birds, Animals, Scenery) By Millicent H Morrison Pp 42 (London Green Cross Society) 1*s* [118

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1937 Pp 294+15 plates (Bristol, The University) [158

British Association for the Advancement of Science Gray-Milne Trust Tables for converting Geographic into Geocentric Angular Distances By Dr K E Bullen Pp vii+19 (London British Association for the Advancement of Science) [158

Other Countries

Union of South Africa Report of the South African Museum for the Year ended 31st December 1937 Pp. 18+2 plates (Pretoria Government Printer) [38

Bulletin of the American Meteorological Society Vol 19, No 5 Some American Papers and Notes on Climatic Variations Report of the American Committee of the International Commission of Climatic Variations, to the International Geographical Congress, Amsterdam, Holland, July 1938 Pp 161–224 (Milton, Mass American Meteorological Society.) 50 cents [38

Union of South Africa Department of Agriculture The Onderstepoort Library Index Pp 153 (Pretoria Government Printer) 2*s* 6*d* [38

U S Department of Agriculture Technical Bulletin No 609 Chemical and Physical Properties of Certain Soils developed from Granitic Materials in New England and the Piedmont, and of their Colloids By Irvin C Brown and Horace G Byers, Pp 56. (Washington, D C Government Printing Office.) 10 cents. [38

New York Zoological Society. Report of the Director of the Aquarium. Pp 20. (New York New York Zoological Society) [38

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 164 On the Standing Wave in a Water Column measured by a Broca-Tube By Yûtaro Nisimura and Yutaka Kohasi Pp 245–272 (Tôkyô Kôgyô Tosho Kabushiki Kaisha) 45 sen [58

Hamburger Sternwarte in Bergedorf Zweites Bergedorfer Sternverzeichnis 1930 0 2 Nachtrag enthaltend Eigenbewegungen von 251 Sternen *sowie Zusätze und Berichtigungen zum Sternverzeichnis* Herausgegeben von Dr Richard Storr Pp 91–98 (Bergedorf Hamburger Sternwarte) [58

The Rockefeller Foundation Annual Report, 1937 Pp ix+506 (New York The Rockefeller Foundation) [98

Publications of the Observatory of the University of Michigan Vol 7, No 4 Spectrophotometric Determination of Stellar Temperatures, the Color Temperature of α Lyræ By Robley C Williams Pp 93–125+1 plate (Ann Arbor University of Michigan) [98

Smithsonian Miscellaneous Collections Vol 97, No 5 Three Pictographic Autobiographies of Sitting Bull By M W Stirling (Publication 3482) Pp ii+57+46 plates (Washington, D C Smithsonian Institution) [98

U S Department of Agriculture Technical Bulletin No 616 The Reproductive Cycle of the Coyote By G W D Hamlett Pp 12+2 plates (Washington, D C Government Printing Office) 10 cents [98

University of Missouri Studies a Quarterly of Research Vol 13, No 2 Distance Geometries, a Study of the Development of Abstract Metrics By Prof Leonard M Blumenthal Pp iv+145 (Columbia, Mo University of Missouri) 1 25 dollars [98

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 117 The Regional and Seasonal Incidence of Grasshopper Plagues in Australia By Dr K H L Key Pp 87+3 maps Pamphlet No 78 A Copper Deficiency in Plants at Robe, South Australia 1 Preliminary Investigations on the Effect of Copper and other Elements on the Growth of Plants in a "Coasty" Calcareous Sand at Robe, South Australia, by D S Riceman and C M Donald, 2 The Occurrence of "Reclamation Disease" in cereals in South Australia, by C S Piper Pp 28+6 plates Pamphlet No 79 A Report on the Conditions of Animal Production in Australia By Dr John Hammond Pp 24. (Melbourne Government Printer) [98

Indian Forest Records (New Series) Utilization, Vol 1, No 6 Ascu—a Wood Preservative By the Forest Research Institute, Dehra Dun Pp iv+143 187+5 plates 14 annas, 1*s* 6*d* Entomology, Vol 3, No 10 Immature Stages of Indian Lepidoptera (1) Lymantriidæ By J C M Gardner Pp 187–212+4 plates 1 rupee, 1*s* 9*d* (Delhi Manager of Publications) [98

Bulletin of the Madras Government Museum New Series, Natural History Section, Vol 4, No 2 Supplement to the Flowering Plants of Madras City and its immediate Neighbourhood By E Barnes Pp iii+46+7 plates (Madras Government Press) 1 10 rupees [98

Yale University Publications in Anthropology No 18 The Agricultural and Hunting Methods of the Navaho Indians By W W Hill Pp 194+4 plates (New Haven, Conn, Yale University Press, London Oxford University Press) 11*s* 6*d* net [98

City of Durban Durban Museum and Art Gallery Annual Report for Municipal Year 1936–1937 Pp 12+4 plates (Durban Museum and Art Gallery) [98

Newfoundland Government Department of Natural Resources Research Bulletin No 4 Some Fishes of Newfoundland Waters (with Notes on the Distribution of Eggs and Larvæ) By Nancy Frost Pp 16+8 plates 20 cents Research Bulletin No 5 The Genus Ceratium and its Use as an Indicator of Hydrographic Conditions in Newfoundland Waters By Nancy Frost, with an Appendix on Hydrographic Conditions (reprinted from Annual Report 1936–37) by Anna M Wilson Pp 15+9 plates 20 cents (St John's, Newfoundland Department of Public Works) [108

University of California Publications in American Archæology and Ethnology Vol 35, No 6 The Kepel Fish Dam By T T Waterman and A L Kroeber Pp iii+49–80 (Berkeley, Calif University of California Press, London Cambridge University Press) 1*s* 3*d* net [10

Malta Report on the Work of the Museum Department for 1937–38 Pp xx (Valletta Valletta Museum) [11

Trinidad and Tobago Forest Department Council Paper No 30 of 1938 Administration Report of the Conservator of Forests for the Year 1937 Pp 16+1 map (Trinidad and Tobago Government Printer) 12 cents [158

Journal of the Indian Institute of Science Vol 21 A, Part 1 Activation and Clarifying Properties of Fuller's Earth, Part 4 Equilibrium in the Ionic Exchanges in Fuller's Earth By B S Kulkarni and S K K Jatkar Pp 8 12 annas Vol 21 A, Part 2 A Preliminary Study of the Clarification of Extracts for Estimatin Sugars in Plant Materials By A V Varadaraja Iyengar Pp 9–14 10 annas Vol 21 A, Part 3 Refractive Dispersion of Oils and Fats Part 1 Dispersion of Ghee and Vegetable Oils By V T Athavale and S K K Jatkar Pp 15–26 1 rupee Vol 21 A, Part 4 · Researches on Utilization of Cane Molasses, Part 1. Dissolution of Bone by Fermentation of Cane Molasses By T R Bhaskaran S C Pillai and V. Subrahmanyan Pp 27–40 1 2 rupees Vol 21 A, Part 5 Constitution of the so-called Dithiourazole of Marti Freund, Ring Closure of Hydrazo-Dithio-Dicarbonamide and it Mono- and Di-Substituted Derivatives, Part 7 Action of Heat Part 8 Action of Sodium Hydroxide (Contd), Part 9 Action o Hydrochloric Acid (Contd.), Part 10 Action of Acetic Anhydrid (Contd), by P C Guha and D R Mehta, Part 11 Isomeric Change of some Triazoles and Thiobiazoles, by P C Guha and S L Janniah Pp 41–64 1 12 rupees, Vol 21 A, Part 6 · Coupling of Methon with Tetrazonium Compounds By Balkrishna H Iyer. Pp. 65–76 1 rupee Vol. 21 A, Part 7 System Sulphuric Acid-Ethers, Par 2. System Sulphuric Acid Propyl Ether By S. K. Kulkarni Jatka and N G Gajendragad Pp 77–88 1 rupee (Bangalore. India Institute of Science) [15

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Vol 142 SATURDAY, SEPTEMBER 3 1938 No 3592

Co-operation between the British and American Associations

IT is probable that Lord Rayleigh's term of office will mark one of the most momentous periods in the long history of the British Association To take the initiative in forming a Division to deal with the social and international relations of science is to undertake an onerous and responsible task for which the Association is peculiarly fitted and in which it will have the good wishes of all who realize the effect that advances in science may have for good or ill on the welfare of our own community and of the nations of the world at large As the Council of the Association does not meet until November the General Committee at its final meeting at Cambridge approved the appointment of a provisional committee and a few possible members of this committee were suggested to be invited to serve upon it The publication of a list of the names of these members as forming even a provisional committee is, however, premature and unauthorized

The Cambridge meeting has been signalized by yet another advance of international importance The American Association for the Advancement of Science has aims and interests which have much in common with those of the British Association and it has long been felt that a closer liaison between the two Associations would hasten the realization of those ideals of international co operation and good will and would form a very considerable contribution made by men of science to the cause of world peace

By a happy chance the principal officers of the American Association were able to be present at the Cambridge meeting of the British Association and they have agreed to transmit to their executive two suggestions, which have the full approval of the General Committee of the British Association for promoting a closer union between the two Associations It is suggested that in alternate years a distinguished American man of science should be invited to deliver an address before the members of the British Association at their annual meeting and reciprocally in the years not marked by such lectures that a distinguished British scientific worker should address the members of the American Association at their summer meeting

These addresses which will be devoted to a topic of broad scientific interest will usually but not necessarily deal with some of those aspects of science and society which are the concern of the new Division of the British Association

Further the officers of the Associations are anxious that the Associations through their members should have more intimate knowledge each of the other's work As a beginning to that end it is suggested that a number of those actively engaged in the work of either Association as members of Council or otherwise, should be elected to membership of the sister Association with the full privileges of attendance at meetings and of reception of journals

This principle of exchange of the privileges of membership may be greatly extended in the future but in this connexion much will depend on the form taken by the new quarterly journal which will replace the present annual report of the British Association after the publication of the report of the Cambridge meeting

The Associations are to be warmly congratulated on their courage and initiative in taking these steps steps which are obviously but the beginnings of others which will lead to greater understanding and closer co operation with corresponding repercussions on the friendship between two great democratic communities

Business Research

> "That which man altereth not for the better,
> Time, the great Innovator altereth for the worse "
> FRANCIS BACON

TO DAY we are almost all of us forced to think in terms of progress, although there are still some who find no interest in the idea of change and think rather of conserving the ancient values Human wants are increasing both in variety and in intensity On all sides and in all countries the standard of living is advancing rapidly The word living no longer implies food and warmth and shelter only, but includes much in the way of recreation and amusement

The present world wide state of unrest is an expression of the need for adjustment to change partly arising from the effect of scientific discovery upon the whole framework of economics politics and sociology Adaptation to new conditions always requires increased effort and has to overcome indifferent and vested interests, political and academic, just as change in industry is resisted by financial interests Whatever the attitude may be to the process, it must be admitted that we are in the presence of constant and relatively rapid change The outstanding problem in business of all kinds is that of peaks and depressions, the ups and downs of the curve of prosperity become apparently more pronounced and more frequent Planning has failed to flatten the curve, business sentiment and action are all one way at any particular moment, and the short view prevails

The consequences, both social and political, are very disturbing It has been suggested that commerce, or those engaged in it, is insufficiently educated in science to be able to grasp the potentialities of the application of scientific method to industry These changes have been brought about by engineering science almost everywhere, except in commerce as distinct from industry An example is the recent sharp rise and fall in base metals An apparent shortage encouraged a rush to buy forward and some speculation The price increase brought largely increased supplies into sight through technical activity, the buying became unnecessary and ceased, the speculators threw their holdings on a market bare of buyers, and a serious slump followed

Improvement means research, and it is indicative of the new trend that the chairman of company after company announces that organized research has become the dominant competitive weapon for their particular establishments The research is not always or necessarily scientific, but that is partly because the word science is used to indicate the applied natural sciences What is wanted by business men is a wider training in scientific method, which perhaps can best be gained through natural science The ability to weigh evidence is the faculty of the legal profession, which makes use of it to sway judge or jury In science it is Nature which has to be interpreted, and every observation should be followed to a logical end, theories should act merely as working hypotheses the greatest investigator is he who can devise an experiment to test a principle and can carry it out

In business the demands are more complex, yet the business man should at least have scientific method as the foundation of his knowledge and not regulate his activities by a series of shots which are described in city language as 'market anticipation'

Research in industry has been defined as the development of a new idea from its genesis until the time when it meets the approval of the consumer A progressive company has to be ready to introduce the new product, the new design, the new formula, with as great facility as it introduces new raw materials or new machines As the Americans say, the rate at which older markets wane establishes the rate at which newer markets must be developed This is an important principle which is not always understood, firms have been known to overdo the issue of new lines to the confusion of their customers and the detriment of their trade

The gas industry affords an interesting example of the recognition of the need of business research in catering for its customers, we make use here of Sir David Milne Watson's address to the International Engineering Congress at Glasgow Gas-fires made their appearance on the market about 1853, when an early technician remarked "to meet the wishes of that unreasoning portion of the community which liked its source of heat to be bright, two classes of stove have been designed, viz, the cheerful stoves and the class known as gas-fires". Much later, when electrical competition became a serious threat, modernization of appliances and of its whole contact with the public became an urgent task for the gas industry. Research was strengthened with the view not only to efficiency but also to appearance. In five years the new armament of the industry was forged, the enamelled gas cooker, the modern coke fire, thermostatic control, water-heaters, stream-lined coloured gas-fires, refrigerators, all became available for the public with an efficiency of twenty per cent greater than before. No wonder the industry strengthened its grip on the market and is casting around for wider fields of development

In these days of quick change, it is not surprising that the relation of industry to the State should come under consideration and that there are some who would displace industry as it is now constituted by some form of national effort. On the other hand, Prof. E H Schell, of Massachusetts, recently expressed the view that industry will continue in the main to evolve along the present lines whatever developments may take place in the social structure. The future policy of industry must be one of continuity, although it must be even more flexible to change Such change must not be emotional and hasty, but studied and calculated, the result of what has been sought to describe here as business research

Flame

Combustion, Flames and Explosions of Gases
By Dr Bernard Lewis and Dr Guenther von Elbe
(The Cambridge Series of Physical Chemistry)
Pp xiv + 415 (Cambridge At the University Press, 1938.) 21s net.

ELEVEN years ago appeared the comprehensive monograph entitled "Flame and Combustion in Gases" by Prof W. A. Bone and D. T. A Townend, followed a year or two later by "Gaseous Combustion at High Pressures" by Bone, Newitt and Townend. Except for a small volume on "Flame" by O C de C Ellis and W A Kirkby (1936), the subject has not since been treated as a whole in English, until the recent appearance of the work by Bernard Lewis and G von Elbe now under review.

The new book deals almost entirely with developments in the last eleven years, and admirably supplements Bone's books. It covers a period in which the ruling idea among many of those who have studied the chemistry of combustion is that of chain reactions, for the year after the publication of Bone and Townend's book saw the appearance in the *Zeitschrift für Physik* of Semenoff's paper on the "Theory of the Mechanism of Combustion"

The authors accept the view that chain reactions are characteristic of most processes of gaseous combustion, although "the question has to be decided in every individual case from the sum total of experimental data Sometimes there are compelling criteria, such as a large quantum yield in the photochemical reaction or the phenomenon of the upper explosion limit" (that is, the experimental fact that many gaseous mixtures can be maintained at a suitable temperature and pressure without undergoing more than very slow chemical change, but inflame at the same temperature when the pressure is reduced to a well-defined value) "In other cases it is difficult to demonstrate more than the great possibility of the chain mechanism because it is difficult to eliminate positively all other alternatives" The main criticism that has been made against the somewhat facile explanation of combustion reactions by a chain mechanism is that the postulated chain carriers have rarely been isolated from, or detected in, the reacting mixtures Moreover, it seems that each student of any one reaction postulates a different scheme for the sequence of events of his chain reaction.

The idea of a chain reaction in combustion processes has historical authority, for H B Dixon's interpretation of the catalytic effect of small amounts of water vapour on the inflammation of carbon monoxide was a chain mechanism ; carbon monoxide was oxidized by water vapour, hydrogen being set free and in turn oxidized by molecular oxygen to re-form the catalyst Much further back, Mrs. Fulhame in her remarkable "Essay on Combustion" (1794), writing of the reduction of metallic oxides by carbon, says, "water is essential to the reduction of metals in low degrees of heat—since the water is instantly decomposed by the charcoal, it is a necessary consequence, that its carbone must unite with the oxygen of the water, while the hydrogen of the latter unites, in its nascent state, with the oxygen of the metal, and reduces it, forming a new quantity of water equal to that decomposed : this new quantity of water may be decomposed in its turn : so that a thimble full of water would be sufficient to reduce any quantity of metal provided the water were prevented from escaping and time enough allowed

The authors own attempts to postulate a chain mechanism capable of explaining both the slow and the explosive combustion of hydrogen with oxygen have appeared in print hitherto in part only They now present the whole picture in some forty pages of concise exposition which covers most of the experimental results of the many workers on the subject Whether it is a true view of what happens may be questionable but the summary alone is valuable By somewhat similar schemes they describe the combustion of carbon monoxide and more hypothetically and still more elaborately the combustion of hydrocarbons

Following this lengthy but not too long treatment of the chemistry of combustion there are brief chapters on emission spectra and ionization in the flame front (6 pages) on ignition by sparks (11 pages) and on limits of self propagation of flame (5 pages) Photographic methods of recording flame movements are next described briefly with a mathematical analysis of the mechanism of combustion when an explosive mixture is ignited at the centre of a closed spherical container by the application of this analysis the speeds of flame in a stationary gas mixture over a range of pressures have been deduced from explosion records of oxygen ozone mixtures

The authors describe as burning velocity of a gas mixture what previous writers have variously called vitesse normale entzundungsgeschwindigkeit and fundamental speed of flame that is the linear speed of flame in a direction normal to its surface through a mixture at rest and at constant temperature and pressure just ahead of the flame They describe various methods of determination of this constant the analysis of which is perhaps the outstanding unsolved problem in the subject of flame propagation

Chapters on detonation (33 pages) and on thermodynamic functions of gases deduced from band spectroscopy (15 pages) leading to the calculation of explosion pressures temperatures and flame volumes (64 pages) are welcome summaries of mathematical and experimental work on difficult subjects

A short discussion of problems in technical combustion processes (29 pages) is confined almost entirely to those of internal combustion engines perhaps because the most interesting theoretical problem in technical combustion processes is that of knock in these engines

Some useful appendixes contain tabulated data on the energy contents of gases up to flame temperatures equilibrium constants of various reactions in flames heats of combustion and of other flame reactions limits of inflammability and flame temperatures

The book appeals to the reviewer as on the whole a well balanced account of modern work on flame If not unnaturally it may seem to give relatively somewhat great attention to American work most readers will nevertheless be grateful for the concise way in which the more intricate parts of the subject are expounded and co ordinated

H F COWARD

Organisms and the Earth

The Origin of Life

By A I Oparin Translation with Annotations by Prof Sergius Morgulis Pp x+270 (New York The Macmillan Company 1938) 8*s* 6*d* net

THIS book falls into three distinct parts the history of ideas on the origin of life geochemistry and the author s picture of a possible mode of development of organisms The historical part is reasonably complete and is suitably garnished with quotations from Engels but it is spoilt by occasional lapses of which it is very unlikely that Engels or his immediate followers would have been guilty A reader of the book will realize that the following sentence is no more ridiculous when taken out of its context than it was when in it No matter how minute the ultramicrobes are if they are living organisms they must be endowed with a definite and complex organisation which makes it possible for them to perform a number of vital functions

In the section on geochemistry a picture is presented of the composition of the earth s surface layer when there was nothing on it that could conceivably be described as living We have long been accustomed to the idea that the earliest forms of life were strictly anaerobic and that atmospheric oxygen is a biological product made chiefly by the green plants Oparin carries these ideas a stage further and maintains that the primitive atmosphere contained neither carbon dioxide nor nitrogen and that carbon was present on the surface of the earth either in the elementary form or as hydrocarbons The well known fact that volcanic gases contain carbon dioxide is interpreted as a present day phenomenon due to the descent of carbonate containing metamorphic rocks into the earth s interior

The third section will probably be found the least satisfactory by those readers who do not feel that any hypothesis is preferable to a suspension of judgment In it the chemical and colloid chemical processes which might be expected to take place in an environment consisting largely of hydrogen water ammonia hydrogen sulphide and an extensive range of hydrocarbons are discussed In this discussion plausible mechanisms are put forward for the origin of relatively complex molecules similar to those now found in biological material The resulting pabulum will naturally accumulate century by century until in parts its complexity becomes sufficient for colloidal phenomena to play a part and it is in a system of partially miscible liquids that the origin of life is envisaged It is possible that Oparin has taken rather too seriously Hopkins s epigrammatic description of the cell as a dynamic equilibrium in a polyphasic system

The most important idea put forward in this book is the heterotrophic character of primitive living forms It is argued that the autotrophic organisms developed from these primitive heterotrophic forms when the latter had used up so much of the available complex material that a new mode of metabolism began to have survival value The process would then continue in the manner generally assumed with the formation of free oxygen by the photosynthetic autotrophes and lead finally to the evolution of oxygen using organisms

The book is stimulating instructive and so far as the reviewer is competent to judge reasonably accurate over matters of fact The title page would have been more descriptive of the contents if it had included as a sub title Dr Oparin s answers to a scientific general knowledge paper

N W P

Symbolic Logic and the Philosophy of Science

(1) An Introduction to Symbolic Logic

By Sussanne K Langer Pp 363 (London George Allen and Unwin Ltd 1937) 12*s* 6*d* net

(2) Grundzüge der theoretischen Logik

Von Prof D Hilbert und W Ackermann (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berucksichtigung der Anwendungsgebiete Band 27) Zweite verbesserte Auflage Pp viii+134 (Berlin Julius Springer 1938) 10 80 gold marks

(3) An Introduction to the Philosophy of Science

By Prof A Cornelius Benjamin Pp xvi+469 (New York The Macmillan Co 1937) 16*s* net

(4) Die Bedeutung der Modernen Physik für die Theorie der Erkenntnis

Von Dr Grete Hermann Dr F May und Dr Th Vogel Pp viii+210 (Leipzig S Hirzel 1937) 6 50 gold marks

(1) A KNOWLEDGE of the techniques of symbolic logic is now almost essential for an appreciation of modern philosophical thought with its increasing dependence upon purely formal studies such as mathematical logic semantics and the like This introduction to the subject by the tutor in philosophy in Radcliffe College which as the author justly claims is the first of its kind is therefore particularly welcome especially as it is designed for students who are often puzzled by the seeming unrelatedness of the different branches of the subject and by the varying terminologies used

The book is planned to show the connexions between the different branches of the subject and is built around the two great achievements in symbolic logic—that masterpiece in logistics represented by the Principia Mathematica of Whitehead and Russell and the Boole Schroeder algebra It is both a text book with numerous exercises to train the student in the manipulation of symbols and an essay on these forms of logic

Thus anyone who masters the material provided in the book will be well equipped to pursue the subject further for himself in one or more of the special branches Furthermore since the author lays special emphasis upon the principles of logical construction the possibilities and limits of formalization the fundamental types of formulæ and the difference between fertile and sterile ideas the student should also be in a position to understand the epistemological problems which arise in the contemporary philosophy of science

(2) The main structure of Hilbert and Ackermann s work on theoretical logic has been retained in the second edition which appears now after an interval of ten years In the meantime the first volume of a comprehensive work in which Hilbert and his other collaborator Bernays have

applied the logical calculus in an attempt to achieve non contradiction in the foundations of mathematics has been published

The principal alterations and improvements in the present edition of the work under review, which are consequent upon advances made in the subject during the past few years, begin in the third chapter Here the rules of derivation for the functional calculus which were not formulated with sufficient precision in the earlier edition are re stated Further, since an exposition of the so called branched theory of types of Whitehead and Russell seemed no longer necessary, in view of the fact that it has become almost universally abandoned to day Chapter iv has been considerably shortened On the other hand the section dealing with the construction of the calculus of predicates of the second type and of the calculus of types itself has been both improved and rounded off The terminology of the whole treatise has been altered to conform to that of the larger work of Hilbert and Bernays Thus for example the expression 'functional calculus' has been replaced everywhere by calculus of predicates', and in accordance with current logistical terminology, the terms logical sum' and 'logical product' changed to 'conjunction and 'disjunction' respectively

(3) In this ample philosophical treatise, which is modestly termed an introduction' to a new discipline that is alternatively called philosophy of science, logic of science science of science and metaphysics of science Prof Benjamin divides his subject matter, or problems into three sections He considers the task of the philosophy of science to be, in the first place, the ascertainment of the limits of the special sciences, of their integrations with one another and of their implications in so far as these contribute to a theory of the universe or to some pervasive part of it Examination of the method of science constitutes the second part of the task and a clarification of the basic concepts and postulates of science to reveal the fundamental empirical grounds (or absence of grounds) on which they rest, the third

Thus in Part 1 of the treatise, Prof Benjamin examines such problems as logical structure, the nature of symbols perception, descriptive techniques, descriptive science and the theories of concepts represented by empiricism, operationalism, constructionalism, logical positivism and so on In Part 2 he deals with problems in the analysis of the concepts of science—number, quantity, space, time, motion, etc , and finally, in Part 3, he discusses such speculative problems as human freedom and the nature of reality He emphasizes the necessity of recognizing that the latter are dependent upon the more critical problems, and considers it fortunate that in recent years the attention of investigators has been directed principally to problems of formal logic and to those of the foundations and inter relations of the sciences He further points out, that the distinction between a general text book of the philosophy of science of this kind and an introduction to philosophy by way of the sciences, lies in the fact that the latter pays more attention to the subject matter than does this book which attempts to acquaint the student with the foundations rather than with the facts of science

(4) In awarding the Richard Avenarius Prize of 1936 jointly to the authors of these three essays on the significance of the quantum and field theories of modern physics for the theory of knowledge, the Saxon Academy of Science was influenced by fertility and originality in the ideas expressed rather than by unanimity in the conclusions Nevertheless although the treatment of the subject is different in each case, there is great similarity in the conclusions

In the first essay Dr Grete Hermann of Bremen, examines all the epistemological implications of the results achieved in modern quantum mechanics and field theories and comes to the conclusion that the only rejection required by the new theories as distinguished from classical physics and mechanics is the claim to absoluteness Further that the whole investigation of Nature from the point of view of the new theories is characterized by the renunciation of a perceptual model of any adequacy

The second thesis, by Dr May, of Gottingen, is the longest of the three, and is richer in historical and philosophical detail as well as in criticism of contemporary tendencies—logical positivism, etc —than either of the others But his researches also lead him to the conclusion that the quantum and field theories of modern physics have virtually no effect upon the theory of knowledge when the latter is considered as the science of the foundations of knowledge So far as the problem of 'rationality' as a result of the apparent renunciation by physics of the principle of causality is concerned, Dr May maintains that the relations between quantum theory and the theory of knowledge are artificially obtained by identifying causality with the ability to predict events He shows at length that logical positivism, inasmuch as it considers all *a priori* knowledge to be tautological and all that is qualitative to be merely subjective, cannot base its conclusions upon the results of mathematical physics, which admits eliminating the *a priori* deliberately, and is therefore not in a position to make any statements concerning that which it eliminates.

Radical positivism is far more concerned with practice and experiment than with knowledge and is equivalent to a calculus whereby future events in the realm of the inorganic can be predicted and whereby knowledge—as admitted by the Vienna circle—is identified with control of Nature But in Dr May s opinion knowledge is more than the logical framework of a mathematics of matter and philosophy must not degenerate into an ancilla mathematicorum

Dr Vogel of Bad Nauheim who approaches the subject from the point of view of language and philosophy considers that every advance in knowledge necessarily changes the concept of knowledge Hence the difficulty in determining epistemologically the nature of objective reality The concept reality does not belong to science at all—it lies beyond limits science from outside and changes as the frontiers of science extend But Dr Vogel thinks that in its basic structure the nature of reality will always be determined by direct experience of the surrounding world (without its ever being possible to determine exactly in what this fundamental structure consists) The thing to remember and reject is the belief—held by most practising physicists—that abstract calculi constitute the whole of science especially as the most essential feature namely the relationship between abstract quantities and experimental science can never be expressed in a calculus at all Quantum mechanics is responsible for the discovery that conditions exist which must be altered by man before he can observe them So that all we can say is that absolute knowledge does not appear to exist To which we might perhaps add the qualifying reflection that it may some day become possible to include this fact itself in an extended and more adequate theory of knowledge

AMETHE VON ZEPPELIN

Essays in Heredity

(1) The Study of Heredity

By E B Ford (The Home University Library of Modern Knowledge) Pp 256 (London Thornton Butterworth Ltd 1938) 2*s* 6*d* net

(2) The Measurement of Linkage in Heredity

By Dr K Mather (Methuen s Monographs on Biological Subjects) Pp ix+132 (London Methuen and Co Ltd 1938) 4*s* 6*d* net

THESE two competently designed books illustrate in their different ways the wide field covered by genetics They will go far to counteract the erroneous impression now prevalent that genetics is primarily composed of cytological and mathematical complexities The books obviously reflect the fact that they are written by well known practising geneticists

(1) The Study of Heredity' is designed to give an outline of modern thought on variation selection sex mimicry human genetics the species concept and other subjects concerning which many exaggerated views exist in popular imagination By describing the way in which genetical knowledge has evolved and by developing the main theme of the gene concept Mr Ford has effectively put such subjects as evolution sex and origin of variation in their proper place For those who have not had the advantage of dissecting pregnant mice (p 243) the essay well documented with facts will provide an excellent introduction to the recent knowledge of heredity It is unfortunate that the author repeats the fallacious story of the influence of temperature on red flowered *Primula sinensis* the red flowered variety does not turn white at high temperatures as is generally supposed

(2) Dr Mather s book fills a long felt want of practising geneticists who feel insecure in using statistical methods While the statistical material is fully dealt with the nature of biological experiments is always fully realized Quite frequently it is necessary to discover the significance of segregation ratios to measure linkage and to combine the results from different families Dr Mather supplies suitable statistical methods well illustrated by examples which exceptionally for a statistical book are fully worked out Novel methods resulting from the properties of the χ^2 function are provided for the measurement of heterogeneity and to meet the difficulties due to disturbed segregation ratios Finally a chapter is devoted to statistical methods for the genetical analysis of the refractory material of man The tables provided enable one to carry out all the more usual computations for genetical experimentation The non mathematical reader should be able to extract much help from this clearly written book which begins with elementary facts and carries the reader to an advanced stage in statistical methods for genetical work

F W SANSOME

Frequency Curves and Correlation

By W Palin Elderton Third edition Pp xi+271 (Cambridge At the University Press, 1938) 12s 6d net

FREQUENCY curves, correlation and sampling together form a subject in which a great deal still remains to be done, notwithstanding the progress that has been made in recent years Much of the work is necessarily highly mathematical, especially where certain small samples are concerned or where mathematical expressions for skew correlation surfaces have to be discovered These aspects lie outside the scope of the present work, but as the author says, there are few subjects which offer greater opportunity for research Prof Karl Pearson and his school have been responsible for an immense amount of the work that has resulted in practical success, and only those who have studied Prof Pearson's original work are in a position to appreciate the greatness of his contribution to statistical science In this book, the author shows that actuarial statistics can be investigated in the same way as the statistics of biology, anthropology or sociology

The advantages of any system of curves depends on the simplicity of the formulæ and on the number of classes of observations which can be dealt with satisfactorily For a complicated expression is no great improvement on the original groups of statistics and if it breaks down the statistician is left in great difficulties Furthermore if a formula be recognized as a suitable one, there must be some method of finding the arithmetical constants which will produce a good agreement in the particular case Such a method if it is to be of practical use must be simple reliable and capable of systematic application This is all the more important, inasmuch as in practice the advantages of systematic treatment are often overlooked and formulæ which have no scientific basis and no connexion with others suitable in similar cases are used in haphazard fashion by many statisticians

In this, the third edition of the book, some chapters—notably those on standard errors, the test of goodness of fit and on the correlation ratio contingency—have been re written The notation for moments has been retained Here, the author treats the 'adjusted statistical moment' as identical with the 'theoretical moment For although some writers find it convenient to use distinct symbols for the two expressions in practical curve fitting they are equated

Dictionary of Scientific Terms

as used in the various Sciences By C M Beadnell (The Thinker's Library, No 65) Pp x+235 (London Watts and Co, 1938) 1s net Library edition, 5s net

ONE result of the twentieth century inclusion of science as a general part of the school curriculum has been the greater interest shown by the reading public in popular scientific literature This interest is probably most lively in biological subjects, and Surgeon Admiral Beadnell has therefore done wisely in giving a preponderance to biological terms in his attractive little dictionary Intended for the layman, the book is as non technical as the subject permits, and many of the definitions are notable examples of conciseness and perspicuousness It would, of course, be easy to make a long list of omissions, but Admiral Beadnell has shown a sound judgment in deciding what to put in and what to leave out, and only a curmudgeon could grumble at the quality and quantity of his shillingsworth

Many readers will regret the complete absence of etymologies, but it is doubtful whether the man in the street—for whose assistance it must be remembered the book was written—will share this view The standard of accuracy is usually high, and though there are occasional slips, they are much less frequent than one might have expected in such an arduous single handed effort The author is to be congratulated upon having accomplished a very useful service to the scientific education of the layman, and his book deserves to have a wide sale A word of praise must be given to the publishers for producing the dictionary so well and at a price which brings it within the reach of even the most impecunious lover of natural philosophy The library edition is on thicker paper and is handsomely bound

The Cultivation of Mushrooms

By Dr W F Bewley and J Harnett Second edition, revised and enlarged Pp 95+18 plates (London Anglo Scottish Press Ltd, 1938) 3s 6d net

THIS second edition is a considerable extension of the first edition published four years ago The authors are well known authorities on the cultivation of mushrooms, and they have made not only commercial cultivators of this plant but also botanists in general indebted to them for a coherent and very practical account of all the processes involved from beginning to end

It is difficult to imagine any query arising in connexion with the cultivation of the mushroom which remains unanswered in these pages Apart from details of cultivation, diseases and pests and even cooking recipes are considered The book is written in a pleasing style, and is illustrated by a few line diagrams and about forty excellent photographs

Organic Chemistry:

a Textbook for Science and Medical Students By Dr Frederick Prescott and Dudley Ridge Pp viii+688 (London University Tutorial Press, Ltd, 1938) 8s 6d

THIS book claims to cover the organic chemistry required by second year medical students and by students reading for a general B Sc degree, the claim is not exaggerated The wants of the former are met by sections on carbohydrates, ureides and purines, proteins and fermentation and enzyme action which occupy nearly a hundred pages, and other sections having physiological bearings deal with hydro aromatic compounds (terpenes, sterols, etc), indole derivatives and the alkaloids

The remarks on modern theories of valency (pp 29–35) may need modification in a future edition, since views change so rapidly

The R.R.S *Research*

FURTHER information is now available about the progress in the construction of the R R S *Research* It may be recalled that the purpose of this vessel is primarily the determination of the magnetic elements at sea work that was formerly undertaken by the S S *Carnegie* a non magnetic ship operated by the Carnegie Institution of Washington The *Carnegie* was unfortunately destroyed by fire after an explosion when loading petrol at Samoa nine years ago During the intervening period the magnetic data in certain parts of the oceans have become uncertain it is known that in some areas there have been considerable changes in the secular variations of the magnetic elements which are not adequately controlled by recent observations In certain areas existing charts of the magnetic declination may be in error by four or five degrees It is fitting that Great Britain as the principal maritime nation should accept the responsibility for the work formerly undertaken by the Carnegie Institution by constructing and operating a non magnetic ship

As in the case of the *Carnegie* the work of the *Research* will not be restricted to terrestrial magnetism Certain work in meteorology atmospheric electricity and oceanography will also be included

The construction of the *Research* which was authorized more than three years ago has taken longer than that of a normal ship The greatest care is being taken to eliminate so far as is possible and practicable all ferrous material from the hull machinery and stores The construction of a vessel of so specialized a nature necessarily gives rise to many problems The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has placed all the information obtained from the *Carnegie* freely at the disposal of the British Admiralty This generous co operation should greatly help to ensure the success of the *Research*

The new non magnetic ship will be larger than the *Carnegie* Her loaded displacement will be 770 tons the length on the water line being 142 ft 6 in The hull is being constructed of teak planks on brass frames subdivided by eight water tight bulkheads and will be copper sheathed The keel stem and stern posts are of teak and the false keel is of Canadian rock elm The ship will have two masts and will be rigged as a brigantine with a full sail area of about 12 000 sq ft Diesel oil engines of 160 B H P four cylinder two-stroke direct air reversing type situated aft driving a two bladed feathering propeller will give an endurance of 3 000 miles with a fuel supply of 14 tons of heavy oil Much research work was carried out by the makers Messrs Petters of Yeovil to reduce the quantity of steel in the engines to a minimum A bronze alloy is being used extensively and the crank shaft is of special non magnetic steel The anchors cables and wire for rigging are of aluminium bronze

The auxiliary machinery comprises two 9 H P and one 18 H P Diesel engines for the dynamos refrigerator air compressor and oceanographical winch The latter will be driven from the auxiliary engines through line shafting and a fluid flywheel

In order to reduce magnetic material to a minimum consideration is being given to such matters as iron nails in packing cases tin containers for food and cigarettes cooking utensils cutlery razor blades drums for paint and lubricating oil and typewriter all of which will be non magnetic Water (37½ tons) will be carried in specially designed teak tanks and there will be 120 cubic feet of cold storage

The upper deck will carry two magnetic observatories an atmospheric electricity laboratory and an oceanographical laboratory The marine deflector for the determination of the horizontal intensity of the earth s magnetic field will be housed in the forward magnetic observatory this instrument is a semi absolute instrument the instrumental constant being controlled by land observations as frequently as possible The marine collimating compass for the determination of the magnetic declination will be placed on the bridge deck above the chart room The after magnetic observatory will contain the marine earth inductor which will be driven at a constant speed by a rotary converter controlled by tuning fork the inductor will be provided with commutator and slip rings so that observations may be made using either a direct current or a string galvanometer A C I W magnetometer earth inductor and a Smith portable magnetometer will be carried for land observations and for comparison with the instruments at fixed observatories

The atmospheric electricity laboratory will be situated immediately forward of the aft magnetic observatory A potential gradient recorder and a point discharge apparatus will be carried The potential gradient observations will be standardized by a Wulf electrometer In addition, ionization measurements will be made with a modified Ebert apparatus and conductivity measurements will be made with a modified Wilson apparatus

The meteorological equipment will include thermometer screen with thermometers mercury barometer aneroid and barograph mercury in steel thermographs for dry and wet bulb temperatures and for sea temperatures an Assmann psychrometer and an Aitken nucleus counter

An oceanographical laboratory will be provided aft of the aft magnetic observatory Echo sounding apparatus will be carried

It is expected that the *Research* will be launched in February 1939 and will be ready for her first cruise in the following October She will carry six officers four scientific workers and twenty two petty officers and men On her first cruise she will first visit Washington in recognition of the assistance given by the Carnegie Institution after calling at the South American ports she will cross the Atlantic and make observations in an area in the South Atlantic between and south of Tristan da Cunha and Cape Town In this area there has been a large decrease in recent years in the secular change of the magnetic declination The *Research* will then make a double traverse of the Indian Ocean first on approximately a great circle track to Perth and then returning on a more northerly track calling at Cocos Island Colombo Seychelles Mauritius and Durban where she is due to arrive about November 1940 The subsequent course has not been decided upon in detail but may include a third crossing of the Indian Ocean and a return via the Pacific and the Panama Canal The Indian Ocean will be the area to be the most completely observed on the first cruise since it is in this area that there is the greatest uncertainty in the magnetic data

H S J

Eye and Brain as Factors in Visual Perception*

By Dr R H Thouless

THAT we see with our eyes is known to everyone and has been known for a long time That we see also with our brains is less generally realized and the implications of this fact are relatively recent importations into the theory of vision The full statement of the physiological mechanism of vision would include not only the sensitive retinal surface and the visual areas of the cortex but also the whole system which includes retina optic nerve visual area of the cerebral cortex and other sensory areas of the brain as well

TRANSMISSION THEORY OF VISION

It is possible of course to study vision in such a way that everything except the activity of the retina is neglected altogether or relegated to a secondary position and it was in this way that the scientific study of vision began This is the point of view which we find in the work of Helmholtz and in much of the experimental research into vision which has followed his deservedly great authority The basic assumption is that the essential process of vision is the formation of an optical image on the retina and its transmission to the visual centres of the brain by means of the optic nerve Differences between the sensations transmitted to the brain and the finished perception which appears in experience were attributed to the action of the higher processes of judgment and the influence of past experience

This theory of vision which we may call the transmission theory has behind it not only the weight of the authority of the great originators of the experimental study of vision it has also the advantage of being the view of the man in the street Its truth seems to many to be so axiomatic that its denial may have the appearance of wilful paradox

It is nevertheless now clear that the transmission theory is wrong and that a wholly different way of approaching the problems of visual perception is necessary if we are not to be led astray To say this is not to deny the greatness of the achievements of those investigators in the past whose work on vision was guided by this theory Within a certain limited field it proved itself a fruitful guide to research This field was that of the sensory physiology of the retina If we wish to discover what is happening on the retina we must arrange conditions of experiment so as to cut out so far as possible the complicating effects of the cerebral components of the visual part of the nervous system This was what was done when the early experimenters made observations through tubes or on black backgrounds So such workers as Helmholtz König Abney and a host of others made a firm foundation for a science of vision in the sensory physiology of the retina The error however has sometimes been made of mistaking the foundations for the completed building When we get rid of tubes and black backgrounds and open both eyes to look at objects surrounded by other objects we find that what we see follows other and far more complicated principles than the laws of sensory physiology

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* From the presidential address to Section J (Psychology) of the British Association delivered at Cambridge on Aug 19

AN ALTERNATIVE WAY OF TREATING VISUAL PERCEPTION

We place on a table an elliptical object with its long axis pointing directly to and from the observer If his head is directly above the object it will of course look elliptical If now he moves his head from the position directly above but still keeping it in the vertical plane passing through the long axis the object will at first still look elliptical but with a smaller apparent elongation than when it is viewed from directly above If the head is now lowered but still kept in the same plane the apparent shape of the object becomes nearer and nearer to a circle It then becomes truly circular and if the head is still further lowered the object appears elliptical again only now with the really longer axis apparently the shorter

So far everything appears to be as one would predict on the transmission theory by the elementary principles of perspective Measurement of the actual angles at which these various appearances are found reveals however a considerable discrepancy from the expectations aroused by the transmission theory At the height for example at which the ellipse looks circular it is found that the retinal image is not of a circle but of an ellipse with the vertical axis much shorter than the horizontal that is an ellipse flattened in the opposite direction It is as if the shape that is seen (the phenomenal shape) is in between the real physical shape of the ellipse and the shape that is projected on the retina (which we may call the stimulus shape) The expectation on the transmission theory would be that the stimulus shape and the phenomenal shape would be identical Plainly they are not and the discrepancy is large enough to show clearly without any great refinement of measurement

We are led from consideration of this experiment to the same conclusion as was arrived at by Werthiemer as a result of his experiment on phi movement that the sensation corresponding to the conditions of local retinal stimulation as an element in a complex perception is a mere fiction Although it is clear that the conditions of local retinal stimulation affect the resultant perception we can find no trace of evidence that they do so by being transmitted to the brain as sensations

The transmission theory is easily intelligible because it can without difficulty be explained by a physical analogy Photographs might be transmitted telegraphically by forming an image on a plate made up of a large number of small photoelectric cells each of which is connected by a wire with a corresponding reproducing cell at the other end This is not of course the method actually used for the telegraphic transmission of photographs but it is physically a possible one If the receiving electric cells are replaced by the retinal organs the transmitting wires by the fibres of the optic nerve and the reproducing cells by the nerve cells of the visual centres of the cerebral cortex we have a perfect analogy to the physiological process of vision on the transmission theory

Yet this advantage of simplicity and easy intelligibility must be given up if the transmission theory does not fit the facts We have so far criticized it only in connexion with one experiment Perhaps this will be a convenient place to summarize the whole case against it

First there is a physiological difficulty as to the mechanism of transmission Such a method of transmission as is suggested by the above analogy would require a number of wires equal to that of the receiving cells This condition is not fulfilled by the visual system since the number of retinal end organs is two hundred times as great as the number of fibres in the optic nerve

Secondly a breach in the transmitting part of such a system would lead to a corresponding gap in the received picture This expectation is not fulfilled in vision We might explain away on the transmission theory the fact that we do not see a gap in the part of the monocular visual field corresponding to the blind spot but Fuchs has shown that similar completion may take place over a blind area of the retina caused by an acquired destruction of part of the optic nerve

Thirdly if this theory were true it would be necessary that differences in the picture at the sending and at the transmitting end should always accompany one another The experiment already discussed has given one example of that not being the case since the impression of a circular shape may be given either by the circular retinal image given by a circular object at right angles to the line of vision or by a retinal image which is a flattened ellipse if this is made by an object which is itself an elongated ellipse viewed at a suitable angle of inclination

There are plenty of other examples of this in visual perception indeed except in those conditions of simplified perception which were characteristic of the early investigation of visual sensations exact correspondence between the details of the retinal image and of what is perceived is the exception rather than the rule In Rubin s reversible figures for example we may have a pattern which is seen either as a row of black T s on a white ground or as a row of white fleurs de lys on a black background Thus we have a single stimulus pattern on the retina giving rise to two wholly different perceptions The after image of a circle moreover, will look large or small as it is projected on to a far or a near object respectively although the area of retinal activity remains unchanged If a subject seated below the object glass of a projection lantern looks at a picture projected on to an inclined screen, he sees the picture as distorted, although it is easy to demonstrate that his retinal image is identical with that which he would have received if the screen had been at right angles to his line of vision

Such facts as these are not easily reconcilable with the theory of simple transmission of a retinal picture to the brain That there is a close relationship between the condition of physiological stimulation of the retina and of the resulting pattern of visual perception is, of course, obvious and is denied by nobody but the relationship may not be of the kind suggested by the analogy with telegraphic transmission

A better analogy for the modern view of perception is I suggest the construction of one of the charts published with weather forecasts The lines of equal pressure on the charts are constructed from information received from various land stations and ships, just as the perceptual picture constructed by central activity depends on information received from the sense organs If no information as to barometric pressure is received from a certain area, this does not mean that the corresponding area must be left blank, but that the person constructing the chart must fill it up by guess work which he generally does by constructing smooth curves consistent with the other information In the same way, in Fuchs's experiments, it was found that central perceptual activity tended to fill in areas from which no information was received from the retina by simple completions providing good continuation' with the figure received on the rest of the retina

The analogy of the construction of a weather chart suggests a possible way of looking at the process of visual perception which is alternative to the transmission theory and which, I think, gives a much better account of the experimental facts It regards the mind (or the brain acting to some extent as a unitary whole) as active in perception, responding to information given by the sense organs and not merely reproducing a pattern of stimulation from the sense organs

INDIVIDUAL DIFFERENCES IN VISUAL PERCEPTION

Let us now return to the experiment with the inclined ellipse to note a particular feature in it which is, I think, a characteristic of the perceptual processes that has often been ignored This feature is the wide range of individual differences Apart from such obvious differences as errors of refraction, colour blindness, etc , the optical system of different individuals' eyes and consequently the conditions of local physiological stimulation on the retina for a given arrangement of external objects is very much the same The perceptual responses of different individuals are however, widely different, so that any two of us in the same physical surroundings may create from them a very different phenomenal world

If two or three people perform the experiment I have just described, we shall find that the height at which they say the apparent shape of the inclined ellipse is circular is different to an almost incredible extent One may see the ellipse as circular when his head is only a few inches from the table so that his retinal image is of a very much flattened ellipse, while another sees the ellipse as circular when he is looking well down on it, so that his retinal image is itself not very far from circularity The first individual shows a very great effect of the real shape of the ellipse in determining its apparent shape, the second shows a relatively smaller effect of the real shape on apparent shape

That these are real individual differences and not merely accidental variations in measurement is shown by the fact that they show great consistency from one time to another I once retested, after an interval of two years, a group of twenty five subjects for each of whom I had measured the apparent shape of an inclined object They differed widely amongst themselves at each test, but the agreement between the two sets of tests was extraordinarily high The coefficient of correlation was 0 92, which is as high as one expects to get in psychological measurements

There are, then, genuine and large individual differences between different persons in the apparent shapes of inclined objects We may add that there are similar individual differences in the apparent sizes of objects at different distances and of the apparent whiteness of objects under different illuminations In both of these cases, the same general law holds If an object is moved to twice its previous distance from our eyes, it does not look half its previous size It may, for different individuals, look threequarters of its previous size or nineteen twentieths With rare exceptions (which I shall mention later) the law holds that the apparent size is in between the retinal size and the real size In the same way, if a piece of white paper is put into shadow so that it reflects less light to the eyes than a brightly lighted piece of black paper, it does not necessarily look less white than the black paper, although it may do so if the shadow is very deep The seen whiteness is in between the real whiteness and the stimulus intensity of the retinal image Again in this tendency to see objects in their real whiteness irrespective of illumination we find wide individual differences I have suggested that we should call these effects the tendency to phenomenal regression to the real characters of objects

If we test a group of subjects in their tendency to phenomenal regression for shape for size and for whiteness we find that those who have a large tendency to see the real size of an object tend also to have a large tendency to see the real shape and the real whiteness The correlations between these tendencies are about 0 6 which shows that they have a considerable factor in common We can thus speak of individuals as having high phenomenal regression if their perceptions of apparent shape size and whiteness are largely determined by the real characters of the objects looked at while those whose perceptions are determined relatively more by the conditions of retinal stimulation (that is who see objects getting much smaller as they go farther away and so on) we shall describe as those of low phenomenal regression

Practical Consequences

It may be asked whether the kind of thing we have been talking about has any practical importance It certainly may have We test for such differences in the sensory physiology of the eye as colour blindness because they may lead to practically important incapacities and it is very likely that individual differences in the cerebral side of perception may also affect an individual s practical capacities Some years ago I suggested that a person of high phenomenal regression might be expected to drive a car more easily through traffic than one with low He sees a gap in the traffic in something near its real size before he drives up to it whereas the person with low phenomenal regression sees it as smaller than it really is when it is at a distance Neither of course adjusts his driving to the apparent size of the gap both must make a judgment as to its real size The person with low phenomenal regression has however a much larger gulf between appearance and reality to bridge by means of judgment Judgment being a slower and more uncertain process than perception he may be expected to drive through gaps with more difficulty and less certainty than the individual who can trust to his immediate impression of size The individual with high phenomenal regression may therefore be expected to drive more easily and better through traffic This prediction appears to have been justified by a research in motor car driving by the National Institute of Industrial Psychology when it was found that a test of phenomenal regression showed a correlation with driving ability

The effect of drugs on individual organization of phenomenal space is an interesting problem I have made only preliminary experiments on one subject in the hope that someone better equipped to experiment on drugs will take the inquiry further The indication I obtained was that (as might be expected) alcohol decreased phenomenal regression while caffeine increased it I think that it might be worth while for those investigating the effect of alcohol on motor car driving to consider the possibility of disturbance of spatial perception as well as of speed of motor responses That a change of spatial organization can affect driving I am sure from personal experience I was driving one night towards Buxton suffering from the effects not of alcohol but of fatigue (which probably affects spatial organization in the same way as alcohol) At one point I found my perception of the road so much disturbed that I had to stop my car and get out The road seemed to narrow almost to a point in front of me I seemed to be driving not on a parallel sided track but into a funnel I recognize the condition now as one of extreme reduction of phenomenal regression One result of this condition was an almost irresistible impulse to drive in the centre of the road A persistent tendency to drive on the crown of the road is a common fault I suggest it may be a fault characteristic of an individual with low phenomenal regression and that if this were proved to be its origin an understanding by the driver of the cause of his fault would put him into the way of correcting it

Conclusion

The change that has taken place in the psychological study of vision during the last twenty five years may be expressed in a summary way as a change from the time when it was treated as if vision were a function of the eye alone to a time when the eye and higher centres are regarded as co operating in visual perception The psychology of vision is not and cannot be merely the sensory physiology of the eye At the present time these wider aspects of visual perception offer a more fruitful field of research than do those of sensory physiology which have been so adequately dealt with in the past Particularly I should like to suggest that individual differences in visual perception and the statistical study of these differences is a field the surface of which has scarcely yet been scratched Let us hope that in the next twenty five years psychologists may be as successful in resolving the many remaining problems of visual perception as were the great Helmholtz and his contemporaries in making a scientific study of the sensory physiology of the eye

Contacts of Science with Social Problems

By Prof G A. Boutry, Directeur du Laboratoire d'Essai, Paris

PROSPEROUS States and societies are in a state of statistical equilibrium somewhat comparable for the purposes of argument to the state attained at the end of a limited chemical reaction If we consider our present civilization such a stable state seems to exist no longer and the departure from moving equilibrium must indeed be large since everybody agrees about its existence That one of the causes of this new—and uncomfortable—state of things is to be found in the ever accelerated industrial and scientific development or rather in the social sentimental and ethical aspects of our world lagging behind that development few people would now care to deny

This means that science—the word is here used to signify the natural sciences—has slowly come to have a social and *political* importance of the first magnitude There is no reason to insist upon this idea which has been often stated and discussed in NATURE A century ago politics and science had only a nodding acquaintance the influence of the second on the first has since grown more and more powerful more and more *direct* until at last a development which could have been foreseen so early as the beginning of this century has taken place Men in various countries speaking severally have claimed in the name of science a share in the ruling of nations This claim—which has had its echo in the columns of the present journal—is far reaching and important enough to attract study

Common sense points out that Science being only a spiritual construction made up of countless sheets of thought laid up and sealed by countless dead or living men has no separate and discrete existence no personality no will and no power to act Scientists being men possess those properties men who are not scientists also do Therefore when we hear someone speaking in the name of science about political matters three possibilities are to be considered namely (1) the speaker is a politician influenced by scientific ideas (2) the speaker is a scientist influenced by political or non scientific ideas (3) the speaker is a scientist interested in a new field of application

In the first instance by the term politician influenced by scientific ideas we allude to those men whose speech has caught the knack of scientific wording but whose minds continue to run along the well worn political grooves The political language has a marvellous way of generalizing and distorting ideas principles and laws We have seen during recent years outstanding examples of such a technique and the world is teeming with such attempts Racism is nothing else than a provocative distortion and generalization of well known biological results yet it seems to have become powerful enough to rule a great nation Another and much older example of the curious sentimental reactions and upheavals which a badly understood scientific theory may originate is to be found in the anti Darwinist movement in the United States which so I am told is still discussed there from a religious point of view It is unnecessary to give more historical examples of this kind they are well enough known These contacts between misunderstood science and politics are not the principal object of the present paper Indeed they would be dismissed with contempt if their advent was not in itself a danger to science a risk of creating in the mind of men uncalculated aversion for the innocent techniques thus misunderstood or misapplied

Far more interesting is the same claim when it is made by real scientific workers It is not intended here to contest the principle that if a little more scientific thinking were used in the ruling of countries some blunders would be avoided and some progress made What has to be considered is the claim as to a proposed scientific experiment and treating it as such to find whether that experiment has any limitations (voluntary or otherwise) whether it can be stopped and started again at will whether finally it will endanger in any way the human commonwealth already acquired It is at once evident that caution is necessary the experiments of a mathematician are dangerous only to his paper supply those of a physicist or chemist may raise the roof of his laboratory and reduce him to small particles those of the biologist or pathologist may be fatal to thousands of people What can be said of an experiment in the science of ruling nations ? Wars have shown that mistakes in this art have led to the death of millions and the misery of generations it is conceivable also, that they may be dangerous to the spiritual qualities of mankind since we know next to nothing about this side of things

It follows that great pains must be taken to ascertain that the claim we are considering is pure We have seen Governments making a masquerade of scientific principles Scientific workers being human might do the same and could be infinitely more dangerous since the disguise would be much better worn If a man of science is moved on such a course by purely personal motives or feelings such as money lust of power family politics etc the process is generally petty and cheap as it is in ordinary political life and the activities of the man will cease when he reaches his small goal Very different is the result of a metaphysical bias The mixture of metaphysics of any kind with scientific theories and results is constantly occurring in second rate scientific minds and it is very easy to understand such a mixture leads to single minded pictures of the world generally easy to grasp these appear endowed with absolute fixed immovable properties rules and laws this again is very satisfying to the human mind as creating what one of this school aptly termed a rational religion One is led along such a line of thought to the idea that science rules the world and that no principle of hers may be transgressed by Nature From such a conclusion it is evident that rules of government may be deduced and that further experiments to prove them are unnecessary this is why such schools of thought (which are as old as science itself) are always unable to admit failure if facts disappoint their hopes facts are wrong and if people do people should know better or had better die

The first modern trials at scientific interference of this kind have already happened One born in the United States based upon a misunderstood conception of the principles of thermodynamics was called technocracy Another is slowly developing in the U S S R where the simple creed of Marxism is slowly being replaced by the metaphysic faith known as empirical materialism Another born in France recently of the same principles as the Russian theory can be followed and studied in its rapid growth in the sayings and doings of some well known physicists of that country The 1937 Congress of the Palais de la Découverte afforded in its opening speeches some good examples

From these views it would be gathered that science supreme master is not the servant of men but should be served by them thus new gods are born in fair disguise they are no longer anthropomorphic but they are still man made It is indeed a shattering thought for those who hope in the ultimate progress of humanity to remember that misunderstood Christianity in old days was a foe of science, while a new religion can be now found in the principles of thermodynamics and statistical mechanics It is another shattering thought to reflect that most of the men who fall into such errors are sincere and therefore powerful leaders of men Have we made no moral progress since the spectacular failure of Auguste Comte and of his religion de l humanité ?

Let us now consider the last kind of claim that laid by fair minded men who consider that a new field of application will be shortly opened for scientific thought through the helpless state of most political Governments in this our world Indeed we all feel it is highly desirable and urgent to make a start But we are also convinced that prudence and humility must be the order of the day—rashness and pride would be fatal to this new born cause We must always remember that this application of scientific training reasoning and principles to a field where the work already done is scarce and of a fragmentary character will be the biggest extrapolation that science has ever attempted

It must always be remembered that experiments may fail and while being ready to accept such failures and take them into account we must keep before our mind the fact that social experiments are costly and that failures must be few and far between in ancient days experiments on living men were impossible—they are still rare and difficult so will be experiments on nations Also we must never forget that this new development of science must introduce new variables into its reckoning that it must be human while remaining impersonal that it must build a world not only efficient but also happy From this point of view problems such as that of human liberty (its scope and limitations) sexual relations the fostering and development of intelligence appear as peculiarly dangerous since few more mistakes can be allowed in their treatment Indeed had science only to deal with the financial conduct and foreign relations of nations its task would appear almost light compared with the heavy burden it is now preparing to shoulder It is however certainly high time for the proposed organization of the study of social relations of science to be established and NATURE is to be congratulated since this journal was the first to urge its necessity

[To prevent possible misunderstanding it should be stated that the above article by Prof Boutry was written by him several weeks ago and submitted for publication in NATURE long before the recent Cambridge meeting of the British Association at which it was decided to constitute a new Division of the Association to be concerned with social relationships of science —Editor of NATURE]

News and Views

A Founder of the Institution of Electrical Engineers

ON September 5 occurs the centenary of the birth of Major-General Charles Edmund Webber, who in 1871, with Colonel Sir Francis John Bolton (1831–87), was instrumental in founding the Society of Telegraph Engineers and Electricians, since 1889 the Institution of Electrical Engineers Webber, who was the son of an Irish clergyman, passed through Woolwich Academy and in 1855 received a commission in the Royal Engineers After service in India, he became an instructor in military surveying at Woolwich, and in 1866 was attached to the Prussian Army to report on engineering operations and military telegraphs His knowledge of the latter led to his being lent to the British Post Office in connexion with the organization of the telegraph service, and it was while engaged on this service in 1871 that with Bolton he founded the Society of Telegraph Engineers, of which Sir William Siemens became the first president Bolton was for some time the honorary secretary, while Webber was elected to the presidential chair in 1882 He had just previously, in 1879–80, been through the Zulu War, and in 1881 had served as British Commissioner at the Electrical Exhibition In 1882 and 1884 he again saw active service, this time in Egypt, and in 1885 retired from the army with the rank of major-general. He was afterwards connected with several electricity supply undertakings and was elected a member of the Institution of Civil Engineers, being, it is said, the first military officer to qualify for election He died at Margate on September 23, 1904

Protection from Air Raids

THE scheme of air raid protection prepared by a committee of scientific workers, including Profs J B S. Haldane, J. R. Marrack and J. B Bernal, working in conjunction with engineers and medical men, and recently submitted to the Home Office, presents what may be regarded as a scientific and technical view of the best preparation against the eventuality of air raids The scheme, which is also being placed before the L C.C and all the London Borough Councils, has been prepared at the instance of the Science Commission of the International Peace Campaign and might with advantage be studied by all who take an interest in this matter. Because it combines an important strategic centre containing three main line railway termini, a better-class residential district with many open spaces, and a densely packed working-class area, the Borough of St Pancras was chosen as typical of the conditions to be dealt with and has been made the basis of a typical scheme worked out in broad details. Experience in Spain and China shows that air raids now are of a very different character from those of the Great War and that the civilian population has become a definite objective. The scheme is based on the assumption that all four types of attack—machine guns, gas, incendiary bombs, and high explosive bombs—may be used either separately or in conjunction, and figures are quoted as to the destructive and penetrative powers of these weapons.

THE Commission proposes the evacuation to the country of children up to fourteen years of age, the mothers of infants, people over seventy years of age and the sick and infirm For the rest of the population shelters are proposed, and these take the form of tunnels in the London clay 50 ft below the surface, of inverted U section and lined with steel sheeting. In the design of these, provision has been made for every necessity which it is possible to foresee Some of the suggestions made deserve consideration on the broader ground of their intrinsic value in times of peace, for example, that hospitals should now be built in the country, and that school camps be prepared for children of school age Such a scheme as is here proposed is necessarily of a tentative nature, but the work of the Committee has reached the stage at which its publication is of value to the public and the details of the scheme are sufficiently clear-cut to stimulate criticism, suggestion and discussion which will lead to modifications and improvements Copies of the memorandum can be obtained (price 3*d*) from F J Sander, 85 Beechwood Road, Sanderstead, Surrey

Radcliffe Observatory, Pretoria

NEWS has recently been received from the Corning Glass Co that it has been successful in the third attempt to make a Pyrex disk for the 74-in reflector of the new Radcliffe Observatory, Pretoria. The glass is now being shipped to Newcastle, where grinding and polishing will be commenced immediately by Sir Howard Grubb, Parsons and Co. Meanwhile, work on the site at Pretoria is proceeding satisfactorily, and erection of the turret and the telescope mounting should be completed by the end of this month The turret steelwork is all assembled, including the shutters, and the outer sheeting has been fixed in position. The telescope itself is practically entirely erected, despite some difficulty which was encountered in procuring lifting tackle sufficient for handling the heavier parts, especially for the polar axis, which when fitted with its circles, etc., weighs 16 tons. The tasks now remaining are concerned chiefly with the electrical equipment. Subsidiary apparatus, all of new design, is still under construction in Great Britain. A measuring machine for spectrograms has been finished and has passed thorough tests, a microphotometer is near completion, and work is in active progress on a Cassegrain spectrograph. Dr. T. Dunham, jun., of the Mount Wilson Observatory, is preparing plans in conjunction with the Radcliffe staff for a large spectrograph of very advanced design, which it is hoped will be installed at the coudé focus very soon after the new reflector comes into operation

Biblical Botany at the Hebrew University

STUDY of the flowers of the Bible has just been introduced to the Hebrew University at Jerusalem as a subject for students, who are showing considerable enthusiasm for it. Coupled with biblical botany is the study of Jewish and Arab plant-lore Dr. Ephraim Hareubani is the lecturer, and he brings to his task thirty years of research into the flowers and plants mentioned in holy scripts Together with his wife, also a botanist, he has collected almost all the specimens named and, using Mrs. Hareubani's own methods of preservation, has placed the whole collection in the University's Museum of Biblical Botany. He has identified and classified all the plants of ancient Palestine, Syria and Babylon mentioned in the Bible, the Hebrew Talmud and later Jewish writings. A conspicuous feature of the Museum of Biblical Botany is the fresh-looking appearance of the permanent exhibits which, without pressing or bathing in liquids, seem as though they have just been plucked, and retain their original colour and greenness of stalk. They are displayed in their natural groups in sealed cupboards Among the many curious plants may be mentioned a species of *Capparis*. This blooms, matures and dies in a single day, and, by the exercise of considerable patience and vigilance, Dr. Hareubani has been able to show it in a series of half-hourly stages of growth

STUDY of botany on a scientific plane was first begun in Palestine by Dr. Alexander Eig, late director of the Department of Botany at the Hebrew University. His researches, from 1921 onwards, led him to Syria, Turkey, Kurdistan and the desert tracts, and he built up a comprehensive collection of Near Eastern flora The Palestine plants he classified according to the geographical and climatological types of the world groups (the country comprises two different floral regions), and he published a remarkably detailed phytogeographic map of Palestine. According to Faba Turovlin, broadcasting from the Jerusalem wireless station, "by following Dr. Eig's observations on the subject, the character of any particular district in Palestine may often be learned from the study of its plants, and in some cases from the occurrence of a single plant only". There is now periodically published a *Palestine Journal of Botany*.

Excavation of a Hill Fort in Sussex

THE hill fort or camp at Mount Caburn, near Lewes, which is under excavation by the Brighton and Hove Archæological Society, continues to yield interesting results. The investigations have now revealed the character and constructional history of the ramparts in some detail. According to a report on recent work (*The Times*, August 25), excavations in the upper rampart show that, when first constructed, it was retained by a line of posts and a net palisade. A channel in the chalk indicates the line of the palisade The second stage of the outer rampart, which covered the final period of occupation of the camp, is indicated by the fact that the original rampart was reinforced by a mixture of chalk and black mould Post holes show that the rampart was further strengthened by fresh timbering. On the south side of the gateway a long cut has shown that the inner ditch had been filled up by the slipping of the inner rampart Occupation floors of huts are clearly evident There is no trace of occupation during the neolithic period, but a small piece of bronze has been found.

Archæology and the Unemployed at Oxford

OXFORD, like the Irish States (see NATURE of June 11, p 1041), has made use of measures for the relief of unemployment to further archæological studies. Voluntary labour from the Oxford and Wales camps of the Universities Council for Unemployed Camps has carried out excavations on Farington Clump during two seasons, proving it to be the site of the Adulterine Castles raised by Robert of Gloucester against King Stephen In 1937, excavations were begun on a Romano-British and early Saxon cemetery site at Frilford Here, under the direction of Dr L. H Dudley Buxton, members of a camp near Eynsham, consisting of ninety men from South Wales and twenty-five university men, worked daily on the Romano-British area. They located six graves and established the north-western limits of the cemetery A hoard of thirty coins made it possible to date the site with some precision The Saxon area is of special interest, as it is one of the sites, rare in Britain, which was in continuous occupation during the period of Saxon penetration Excavations are being continued at Frilford and on a site in the north of England The men, some of whom have been out of work for years, showed a ready response, both technically and intellectually, to archæological training, and their interest in the results was keen The three weeks in camp produced a marked improvement in physique Funds for the continuation of this work are urgently needed, especially as the applications from clubs for the unemployed are increasing. Contributions may be sent to the treasurer of the appeal, Mr. J Kelly, 16 Charlbury Road, Oxford

Insulin Treatment of Diabetes

PROF. CHARLES BEST, of Toronto, delivered the twelfth Stephen Paget Memorial Lecture at the annual general meeting of the Research Defence Society on June 9 (*The Fight against Disease*, 26, No. 3; 1938). Prof. Best is the co-discoverer, with Prof. Banting, of the anti-diabetic substance known as 'insulin', now universally used for the treatment of the disease, and the subject of his lecture was "Insulin and Diabetes: The Present Position". The stages in the discovery and preparation of insulin were first outlined, and Prof. Best then described recent modifications—protamine- and protamine-zinc insulins—by the use of which the effect of the dose is prolonged. He next discussed the influence of insulin treatment upon diabetic mortality in Canada where since 1922 insulin has been available for everyone who wished to have it In certain age groups the mortality from diabetes is not coming down it may even be going up because there are now many more diabetics who reach the older age groups When these people die as even the diabetic must the cause of death is usually stated to be diabetes But in the earlier age groups up to fifty years diabetic mortality has markedly declined From 1891 until 1920 before the use of insulin the percentage mortality among diabetics up to 50 years of age remained steadily at about 45 per cent that is nearly half the cases died Since 1922 when insulin began to be used the mortality first steadily declined and for 1929–33 has been about 15 per cent (statistics for Ontario) This great saving of human life as well as of much suffering must be ascribed to experimental work done upon animals and Sir Edward Mellanby in proposing a vote of thanks to the lecturer bewailed the fact that it is necessary even now for scientific men to come forward and justify the use of animal experiments

Measurement of Mechanical Power

IN a lecture on the measurement of mechanical power by Dr C V Drysdale delivered to the Junior Institution of Engineers and published in its *Journal* of August he points out the urgent demand there is for the accurate measurement of mechanical power under service conditions and how impossible it is to judge the relative merit of various mechanical devices without knowledge of this and the economy of the fuel used In mercantile shipping this is fully recognized and has led to great improvements in torsion meters Many engineers are now studying the performance of aero engines especially at high altitudes and this involves the making of power measurements more especially at high altitudes during actual flight The Royal Aircraft Establishment has now designed and constructed a mechanical power (watt) meter for air screw testing Utilizing the principle that a constantly excited generator produces an electromotive force proportional to the speed and that the torque is proportional to the current it has constructed a mechanical power meter which acts satisfactorily Alternating current at a frequency of 1 500 is supplied by a small wind driven alternator on the plane Records are given which prove that accurate testing of power during flight has been accomplished Dr Drysdale states that of the millions of mechanically propelled vehicles in use it is probably safe to say that not one per cent of their engines are working with anything like their maximum efficiency One has only to watch the tuning up of an engine after decarbonization and regrinding of the valves to realize how much it depends upon the almost unaided judgment of the mechanic

The Agricultural Research Council

THE third report of the Agricultural Research Council (London H M Stationery Office 5s 6d) surveys the research work aided from State sources during the period October 1935–September 1937 Besides its co ordinating functions in respect of much of the work carried out at the various research institutes in Great Britain and its advisory capacity as regards the Development Fund the Council now possesses a field station of its own at Compton Berks where it is proposed to establish disease free herds of cattle pigs etc and to provide opportunities for experiments under scientifically controlled conditions on a larger scale than is ordinarily possible at any individual research institute The first group of experiments with cattle will be concerned with contagious abortion and will involve the testing of various vaccines Among other problems to be investigated are the causes of the unduly high death rate among pigs and poultry particular attention being paid to fowl paralysis as regards both its hereditary and its infectious aspects A new interest of the Council was marked by the setting up of an equine research committee to deal mainly with horse diseases a substantial aid for which is being provided by the Racecourse Betting Control Board The review of the research work on foot and mouth disease recently undertaken by the Council is particularly appropriate in view of the serious outbreaks this year The general conclusions are that in spite of the high cost and slow progress of the investigations they should be continued in the hope that eventually measures will be found that will make possible some modification of the slaughter policy

League of Nations Social Surveys

THE report on the work of the Advisory Committee on Social Questions of the League of Nations in 1938 (Second Session) refers to the proposed review of social questions to be published quarterly and contains in addition to information regarding the League s work on social questions special articles by experts and selected bibliographies on social questions (C 147 M 88 4 Pp 28 Geneva League of Nations London George Allen and Unwin Ltd 1s 3d) On the recommendation of a sub committee, the Committee has decided to place three new subjects on its agenda the principles adopted in the organization and administration of welfare work among the young including social assistance the training of persons engaged in social work and family desertion The first study is to be limited in the first instance, to a selected number of representative countries emphasis being placed on the study of principles adopted in organization and administration of the administrative machinery The study on training for social work will take note of the work already carried out by the International Committee on Social Service Schools in regard to the participation of universities in the training of social workers and will deal with other aspects, such as the extent to which different groups of social workers, including voluntary workers, are trained, and the training given Developments in child welfare in the past year are summarized in the report, which includes reports from the liaison officers with the International Labour Office and the Health Organisation, and formulates the broad principles arrived at from its investigations on the placing of children in families

Surveys of Town Planning

A broadsheet recently issued by Political and Economic Planning (P E P) reviews the report of the National Survey and National Planning Committee of the Town Planning Institute, the first really thorough and informed analysis of the reasons for the wasteful and undesirable development of the land which is still occurring all over England. Together with the Bressey report on the Highway Development of Greater London, it makes a major contribution to the national planning of the use of land, and as such has claims on the attention of all scientific workers who are concerned with the social problems of our technical civilization. Essentially the primary task is one of co-ordination—of fitting together the requirements of many different and often rival users of land, and where necessary choosing between them. Pointing out that there are national aspects of planning urgently requiring comprehensive study, decision and action, and that the existing planning system is quite inadequate to deal not merely with these national aspects but even effectively with the broader regional requirements, the report recommends the creation of a National Planning Commission.

The functions of this Commission would include the compilation and collation of all relevant information bearing on the use, development and planning of land from a national point of view; advising and co-ordinating Government departments, statutory undertakers and highway authorities in their use and development of land; providing planning authorities with constructive advice and guidance, such as the Minister of Health is prevented by his quasi-judicial position from providing, watching their planning operations, and making appropriate representations to the Minister of Health when necessary. The Commission would also keep the general progress of planning under review, investigate its problems, defects and delays, frame proposals for overcoming them and generally advise the Minister and the Government on the legislative and administrative development of the planning system. As a basis for its activities and as a background for local and regional planning, it would formulate a national plan or policy on broad and flexible lines for the allocation of major land uses and developments. The wisdom of this proposal is emphasized by the revelation in the Bressey report of the widespread damage being done in the absence of such measures, and the indictment it contains of recent official policy in regard to roads.

An Adolescents' Charter from Manchester

The Federal Council of Lancashire and Cheshire Teachers' Associations has recently issued a "Report on Entry into Employment" which includes a formulation in fourteen points of what the Council regards as "a working basis under the conditions at present prevailing in the industrial world and under the Acts dealing with school leaving and the regulation of factories and workshops now in force". Among the more significant of the fourteen points are: vocational guidance for all and, as a means for ensuring this, insistence on the submission at regular intervals by every juvenile advisory and choice-of-employment committee of reports to the appropriate authority (in one area 23 out of 24 such committees were found to have ceased to function); entry into employment of a school leaver to be preceded by medical examination and report, co-ordinated in each case with the child's 'health sheet'; all school planning to include 'equipment suitable for the use of older persons, and such amenities and arrangements as will appeal to the developing mind and character of the ex-pupil' (especially in rural and detached areas); continuative education for all, and *definite* arrangements to induce all school leavers to continue their education, whether in technical, commercial or art schools or in less exacting or more general courses; recreative facilities to be provided in connexion with all further education. The report dwells on the distressing waste of much of the good work done in the *primary schools owing to lack of effective means* for ensuring further education up to the point at which the adolescent attains to the will and capacity for self-instruction. In the interval between leaving the primary school and the desire to proceed further, the foundation laid in the primary school has been lost since no means or care have been taken to retain it".

The National Central Library

We read in the daily newspaper that 'the lecture system has been obsolete ever since the invention of printing". Notwithstanding, the system has led at least to the demand for public libraries. The need arose from the establishment of mechanics' institutes and the foundation of lectures for adult education. Actually the public libraries movement dates from the Select Committee of 1845, which authorized a ½*d* rate for their maintenance. The corner stone of this movement is the National Central Library, unifying and binding together, as it does, the independent units of the system. The National Central Library constitutes a central bond, through which the books in any one library are made available for use in any other. The annual report for 1937 shows that, in addition to the ten million books contained in the urban and county libraries, the National Central Library has built up gradually a supplementary reservoir of another ten million books, which may be borrowed from university libraries, and those of learned societies and similar institutions.

Commencing as an experimental library for workers' educational classes at Toynbee Hall in 1914, the Library was given a Royal Charter, as recommended by the Public Libraries Committee in 1927. This report also recommended that the Science Library at South Kensington should be the principal source on which the National Central Library should rely for the loan of books needed by students of science and that the Science Library should be made as complete as possible. Thus the National Central Library has become the centre of a national library movement, with which nearly all the public, university and other libraries in Great Britain are associated. The past year has seen the completion of a series of more self-contained regional library systems. Such a vast scheme of mutually supporting libraries must depend for its greatest efficiency on the maintenance of central catalogues. Union catalogues by authors of the books in the affiliated libraries are being compiled at various centres. The total number of entries in that at the National Central Library has reached ¾ million. A subject-catalogue of books and original articles is maintained at the Science Library and has reached 2¼ million entries. A "Union Catalogue of the Periodical Publications in the University Libraries of the British Isles" was published in 1937. The total number of books lent during that year was nearly 140,000, of which it is significant that some 400 were supplied to foreign libraries.

Prices of Biological Books in 1937

FOR twelve years the *Quarterly Review of Biology* has analysed and compared the cost to Americans of biological books, based upon the prices of all such received for review by the *Quarterly*. The analyses have produced some interesting figures regarding the relative cost of books produced by different nations, and to some of them attention has been directed in NATURE. In point of price, German books are still the most expensive, despite the announced policy of German publishers, a German average of 1·95 cents a page comparing with 1·27 for British books, and 0·85 for French. Than the last the only cheaper books published are those issued by the British Government (0·34 cents a page) and the U.S. Government (0·16), but since the last three categories are often published in paper covers, some of the saving may be on binding. Comparing 1937 with 1936, it is remarkable to find that the average price per page from every origin, except Germany and Great Britain, has been lowered —by from about 10 per cent in U.S. books to so much as 79 per cent in British Government official publications. But while the British Government has been so greatly reducing its charges, the ordinary British publishers of biological books have been compelled to increase by 16·5 per cent. However, it is possible that the particular books received by the *Quarterly* for review do not represent fair samples in every case; indeed, the total of British Government publications received in all the twelve years only amounts to 8,836 pages, so that, as the authors, Raymond Pearl and Maud DeWitt Pearl, point out, general conclusions must be drawn with caution from this material.

The First Slovakian Polytechnic

IT is true that, for a country of fifteen million inhabitants, Czechoslovakia is well provided with facilities for higher education. There are four universities, one of which is German, and numerous academies and schools of technology that grant recognized diplomas; but until now there has been no Slovak polytechnic. When the new academic year commences in October, however, this will be remedied by the opening of a polytechnic at Košice, in east Slovakia, to be named after Dr. Milan Stefaník, the Slovak astronomer who became the first Czechoslovak Minister for War. This technical institute will rank after the Comenius University of Bratislava as the second most important educational establishment in the eastern half of the Republic. The president, Dr. E. Beneš, has nominated the principal members of the staff, which will include a number of Slovaks who have graduated in science or technology. Their colleagues will be certain lecturers from the Universities and Polytechnics of Prague and Brno, and the new institute will doubtless soon be able to supply local industrial undertakings with students who have obtained their diplomas at Košice.

The Public Health of India

THE vital statistics and public health of India are dealt with in the recently published annual report of the Public Health Commissioner with the Government of India for 1935 (Vol. 1. With Appendixes. Delhi: Manager of Publications. 1937. Rs. 2, or 3*s*. 6*d*.). The mid-year estimated population was 278,199,545, the birth-rate and the death-rate per 1,000 were respectively 35 and 24, and the infantile death-rate per 1,000 live births was 164 (the corresponding rates for England and Wales are 15, 12 and 57). The total mortality from the three principal epidemic diseases—cholera, plague and smallpox—decreased by 24,000 compared with 1934, but this was more than covered by the large reduction in deaths from plague, which fell from 80,000 in 1934 to 32,000 in 1935. Cholera mortality rose to 217,000, the highest figure for the past three years. Smallpox caused 91,000 deaths, as against 84,000 in 1934. Tuberculosis is another disease the incidence of which has increased rapidly during recent years, and which is causing a heavy mortality, particularly in urbanized and industrialized areas. Of fevers, malaria caused the heavy toll of 1,632,000 deaths. No less than 150,000 women died in childbirth or from causes associated with childbirth. An account is also given of the public health services and administration, and of the work of the laboratories and institutes for medical research.

Institution of Electrical Engineers Awards

THE following scholarships have been awarded by the Institution of Electrical Engineers for 1938: *Ferranti Scholarship* (annual value £250; tenable for 2 years): L. S. Piggott (University of Oxford); *Duddell Scholarship* (annual value £150; tenable for 3 years): J. B. Higham (Penarth County School); *Silvanus Thompson Scholarship* (annual value £100, plus tuition fees; tenable for 2 years): H. Darnell (Mersey Railway Company); *Swan Memorial Scholarship* (annual value £120; tenable for 1 year): J. G. Hutton (Sunderland Technical College); *David Hughes Scholarship* (value £100; tenable for 1 year): H. E. Newton (University of Sheffield); *Salomons Scholarship* (value £100; tenable for 1 year): C. Halliday (King's College, Newcastle-on-Tyne). Grants have been made from the War Thanksgiving Education and Research Fund (No. 1) to J. W. Carroll (King's College, London), to E. Franklin (University of Birmingham), and to G. Y. Shute (University

College, Nottingham). Thorrowgood Scholarships have been awarded to C. R. Smith (London & North Eastern Railway), and E. C. Norris (Southern Railway Company).

Indian Cotton

TECHNOLOGICAL CIRCULARS Nos 323 to 338 issued by the Indian Central Cotton Committee's Technological Laboratory during the first three months of 1938 exemplify very thoroughly the work which is being done in India to improve the cotton crop of the country. Each season early samples of the crops from different parts of the country are sent to the Laboratory for test and each circular summarizes the results obtained in the last six years. No 336 deals, for example, with a pure line strain isolated in 1931 and grown at the Government Experimental Farm, Akola, where the rainfall is 28 inches per annum, the soil black cotton soil, the growing period from June until November and the maximum temperature varies from 85° to 115° F.; weight of cotton per seed, 30 milligrams, of seed, 62 mgm 26 seeds per boll, 16 to 18 bolls per plant, yield, 400–800 lb. per acre; 43 thousand acres under cultivation as against 120 acres in 1933. The average length of fibre (staple) is ⅞ inch, the curve of deviation being approximately the error curve In manufacture, the percentage of loss from dirt is low, that from carding is normal, about 8 per cent. Fibre strength was best in 1933 and then suitable for yarn of 31 counts, that is, 31 hanks of 480 yards to the pound

Butterfly Migrations in the Tropics

THE attention of travellers and residents in the tropics is directed to an attractively produced booklet entitled "Butterfly Migrations in the Tropics", recently published by the British Museum (Natural History). It is written on behalf of the Trustees of the Museum by Dr. C. B. Williams, and is well illustrated by means of five three-colour process plates of typical migrant species. The booklet is issued primarily with the object of obtaining information on the subject of migration. Very little is known relative to this problem in the tropics, and it is easy for any accurate and willing observer to assist in this matter. Instructions are given with regard to the special points upon which information is desired. The booklet may be obtained from the British Museum (Natural History), London, S.W.7, price 9*d*.

International Grassland Congress

THE report of the fourth International Grassland Congress held in Great Britain in July 1937 under the presidency of Prof. R. G. Stapledon has now been published. The volume, which consists of 486 pages, contains the full texts of all papers, both plenary and sectional, delivered to the Congress at Aberystwyth. Each is printed in English or German with a summary in the alternative language, the main items of the discussion being also included. The report can be obtained from the Joint Secretaries, Fourth International Grassland Congress, Aberystwyth, for £2, post paid. A smaller volume (pp. 87), containing abstracts in English and German of the majority of the papers delivered, is available for 5*s* post paid.

Work of the Central Midwives Board

THE report of the Central Midwives Board, recently issued, reviews the work of the Board during the year ended March 31, 1937. The Midwives Roll contained the names of 65,046 women, a net increase of 2,982 on last year's roll. During the year, only 18 midwives were dealt with by the Board under its penal powers on charges of malpraxis, negligence or misconduct, as a result of which seven names were removed from the roll. The Minister of Health approved the revised rules for training and examination, on the preparation of which the Board has been engaged for a considerable time. The two most important changes effected by the new rules are (*a*) an extension of the period of training from 6 to 12 months for State-registered general trained nurses, and from 12 to 24 months for other pupil-midwives, and (*b*) division of the course of training into two parts, each of which will be completed by an appropriate examination. An important decision during the year was the permission given to midwives to administer nitrous oxide and air to women in childbirth, under certain conditions.

Congress of Electroradiology

THE fourth annual Congress of French-speaking Electro-Radiologists will be held in Paris on October 5–8. At the opening meeting, Prof. Joliot-Curie will lecture on neutrons and artificial radio-elements—biological applications and therapeutical hypotheses. The following subjects will also be discussed. the results of radiological methods of examination; the bio-electric phenomena of the nervous system, present state of the question and possible application, anti-inflammatory roentgentherapy; biological action of rays and high-frequency currents; progress of histo-radiography, fresh data on neuro muscular stimulation, interpretation of electrotonic phenomena The subscription is 100 francs, which should be sent to Dr Morel Kahn, 45 rue Scheffer, Paris 16^e. Further information can be obtained from Dr. Delherm, 1 rue Loas Cases, Paris 7^e

Studentships and Fellowships in Medical Research

THE Medical Research Council invites applications for a third series of studentships and fellowships intended to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive a stipend at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. The Council also offers research fellowships for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S W 1

French Association of Microbiologists

ON the initiative of Profs Bordet, director of the Pasteur Institute of Belgium, Martin, director of the Pasteur Institute of Paris, and Lisbonne, of the Montpellier faculty of medicine, an association of French-speaking microbiologists was formed at a meeting held in October 1937 The first meeting of the new association will be held in October next on the occasion of the fiftieth year of the foundation of the Pasteur Institute of Paris, with Prof. Martin as president, and Drs. Lépine of the Pasteur Institute of Paris and Paul Bordet of the Pasteur Institute of Brussels as general secretaries. Further information can be obtained from Dr. Lépine, Institut Pasteur, 25 rue du Docteur Roux, Paris 15^e.

Announcements

CAPTAIN EYSTON in his motor-car *Thunderbolt* broke the world's land speed record on Bonneville Salt Flats, Utah, on August 27 Over the measured mile, the car averaged 345 49 m p h for both ways, the outward run being 347 49 m.p.h, and the return 343.51 m p h. The former record, established also by Captain Eyston in 1937, was 311 42 m p h. The *Thunderbolt* has two Rolls-Royce engines, each capable of developing up to 2,350 h p

DR T H. SANDERSON-WELLS has endowed an annual lectureship at the Middlesex Hospital Medical School on the relations between rheumatism and dietetics.

DR. WILHELM A P. SCHÜFFNER, director of the Department of Tropical Hygiene at the Royal Colonial Institute of Amsterdam, has been awarded the Gold Medal of Honour by the Hanseatic University of Hamburg.

THE College of Physicians of Philadelphia has awarded the Alvarenga Prize to Dr. Richard E. Shope, of the Rockefeller Institute for Medical Research, Princeton, N.J., for his recent researches on the etiology and epidemiology of influenza

THE twenty-seventh meeting of the Italian Society for the Advancement of Science will be held at Bologna under the presidency of the rector of the University on September 4–11.

THE twenty-fifth French Congress of Hygiene will be held at the Pasteur Institute, Paris, on October 3–8, when the following subjects will be discussed: the plan of the sanitary equipment of France; diet and public health; insurance and public health. Further information can be obtained from the General Secretary, Dr. X Leclainche, 18 rue de Tilsitt, Paris 17^e

THE sixth Congress of Physical Re-education organized by the French Society of Specialists in Medical Physical Culture will be held on September 10–12 at the Institute of Physical Education of the University of Paris with Prof. Roussy, rector of the University, as president of honour It will consist of three sections devoted respectively to science applied to physical education and medical gymnastics, the technique of re-education and social realization. Further information can be obtained from the president of the Society, M. Petat, 11 rue Racine, Montluçon, Allier, France

THE tenth Congress of the Far Eastern Association of Tropical Medicine, which meets every three years, will be held at Hanoi, Tonkin, on November 24–30, when the following subjects will be discussed: deficiency diseases, water supply, cholera, malaria, plague, tuberculosis, venereal disease, surgery, diseases common to man and animals, parasitology, and materia medica of the Far East. The official languages will be English and French. Further information can be obtained from the Organizing Committee, 6 rue de la Convention, Hanoi

THE fourth International Conference on Timber Utilization is to be held in Brussels on September 15–17. The subjects to be dealt with include tests on the strength of timber in relation to building regulations, timber and plywood for aeroplanes, shipbuilding, etc, and modern possibilities of the utilization of sawmill waste, and reports on the activities of the Department for Timber Utilization. Further information relating to the Conference can be obtained from the Secretary, Comité International du Bois, 50 rue Neuve, Brussels, Belgium

MESSRS ADLARD AND SON, LTD, have issued a useful diary for the academic year 1938–39, copies of which were presented to members of the British Association attending the recent meeting in Cambridge. It includes, against the appropriate dates, notes of the meetings of learned societies, and there is also a table showing the dates of the terms of the universities of the British Isles.

BRITISH DRUG HOUSES, LTD., have issued a descriptive leaflet dealing with synthetic lactoflavine, which they now manufacture. This substance is phosphorylated after ingestion, and then forms the prosthetic group of Warburg's yellow ferment, which probably plays an essential part in oxidations in all body cells. It cannot be synthesized in the body, and forms one constituent of the complex of substances once known as vitamin B.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 439

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Loss of Energy by Fast Particles in Nuclear Collisions

THE energy lost by a moving particle in traversing matter as the result of exciting or disintegrating atomic nuclei depends on the law of force between it and the particles constituting the nucleus, and also in general on the state of motion and of binding of the nuclear particles However, if the incident particle is fast and the forces are of short range the average energy loss in nuclear collisions may be shown to be independent of the latter factors and is the same as it would be if all the nuclear particles were free and isolated The general reason for this may be seen as follows

Let us consider a nuclear encounter in which the incident particle, velocity βc approaches the nucleus within a distance r The time of collision , τ, is then of the order of $r/\xi\beta c$, where $\xi = (1-\beta^2)^{1/2}$ Strictly speaking, terms of the order of $\lambda/2\pi\beta c$, and $\alpha/\beta c$, where λ is the de Broglie wave length, and α represents nuclear dimensions, should be added in order to avoid contradictions with the uncertainty principle and to allow for the size of the nucleus However, these terms make no significant addition and may be left out here The 'natural period , T, of a nuclear particle is of the order of δ/u, where u denotes its average velocity in the nucleus and δ represents the dimensions of the region to which it is confined (the nuclear cell in Bohr's model, for example) Now if $\tau \gg T$ the conditions are adiabatic, and the energy loss is greatly suppressed by the binding forces However, if $\tau \ll T$ we have the condition of 'sudden impulse', and the average energy loss is the same as it would be if the nuclear particles were free The transition from the one condition to the other takes place for a value, ρ, of r given by $\tau \sim T$, namely, $\rho = \xi\beta(c/u)\delta$ For the nuclear particles we may take $u/c \sim 1/5$, and for fast incident particles, such as those in cosmic rays, $\beta = 1$, $\xi \gg 1$ Thus $\rho \gg \delta$ Now δ is at least of the order of the range of nuclear forces, σ Therefore $\rho \gg \sigma$ This means that, as r increases, the interaction with the nuclear particles ceases altogether long before adiabatic conditions set in, that is, before binding forces have any effect on the average energy loss Inside the range of the interacting forces the conditions are those of a sudden impulse, and the average energy loss is accordingly the same as for a free particle

This result can also be proved by applying Born s theory of collisions in an analogous manner to its application by Bethe[1] to the excitation and ionization of atoms The result, however, holds under more general conditions than those which have to be satisfied to justify Born's approximation The application of the above arguments to the excitation and ionization of atoms leads, under the conditions of Born's approximation, to Bethe's formula for 'stopping power', and to Bohr's classical formula under the alternative conditions Of course, in the atomic problem the interaction, which is Coulombian, is to be classed as long range, and the binding forces play an essential part in limiting the energy loss

Assuming the mutual potential energy of a cosmic ray particle and a nuclear particle to be $Ve^{-b/r}$ (and using Born s approximation) the average energy lost by fast particles per centimetre in nuclear collisions, according to the above result is

$$dT/dx = (4\pi/3)NWV^2b^2/Mv^2,$$

where N is the number of nuclei per c c , W the number of protons and neutrons in the nucleus, M the mass of a proton (or neutron) and v the velocity of the incident particle which we may take as the velocity c of light With $V \sim 40$ M v , and $b \sim 1\ 0 \times 10^{-13}$ cm this formula gives an energy loss about one twentieth of that suffered in the usual collisions with the atomic electrons

The results given here differ from those obtained by Heisenberg[2] in a recent treatment of the problem though the numerical values are not of a different order of magnitude Heisenberg calculates the energy loss assuming the nuclear particles to be free, and then assumes that the effect of the nuclear binding forces is to cut out all those collisions which give an energy transfer less than the smallest excitation energy This procedure is in fact identical with that adopted in a theory of stopping power given by Henderson[3] before the advent of the new quantum mechanics and it gives results correct in order of magnitude only The energy loss calculated by Heisenberg is also greatly increased by his allowance for the initial motion of the nuclear particles in the nucleus According to my results, this motion does not contribute at all to the average energy loss though it affects its distribution The reason for this is that if a free particle with initial momentum p_0 receives in a collision momentum p, at an angle θ with p_0, the energy it acquires is proportional to $p^2 + 2pp_0 \cos\theta$ which on the average is equal to p^2 and is independent of p_0

A more detailed discussion of the points mentioned in this note will be given elsewhere

E J WILLIAMS

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Aug 5

[1] *Ann der Phys* 5 325 (1930)

[2] Leipzig, Akad der Wissen 89 369 (1937) *Naturwiss* 25 749 (1937)

[3] *Phil. Mag* 46 680 (1922)

Anomaly in the Apparent Absorption of Slow Neutrons by Iodine and Boron

IN the course of some experiments on the absorption in boron of the slow neutrons (excluding those of thermal energy) which activate an iodine detector, a rather peculiar phenomenon has been noticed

It has been found that the absorption coefficient of these neutrons in boron remains apparently constant, even when some 85 per cent of the original intensity has been absorbed If, however, some 50 per cent is absorbed in an iodine filter, the boron absorption coefficient of the residual neutrons has decreased to a very marked extent This last effect has also been found by Ruben and Libby[1]. The exact figures obtained are contained in the accompanying table. The errors given are probable errors and not standard deviations.

Thickness of filter	Fraction transmitted through filter	Fraction transmitted through boron absorber	Absorption coefficient
0	1	0·60 ±0·02	0·77 ±0·07
B 0·96 gm./cm.²	0·25	0·57 ±0·04	0·83 +0·12
I 0·5 ,,	0·5	0·75 ±0·04	0·38 ±0·1
I 1·2 ,,	0·25	0·84 ±0·05	0·2 ±0·1

The first and second columns give respectively the thickness of filter used and the fraction of the intensity transmitted by them, B representing a boron filter and I an iodine one. The last two columns give data for the absorption in boron of the beam of neutrons emerging from the filter. They give respectively the fraction of the intensity transmitted through a boron absorber of 0·30 gm./cm.², and the absorption coefficient deduced from this fraction (not corrected for scattering)

These results show that whereas from the boron absorptions one can say that at least 85 per cent of the activity is due to neutrons having a uniform absorption coefficient of 0·77, the iodine filtration experiment shows that some 50 per cent of the neutrons have an absorption coefficient of almost half this, 0·38

It has also been found that when both an iodine and a boron filter are used simultaneously, the activity produced in the detector depends on the order in which the filters are placed The ratio of the activity produced when the boron filter (0·77 gm./cm.²) was followed by the iodine filter (0·84 gm./cm.²) to that produced when the iodine filter preceded the boron filter is 0·78 ± 0·03.

The first experiment has been repeated using a bromine detector in place of the iodine as the absorption regions of these elements overlap to some extent[3], but no change was observed in the boron absorption coefficient of the neutrons on passage through the iodine filter Nor was any effect observed when an arsenic filter and an arsenic detector were used instead of iodine in this experiment, although iodine and arsenic detectors show nearly equal boron absorption coefficients for slow neutrons[2,4].

In all these experiments, the source of slow neutrons used was a (Rn + Be) source placed at the centre of a wax cube of side 10 cm. The sides of the cube were screened with cadmium sheets, and the absorbers and detectors were placed against the sides of the cube.

The results of these experiments do not seem to be at all explicable unless it is assumed that the passage through one or the other of the filters has resulted in a change in energy of a considerable fraction of the neutrons detected The results could be interpreted as being due to slowing down of the higher energy neutrons by boron into the iodine resonance region. Alternatively, the effect could be due to an increase in energy of some of the neutrons on passage through the iodine, this latter being possible if some of the iodine nuclei exist in a metastable state of long life.

Further experiments are in progress, however, and a fuller account will be published elsewhere.

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London, S.W.7.
July 20.

[1] Ruben and Libby, *Phys. Rev.*, 51, 774 (1937).

[2] Amaldi and Fermi, *Ric. Scient.*, vi-ii, 344 (1935).

[3] Goldsmith and Rasetti, *Phys. Rev.*, 50, 328 (1936).

[4] Frisch, *Math.-fys. Medd.*, 14, 12 (1937).

Scattering of Yukawa Particles by Protons

I HAVE computed the electrical interaction between the heavy electrons as introduced by Yukawa[1] and recently discussed by Kemmer, Fröhlich, Stueckelberg and others[2], using the Dirac-Proca[3] equations for particles of spin one. It was thought that such a calculation would furnish polarization effects analogous to, and yet, because of the different spin, different from the effect found by Mott[4] for the scattering of electrons. The method used was the usual Born-Dirac calculus of perturbation.

It was found that in contrast to electrons, Yukawa particles show a polarization effect even in the first approximation. This effect, perhaps not wholly unexpected due to the similarity of the Proca equations with the Maxwell equations, is caused solely by the transversal wave field; it is proportional to the square of the cosine of the angle between the plane of polarization and the plane laid through the primary and the scattered ray. The second approximation also contains polarization terms, but they are of the form similar to those found by Mott in the case of the electron.

A detailed report of the calculations will be published in the *Physical Review*.

OTTO LAPORTE.

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July 12

[1] Yukawa and collaborators, *Proc. Phys.-Math Soc. Japan*, 17, 48 (1935), 19, 1084 (1937), and 20, 319 (1938)

[2] Fröhlich, Heitler, Kemmer, *Proc Roy Soc*, A, 166, 127 and 154, (1938) Stueckelberg, *Helv. phys. Acta*, 11, 225 and 299 (1938).

[3] Dirac, *Proc Roy Soc*, A, 155, 447 (1936) Proca, *J. Phys*, 7, 347 (1936)

[4] Mott, *Proc Roy. Soc*, A, 124, 425 (1929); 135, 429 (1932).

Direct Proof of the Effect of Temperature on the Conduction Electrons of a Metal

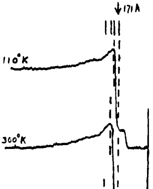
IT has been recognized for some time that the structure of the *K*-, *L*-, etc., emission spectra of the metals in the soft X-ray region (about 10–500 A.) can lead to direct information about the level system occupied by the conduction-electrons[1]. For the radiation of a metal in this region consists wholly (or, in other cases, at least partly) of a band which represents transitions of the conduction-electrons themselves into an inner shell which has been ionized by electron-impact in the X-ray tube; and since the inner level is relatively sharp, the structure of the conduction electron level system is clearly reflected in the emitted radiation. The most characteristic feature is the sharp edge which forms the short wave-length end of such a band; this evidently corresponds to the sharp 'surface' to which the conduction-electrons of the metal fill up the continuum of possible levels. But, theoretically, this surface is only sharp at the absolute zero of temperature. As is well known, the conduction-electrons are subject to Fermi-Dirac statistics and this has the result that at a temperature T, the surface is slightly diffused.

If $N(E)dE$ is the number of levels having energy between E and $E + dE$ and if $N(E)$ is assumed approximately equal to a constant N_0 in a small energy-range near the surface, then the number of *occupied* levels with energies between E and $E + dE$ at a temperature T is given by

$$n(E)dE = \frac{N_0}{1 + e^{\Delta E/kT}}\, dE \quad . \quad . \quad . \quad . \quad (1)$$

where ΔE is measured from the surface at the absolute zero[2].

We have recently been able to show that the edges of the K and L bands of metals of the first two groups are sensitive to the temperature of the anticathode of the X-ray tube from which they are emitted. The accompanying photometer curves (six times enlarged from the original plate) of the L_{23} band of aluminium at 171 A.) correspond to three anticathode temperatures. The total energy spread of the band is about 15 volts. Owing to the separation of the L_2 and L_3 levels (about 0.4 volt) the edge is actually double. Both components show a marked broadening when the anticathode temperature is changed from that of liquid air (110° K.) to 680° K., and a difference can even be detected for the change from liquid air to room temperature.



The breadth of the edge is partly due to a limitation of the resolution due to the width of the spectroscope slit, which is estimated to correspond to 0.12 volt. If this amount is subtracted from the breadth measured in the way indicated by the lines on the diagram, we obtain a corrected edge breadth; and the precise manner of measuring this quantity is such that it should correspond to about 6 kT according to equation (1), if the extra broadening is entirely due to this cause. The table below gives the results.

Temp	Corrected edge breadth (volts)	6 kT (volts)
110° K	0.06 ± 0.03	0.057
300° K	0.17 + 0.03	0.156
680° K	0.44 ± 0.05	0.354

It will be seen that, at the two lower temperatures, the breadth of the edge can be entirely accounted for according to equation (1). At the highest temperature, the breadth seems to be a little more than would be expected; the additional amount may be due to the distortion of the lattice by the large amplitude of the heat motion when the temperature of the aluminium is raised towards its melting point.

H. W. B. SKINNER.

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[1] For example, O'Bryan and Skinner, *Phys. Rev.*, **45**, 370 (1934).

[2] See, for example, Mott and Jones, "Theory of the Properties of Metals and Alloys", 1 5.

Kramers' Absorption Law in Physical Problems

IN a recent letter to NATURE[1], Dr. T. L. Page reports on an interpretation of the spectrum of hydrogen in the discharge tube and in the planetary nebulæ. The observed data consist of measures of the intensities, in emission, of various members of the Balmer series and of the continuum that lies beyond the Balmer limit. Page states: "In the nebulæ and in the discharge it can be shown that the recombination of protons and electrons must account for almost the entire emission". He interprets the data on the basis of this assumption. All the quanta of Balmer α, for example, he regards as being produced by electrons that have arrived in quantum level 3 either by direct capture in that level or by cascade from higher levels after capture. He apparently neglects all other types of excitation, such as reabsorption of the Lyman line radiation or collision. Failing to find agreement between the number of captures calculated theoretically from Kramers' well-known absorption law and the number deduced from the observations, Page concludes that Kramers' law is in error. I should prefer another alternative, namely, that the nebular and discharge spectra are not entirely due to recombination.

The number of captures in level 2 may be directly calculated from the intensity of the Balmer continuum. The number of captures in level 3 and higher are only indirectly inferred, on the basis of Page's assumption, from the intensities of the Balmer lines. According to Page's tabulation, the observed number of captures on level 3 exceeds those on level 2 by 1000 fold. A crucial experimental test of this result could be made by observing, in laboratory or observatory, the spectrum beyond the Paschen limit. I am confident that the intensity of the Paschen continuum, in either example, will not differ greatly from that of the Balmer. Thus only a small fraction of the atoms in level 3 have arrived in consequence of capture. The remainder must have arrived by collisional or by radiative excitation. The former process is likely to predominate in the electrodeless discharge. Page does not give the original observational data, but I should expect the intensities to conform rather closely to those arising from a Boltzmann distribution at the appropriate temperature.

In the nebulæ, a much better agreement is obtained by applying the full theory developed by Carroll[2] and Cillié[3]. This theory is based on the premise that the nebula is optically thick so that *all* the ultraviolet stellar radiation beyond the Lyman limit is converted, by successive absorption and emission processes, into long wave and Lyman α quanta. When the effect of the radiation field is taken into account, the discrepancy practically vanishes. At Harvard Observatory, Mr. James Baker, Mr. Lawrence Aller and I have been preparing a series of papers[4] dealing with the theoretical Balmer decrement under different physical conditions. In Cillié's calculations, the number of discrete hydrogen levels was limited to fourteen, because transition probabilities were available for only this number[5]. In the Harvard investigations no such limitation was imposed[6].

The following table[7] summarizes some of the Harvard results. The observed data, quoted from Berman[8], have been corrected for the effect of space reddening.

	5000°	40,000°	Obs.	80,000°
Hα	2.43	2.71	2.77	2.83
Hβ	1.00	1.00	1.00	1.00
Hγ	0.53	0.49	0.50	0.48
Hδ	0.33	0.29	0.26	0.27
Hε	0.223	0.179	0.18	0.169
H	0.157	0.120	0.12	0.112
H	0.11	0.085	0.09	0.078

The decrement proves to be extremely insensitive to the electron temperatures, indicated at the head of the column. Any temperature between 40,000° and 80,000° will fit the observations satisfactorily. Since the decrement proves to be very sensitive to the radiation field, an even wider range of electron temperatures may be considered. Page[9] has derived a temperature of 1000° from intensity measures of the Balmer continuum. My own independent measures[10] indicate a value at least ten times higher.

In view of the large number of implicit assumptions involved in Page's work, I feel that the outlook for eventually interpreting the nebular and laboratory spectra of hydrogen on the basis of wave mechanics is hopeful. We shall not have to abandon the useful Kramers formula, in so far as it is compatible with the more precise wave mechanical expression. Also, since I see no distinction in the present instance between 'astrophysical' and physical, I have dropped the qualifying 'astro' from the title of this letter.

DONALD H. MENZEL.

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July 11.

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[1] Page, NATURE, **141**, 1137 (1938).

[2] Carroll, *Mon. Not. Roy. Astro. Soc.*, **90**, 588 (1930).

[3] Cillié, *ibid.*, **92**, 820 (1932); **96**, 771 (1936).

[4] Series "*Physical Processes in Gaseous Nebulæ*".
Menzel, I. Absorption and Emission of Radiation, *Astrophys. J.*, **85**, 330 (1937).
Menzel and Baker, II. Theory of the Balmer Decrement, *ibid.*, **86**, 70 (1937).
Baker and Menzel, III. The Balmer Decrement, *ibid.*, In Press.
Menzel, Aller and Baker, IV. The Mechanistic and Equilibrium Treatment of Nebular Statistics, *ibid.*, In Press.
Baker, Menzel and Aller, V. Electron Temperatures, *ibid.*, In Press.

[5] Menzel and Pekeris, *Mon. Not. Roy. Astro. Soc.*, **96**, 77 (1935).

[6] In paper III complete transition probabilities up to $n = 35$ are tabulated.

[7] Abbreviated from paper III of reference 4.

[8] Berman, *Mon. Not. Roy. Astro. Soc.*, **96**, 890 (1936).

[9] Page, *ibid.*, **96**, 604 (1936).

[10] Unpublished.

Ultra-Violet Band System of Silicon Monoselenide

As a result of recent observations of band spectra of monoxides, monosulphides, monoselenides, and monotellurides of the group IV(*b*) elements, the spectroscopic investigation of this group of molecules has now reached a stage at which data are available for the ground states and one or more excited states of all the monoxides, all the monosulphides, three of the five monoselenides (namely, CSe[1], SnSe[2] and PbSe[2]) and one of the five monotellurides (namely, PbTe[2]). A recent study[3] of the related band systems enabled the character and approximate position of the corresponding system of SiSe to be predicted.

It was observed[3] that the ultra-violet system of SiS is well developed in a heavy current discharge through Al_2S_3 vapour in a silica tube. An analogous method has now been successfully employed to develop the corresponding system of SiSe. In a 2.5 amp. discharge through a silica tube containing aluminium selenide a system of some 30 bands degraded to the red has been observed in the region λ 2914–λ 3671, the 0 → 0 band being at λ 3089.3 and comparatively weak. The heads are approximately represented by

$$\nu_{\text{head}} = 32{,}448.7 + (404.3\,u' - 3.24\,u'^2) - (580.0\,u'' - 1.78\,u''^2),$$

where $u = v + \frac{1}{2}$. There can be no doubt that the system is emitted by SiSe formed by the interaction of aluminium selenide and silica at the high temperature (*c.* 1,000° C.) of the positive column tube.

The ratios of coefficients discussed in connexion with SiS[3] have values of the order of magnitude expected. Thus $I_M I_X / E_e = 19.3$, as compared with 19.4 for SiS and 20.8 for SiO, I_M and I_X being the ionization potentials of the atoms, and E_e the electronic energy of the excited molecular state (all in electron volts). Secondly, the ratio $\omega_e'/\omega_e'' = 0.697$ for SiSe, as compared with 0.683 and 0.686 for SiS and SiO. Finally, the ratio (ω_e of SiSe)/(ω_e of SiS) has the values 0.790 and 0.774 for the excited and ground states respectively, as compared with 0.778 and 0.873 respectively for (ω_e of CSe)/(ω_e of CS).

Judged by the data for related band systems in this group, the value 3.24 for $x_e'\omega_e'$ in SiSe is surprisingly large; the discrepancy is due to the existence of perturbations in one or more of the excited vibrational levels $v' = 3$, 4 and 5, and the consequent difficulty in evaluating $x_e\omega_e$ correctly. With this one exception the coefficients are of the same orders of magnitude as those of the iso-electronic molecule GeS.

Work on the corresponding system of SiTe by an analogous method is in hand.

R. F. BARROW.

Imperial College,
London, S.W.7.
July 19.

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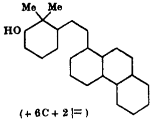
[1] Rosen, B., and Désirant, M., *C.R. Paris*, **200**, 1659 (1935).

[2] Walker, J. W., Straley, J. W., and Smith, A. W., *Phys. Rev.*, **53**, 140 (1938).

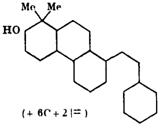
[3] Barrow, R. F., and Jevons, W., NATURE, **141**, 833 (1938), and forthcoming paper.

Structure of the Triterpenes

THE tetracyclic triterpene alcohol basseol, which readily cyclizes to give β-amyrenol[1], which in its turn is related to erythrodiol, gypsogenin and hederagenin[2], on dehydrogenation with selenium gives as major product a phenanthrene homologue, m.p. 125° (Found: C, 92.7; H, 7.2. $C_{17}H_{16}$ requires C, 92.7; H, 7.3; $C_{18}H_{18}$ requires C, 92.25; H, 7.75 per cent), characterized as its picrate, m.p. 165° (Found: C, 61.7, 61.8; H, 4.2, 4.3; N, 9.3. $C_{23}H_{19}O_7N_3$ requires C, 61.45; H, 4.3; N, 9.35; $C_{24}H_{21}O_7N_3$ requires C, 62.2; H, 4.6; N, 9.1 per cent). It is apparently identical with the hydrocarbon "$C_{18}H_{18}$" obtained by Ruzicka, Hösli and Ehmann[3] from hederagenin. Our analyses favour a trimethyl rather than a tetramethyl-phenanthrene formulation, but the latter cannot be excluded. The hydrocarbon gives a marked depression in melting point on admixture with 1 : 6 : 7-trimethylphenanthrene, and it is not identical with 1 2 8- or any other known trimethylphenanthrene The formation of a tri or (tetra-) methylphenanthrene shows that basseol has one of the partial structures I and II



(I)



(II)

The structure (III) suggested for basseol by Ruzicka and Schellenberg[2] cannot be correct, as this would require the formation of 1 6 dimethylphenanthrene on dehydrogenation

The identification of the dehydrogenation product, which will have a considerable bearing upon the structure of the oleanolic acid group is now in progress

J H BEYNON
I M HEILBRON
F S SPRING

University,
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July 29

Beynon Heilbron and Spring *J Chem Soc* 989 (193)

[2] Ruzicka and Schellenberg *Helv chim Acta* **20** 1553 (1937)

[3] Ruzicka Hösll and Ehmann *Helv chim Acta* **17** 442 (1934)

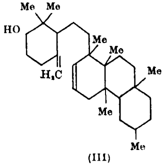
Preparation of 2 8-Diamino Acridine

IT has recently been shown[1] that amino derivatives of acridine combine high antiseptic potency with low toxicity when the orientation of the amino group(*s*) is other than the 1 (that is, 9) position Unfortunately, the general synthetic methods available for preparing specific amino acridines involve many stages and are usually wasteful of both time and material[2], so that a general reaction for converting simple aromatic compounds to amino acridines in a single operation would give valuable assistance in exploring further the chemotherapy of these compounds

A hint of the possibility of such a general reaction seems to lie in a patent of 1921 (*D R P*, 347,819) in which a mixture of glycerol, zinc chloride, *m* phenylenediamine and oxalic acid is stated to give, when heated, a 60 per cent yield of 2 8 diamino acridine, the sulphate of which is the widely used antiseptic proflavine So far, no investigation of this reaction has appeared in the literature, nor does the patent suggest that it has wider applicability

Accordingly we decided to investigate, (*a*) whether substituted *m*-phenylenediamines would take part in this reaction, (*b*) whether aniline reacted in this way either as such or when variously substituted in the *meta* position; (*c*) what the intermediate steps of the reaction are

The work has reached a stage where an interim report may be made, and our findings to date are (*a*) that a variety of substituted *meta* diamines lend themselves admirably to the production of similarly substituted amino acridines of chemotherapeutic interest, up to 72 per cent yields being obtained compared with 62 per cent yield of proflavine-base which we obtained from unsubstituted *m* phenylenediamine, (*b*) that *meta* substituted anilines are most reactive when the substituent is (in descending order of activity) NH_2 $N(CH_3)_2$, OH and least active when it is CH_3 Cl, NO_2, SO_3H or COOH (aniline itself does not react), (*c*) that the weight of experimental evidence strongly suggests in the case of *m* phenylene diamine that the final intermediate is not a diphenyl methane derivative (as would be expected from analogy with the condensations of formaldehyde with aromatic amines in the production of dihydro acridines) but 3 3 diamino N formyldiphenylamine The precursor of the latter compound may be either 3 3 diaminodiphenylamine or 3 aminoformanilide both of which were converted to amino acridines by this general reaction (in the case of 3 aminoformanilide the oxalic acid was omitted)



(III)

Sections (*a*) and (*c*) of the work are still in active progress and a detailed report will appear later

ADRIEN ALBERT
DOROTHY K LARGE

Department of Pharmacy,
University,
Sydney
July 11

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[1] Albert, Francis Garr and Linnell *Brit J Exper Path* **19** 41 (1938) Albert Dyer and Linnell *Quart J Pharm* **10** 649 (1937)

[2] Cf Albert and Linnell *J Chem Soc* 88 1 14 (1936) — (1938)

Effect of Desoxycorticosterone and its Esters

WORK carried out in our laboratories[1] has shown that the output of activity of the male and female sex hormones can be varied almost as desired by suitable esterification By subcutaneous injection of an oily solution, it can reach quite considerable values, in particular, the effect of a few days duration with the free hormone can be raised to several months by using the corresponding esters

An increase in effect in the above sense has not been observed up to the present with progesterone and its derivatives[2] It therefore seemed of interest to investigate the effect of 21 oxyprogesterone or desoxy corticosterone, the artificially prepared hormone of the adrenal cortex first synthesized by Steiger and Reichstein[3] It is known that extracts of the adrenals have only a relatively transitory effect so that, as is the case, for example, with insulin, it must be injected very frequently when used for therapeutic purposes This permits the assumption that the hormone is quickly degraded in the organism In order to solve this problem, we are occupied in preparing and investigating, in addition to the already known acetate, a series of other esters of desoxycorticosterone The accompanying table gives some preliminary results

	Melting point		Average duration of effect in days with a single injection of	
			10 mgm	20 mgm
Desoxycorticosterone	141	142	9	—
acetate	1	159°	10	12
propionate	163	164	11	—
-n butyrate	110	111		20
-n valerianate	84	85	1[illegible]	
palmitate		61	2[illegible]	
benzoate	209	210	20	—
acetate + 100 mgm palmitic acid			14	

Control animals average time of survival 6 5 days

According to the usual test method the cortical hormone is injected *daily* or even more frequently, we gave to adrenalectomized young rats immediately after the operation a *single* injection of 10 mgm and 20 mgm respectively of the substance to be tested the substance was injected subcutaneously in 2 c c of sesame oil and the period of survival ascertained The figures given in the above table correspond to the average values obtained on from 5 to 13 animals per preparation The relatively transitory effect of the free hormone and the slight difference in the period of survival compared with that of the control animals is shown by the table Although with the lower fatty acid esters the average duration of effect is only slightly increased with the palmitate it is raised to more than three weeks The benzoate is also of particular interest as its duration of effect is almost three weeks

A similar increase is obtained by adding an activator such as palmitic acid to desoxycorticosterone acetate and also by converting the desoxycorticosterone ester into an enol derivative The implantation of crystals according to Parkes[4] method appears to be of particular value The duration of effect of the butyrate after implantation of a crystal weighing 10 mgm was 25 days (4 animals)

These experiments will be continued in several fields

In conclusion it should be mentioned that, tested on the rabbit s uterus according to the method of Corner and Clauberg desoxycorticosterone acetate in doses of less than 10 mgm shows a progesterone effect

K MIESCHER
W H FISCHER
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'Ciba' Research Laboratories,
Basle
July 26

[1] Miescher K Wettstein A and Tschopp E *Biochem J* **30** 1970 1977 (1936), Miescher K Fischer W H and Tschopp E NATURE, **140** 726 (1937) Miescher, K Kägi H Scholz C Wettstein A and Tschopp E *Biochem Z* **294** 39 (1937) Miescher K Scholz C and Tschopp E *Biochem J* **32** 141 725 (1938)

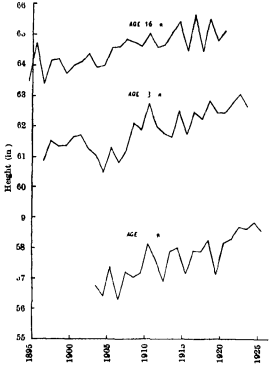
[2] Westphal U *Ber* **70** 2128 (1937)

[3] Steiger M and Reichstein T *Helv chim Acta*, **20** 1164 (1937)

[4] Deanesly R and Parkes, A S *Chem and Ind* **56** 447 (1937)

Heights and Weights in a Girls' Public School

THERE is good evidence to show that the average heights of adults have been increasing in several European countries during the past fifty years Measurements of large numbers of conscripts have been recorded, and for this period they show rates of increase which are not the same in all countries, but are all of the order 1 inch in 25 years This is an extremely rapid rate and it is clear that it cannot have been maintained for any long period in the past The statures of various populations of Europe in prehistoric and early historic times can be estimated from measurements of the long bones of series of skeletons and they do not indicate any marked departures from the averages observed to day The increase in modern times has also been observed in Japanese and Indian groups and in North American groups of European origin and it is possible that the trend has been world wide The cause of this phenomenon can only be conjectured and an explanation which attributes it to better nutrition and hygiene is not altogether satisfactory



HEIGHT GRAPH

There exist no reliable data throwing light on secular variations of the average adult statures for British populations Comparisons of the best figures available are made more difficult owing to the fact that there are clear differences between the means for different social classes More records obtained in the British Isles are available for children but the same difficulty is encountered in interpreting them *

The new measurements here discussed were taken at St Paul s Girls' School at the annual medical inspections from 1907 until 1937, and were made available by the courtesy of the High Mistress Of the majority of individuals whose measurements were used, each girl participated at all three ages, so that the data are therefore more homogeneous than is generally the case If there had been a rise in the social class represented, this would diminish the significance of the results, but in fact the class level has remained almost stationary, and has certainly not risen

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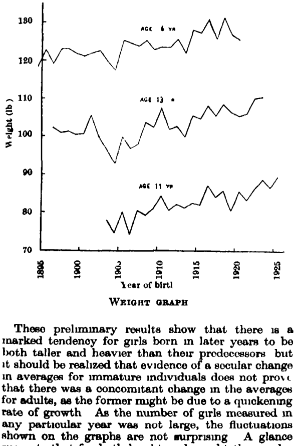
* Miss M N Karn has recently collected various records in a Summary of Results of Investigations into the Height and Weight of Children of the British Working Classes during the last Hundred Years *Annals of Eugenics* vol 7 (1937)

The figures were grouped according to year of birth and age last birthday, and the mean heights and weights of each group have been plotted on the accompanying graphs, kindly prepared by Miss Barbara Shuttleworth of Girton College

The average numbers of measurements in each group for ages eleven, thirteen and sixteen years were 34, 57 6, 63 3, respectively, and no mean is based on fewer than twenty five measurements The standard deviations for each series have also been found, and their means for the three ages are 2 682, 2 651, 2 188 in for the heights and 14 37, 17 30 15 09 lb for the weights



WEIGHT GRAPH

These preliminary results show that there is a marked tendency for girls born in later years to be both taller and heavier than their predecessors but it should be realized that evidence of a secular change in averages for immature individuals does not prove that there was a concomitant change in the averages for adults, as the former might be due to a quickening rate of growth As the number of girls measured in any particular year was not large, the fluctuations shown on the graphs are not surprising A glance suggests that for both height and weight the secular increase was greatest for the girls aged eleven and least for those aged sixteen Both sets of measurements show a fairly steady increase with time, and there is no sign of a decline in the later years or of an arrest of the movement in the case of the girls born during the Great War, although the drop for those measured towards the end of the War and immediately after (most noticeable at age thirteen) may be a reflection of war time conditions at an age at which development normally proceeds rapidly

On the assumption that the graphs for larger numbers would be close to the best fitting straight lines to the points provided by the samples available, it may be said that for the whole period the average height of girls aged eleven was increasing at the rate of about 1 in in ten years that of girls aged thirteen at the rate of about 0 7 in and that of girls aged sixteen at the rate of about 0 6 in in ten years In the case of weight the rates of increase appear to have been approximately 5 5, 4 2 and 3 8 lb, respectively, in ten years

The data presented show conclusively that the heights and weights of girls at St Paul's Girls' School have been increasing significantly in the present century Hence it is impossible to accept the view that a secular change of this kind has been confined to the lower classes of the community The fact that all grades have participated in it does not favour the theory that increasing bulk is due to improved nutrition

It is hoped to publish a fuller account of the investigation when it has been completed

I want to express my sincere thanks to Dr G M Morant of the Galton Laboratory University College London, without whose help and encouragement this work would never have been carried through

RUTH JACOB

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June 27

A Possible Genetic Mechanism in Heterogonic Growth of Limbs of Cattle

IT is well known that the young of most grazing mammals are born with relatively long legs fit to follow their dams To achieve these proportions limbs must exhibit *positive* heterogony[1], or allometry[2] as in the latest terminology during fœtal development, and *negative* heterogony after birth[3]

Analysing data from different sources, I investigated the course of post natal growth of fore limbs relative to the growth of the trunk in the females of six breeds of cattle, differing rather widely in birth, as well as in mature size and proportions The six breeds are the Simmentaler and the Grey Hungarian (data by Szabo v Hangai[4]), the Brown Swiss (data by Engeler[5] and by Carusi[6]), the Holstein and the Jersey (Missouri data[7]) and the Chianina (original data) I found that for all the breeds the growth of fore limbs as measured by height at withers exhibits throughout the whole or the greater part of post natal development, simple negative allometry relative to the growth of the trunk (shoulder to ischium)

The differences in size and proportions during post natal development in five out of six breeds are not at all, or at most very slightly, caused by differences in the *growth constants* α of the allometric equations $y = bx^{a}$, as α shows very close values ranging from 0 74 to 0 78 It is interesting to note that a similar fact has been observed lately by Walton and Hammond in horses[8] Therefore the breed differences must be caused chiefly by the *initial* absolute values of limb and trunk length at the moment at which growth begins to follow the post natal allometric law This moment does not occur after birth, it might occur before or, more likely, at birth

It seems possible that the genetical differentiation of the five breeds consists less of genes acting directly on post natal development than of genes determining, during fœtal development, (1) the *time* at which the post natal allometry begins to act, and (2) the *size* of trunk and limbs at this moment If this moment is not very long before birth, the conclusion might be drawn that the size of limbs and of body of the new born are not negligible factors in the size and pro portions in later life

GUIDO PONTECORVO

Ispettorato Compartimentale
per l Agricoltura della Toscana,
Firenze
July 9

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[5] Engeler W, Untersuchungen ueber die Entwicklung des schweizerischen Braunviehs (Bern 1935)

[6] Carusi A *Annali dell Istituto Zootecnico Sperimentale di Roma* 2 (1929)

[7] *Missouri Agric Exp Stat Bull* 96 (1926)

[8] Walton A and Hammond J *Proc Roy Soc* B 125 311 (June 1938)

Geographical Distribution of Zellerielles

REPORTING the occurrence of zellerielles in frogs at Capetown, Sandon[1] reviewed literature on the distribution of the genus geographically and by host families He contends that the presence of Cape zellerielles is most easily explained on the basis of former land connexions with the other southern continents Sandon noted that the American and Australian species are confined for the most part to the toothed bufonids and, following Metcalf[2], dis counted the Asiatic record of *Zelleriella macronucleata* (Bezzenberger) 1904 from *Bufo melanostictus* Nie s[3] finding of a zellerielle in *Microhyla ornata* at Nanking, however, establishes it as an Asiatic genus as well While Wenrich[4] has shown that host specificity of the Opalinidæ is much less rigid than Metcalf sup posed, the fact that in Asia (Microhylidæ) and in South Africa (Ranidæ) the host families are not toothed bufonids may be significant Further, daCunha and Penido[5] have found a *Zelleriella* in a catfish in the Paraguay River, while Carini[6] and Wenrich report others from snakes

In work on a truncate *Opalina* from *Rana boylii* of California, I have observed in the development of this species a flattened binucleate zellerielle stage, whereas a cylindrical proto opaline form is the larval type previously described as characteristic for the genus This plasticity of form in development within the multinucleate genus *Opalina* suggests that the geographical occurrence of *Zelleriella* and the diversity of its hosts may be explained by the hypothesis that zellerielles have been derived from the cosmopolitan proto opalines at various times and places

Sandon s observations on the Ranids included the statement that only one species has penetrated to North America, the Wrights[7] list twenty four species and subspecies of *Rana* for the United States

J L MOHR

University of California,
Berkeley
July 12

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[2] Metcalf M M The Opalinid Ciliate Infusorians *Bull U S Nat Mus*, 120 (1923)

[3] Nie Dashu, *Contrib Biol Lab Sci Soc China* 11 67 (1935)

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[5] daCunha and Penido, *C R Soc Biol*, 95 1003 (1926)

[6] Carini A, *C.R Soc Biol*, 112 400 (1933)

[7] Wright and Wright, ' Handbook of Frogs and Toads (Ithaca 1933)

Antarctica and Glacial Ages

IN his interesting article on "Antarctica and Glacial Ages' [1], Prof MacBride states "If we add the breadth of the ice shelf to the length of the Beardmore Glacier, we arrive at a total extent of ice floe of about five hundred miles, and this is considerably longer than any glacier the existence of which we have evidence in the Pleistocene Glacial Age But, as is well known, rocks of Scandinavian origin are found in the Pleistocene glacial tills of the north east coast of Norfolk, and there seems very good reason to believe that these erratics were brought into East Anglia by ice originating in Scandinavia Thus this Pleistocene ice flow cannot have been much less than 500 miles long, and may have been considerably more Again, on p 98, Prof MacBride claims—after enumerating the Penckian glaciations, that The most interesting thing about these periods is that the bones and tools of the oldest indubitably human race are found in the inter glacial interval between the Wurm and the Reiss periods Further, on p 99 he mentions the interglacial period between the Reiss and the Wurm glaciations—the time indeed when Neanderthal man flourished I imagine that Prof MacBride is referring to the inter glacial epoch (whether it is correctly assigned to that of the Reiss–Wurm is another matter) when Late Acheulean man existed, and at the close of which the Neanderthal people lived in Western Europe and made the classic Mousterian implements Is it to these races and implements that Prof Mac Bride would confine the term indubitably human ?

It is well perhaps to remember in this regard that Neanderthal man was, to say the least of it, a very peculiar, and in several ways, simian being in his physical make up, while, more ancient in time than the Late Acheulean and Mousterian implements, are those of Lower Acheulean and Chellean times It is probable that the Lower Acheulean specimens date back to the inter glacial phase preceding that mentioned by Prof MacBride, while the Chellean artefacts are located in the deposits of the still earlier warm period—the Gunz–Mindel As both the Chellean and Lower Acheulean hand axes exhibit a skill in flaking equal to if not exceeding that of the Mousterian implements, surely the former specimens are entitled to be classed as of the indubitably human ' standard

As to whether the drift into high latitudes affords a complete explanation of all glacial phenomena previous to the Pleistocene ', I cannot express an opinion But if this drift does at last provide a complete explanation of any glacial phenomena, it will be hailed with joy by all those who are making a study of these problems For, up to the present, their explanation has been sadly lacking in completeness

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[1] NATURE 142 97 99 (July 16 1938)

I THANK Mr Reid Moir for his valuable criticism of my article "Antarctica and Glacial Ages" shall reply as briefly as possible to the two point which he raises

First, as to the size of the Pleistocene Scandinavian ice sheets, I am well aware that these sheets extended across the North Sea and that their terminal moraines form the cliffs ' of Cromer and the neighbourhood I paid two visits to Norway and in the course of the first I dredged extensively at the mouth of the Hardanger fiord and climbed to the crest of the Folgefond snowdrift 5000 ft above the sea The distance from Stavanger to Hull is about 400 miles and the origin of the Scandinavian ice flow was close to the coast where the highest ground is found But the case I put for Antarctica only included the part of it opposite South America which was explored by the Grahamstown expedition, and the highest points from which that flow originated were only 200 miles from the coast But as the diameter of Antarctica is 1,500 miles—their distance from the opposite coast must be at least 1,200 miles ! Further, since Antarctica is 7,000,000 square miles in area and the whole of it is covered by one gigantic ice sheet, it is safe to say that there is no evidence that any Pleistocene ice sheet attained anything like these dimensions

The second point which Mr Reid Moir raises is the presumed age of Neanderthal (*alias* Mousterian) man I placed him in the Reiss–Wurm interglacial interval I did so because there are no undoubted human remains from any earlier horizon The terms Chellean and Acheulean are based not on remains but on stone tools, and I am heretic enough to doubt whether the differences between these tool types represent anything more than slight changes in the same culture If we had corresponding remains I have no doubt that Chellean bones would be essentially similar to the Neanderthal type But if the Chellean tools can really be placed in the Mindel Reiss interglacial interval I am most ready to stand corrected That the first appearance of man belonged to a somewhat earlier horizon in the glacial epoch than I had imagined would make no difference to my argument

E W MACBRIDE

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Pelagohydra mirabilis Dendy in New Zealand

DENDY[1] found a single specimen of *Pelagohydra mirabilis* late in 1901 on the beach at Sumner, near Christchurch The description gives no location of the material after it was finally deposited but apparently the work was carried out at Owens College Manchester

A further specimen came into my hands, collected by one of my students on April 11, 1929, and is now in the Canterbury Museum Christchurch It was found on Sumner Beach in very similar circumstances to those described by Dendy

F PERCIVAL

Canterbury University College
Christchurch N Z
April 11

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[1] Dendy A On a Free Swimming Hydroid *Q J M S* **48** (1903)

Points from Foregoing Letters

BY applying Born s theory of collisions, and also by an independent method, Dr E J Williams estimates that the energy lost by fast moving particles in nuclear collisions when traversing matter, is the same as it would be if the nuclear particles were free and isolated

Experiments by J L Michiels with slow neutrons show that they are anomalously absorbed in boron and iodine filters, and that the activity produced in the detector depends on the order in which the filters are placed The results seem to indicate either a slowing down of the higher energy neutrons by the boron into the iodine resonance region, or an increase in the energy of some of the neutrons on passage through iodine

Photometric curves of the X ray spectra of aluminium at different temperatures (110°, 300° and 680° K) are submitted by Dr H W B Skinner, showing changes in the breadth of the edge of the L_{23} band at 171 A The change between the lower temperatures can be explained by the heat effect upon the conduction-electrons, but the broadening at the higher temperature seems to imply a distortion of the lattice near the melting point

Dr D H Menzel points out an alternative interpretation of T L Page's conclusions in connexion with nebular and laboratory spectra of hydrogen, which does not invalidate Kramers absorption law

R F Barrow reports the observation and vibrational analysis of the ultra violet band system of SiSe corresponding to that of SiS recently described by him and Dr W Jevons

Further steps in the elucidation of the chemical structure of basseol, a triterpene alcohol are reported by J H Beynon, Prof I M Heilbron and Dr F S Spring who submit two possible formulæ

The reaction by which 2 8 diamino acridine is produced from *meta* phenylene diamine in a single operation has been investigated by Dr Adrien Albert and Miss Dorothy Large and found to be of general application The course of the reaction is indicated

The physiological action of desoxycorticosterone (the artificially prepared hormone of the adrenal cortex) upon rats whose adrenal glands had been removed can be prolonged by using the esterified hormone The longest effect has been obtained by Dr K Miescher Dr W H Fischer and F Tschopp by subcutaneous injection of the palmitic acid ester dissolved in sesame oil

Analysing data from various sources, Dr G Pontecorvo finds that in the females of five out of six breeds of cattle the difference in size and proportion of fore limbs relatively to the trunk in the various breeds (during post natal development) are caused chiefly by the absolute values of limbs and trunk at the moment when the growth changes from positive to negative allometry , and this occurs either before, or at, birth The genetical differentiation between breeds, he suggests may be due to genes acting upon the fœtal rather than the post natal development

J L Mohr points out that the parasitic zellerielles in frogs are more widely distributed than usually supposed, and that their sporadic geographical occurrence may be explained by the hypothesis that the zellerielles have been derived from the cosmopolitan proto opalines at various times and places

Research Items

Pre-Folsom Culture in California

OWING to lack of funds, it has been found necessary to bring to a close the excavations on the stone age site at Borax Lake, California, which were being conducted by an expedition of the Southwest Museum of Los Angeles under Mr M R Harrington This expedition, as already announced (see NATURE, 141 p 1004) had discovered stone artefacts at a depth of eight feet below implements of the Folsom type thought to be contemporary with the Folsom industry found in New Mexico in association with an ice age type of fauna, now extinct Further investigations at Borax Lake since the first announcement only serve to confirm the initial view of the high antiquity of the implements from the lower series, but the deposits are at too great a depth, and the site too vast, for complete systematic examination with the limited financial resources the museum expedition has at its disposal This would be possible only if Government assistance were forthcoming through a grant from the Public Works appropriation In the meantime, it is announced in a statement issued by Science Service of Washington, D C, certain tentative conclusions have been formed on the basis of this first season s work Presumably the Folsom people who camped at Borax Lake were of the same type as those of the Folsom sites of New Mexico and Colorado, and were their contemporaries Before the arrival of the Folsom people, the site was occupied by another race, who lived there for a sufficient length of time to build up an accumulation of more than eight feet of soil mixed with human refuse The building up of this eight feet of soil and refuse gives a minimum period of time for the oldest occupation, as the level of the Folsom culture, on the surface or near it, may have been lowered by erosion, whether by wind or by water, as is known to have happened in some of the sites examined, for example, in New Mexico Much further work on the stratification is needed before these conclusions can be regarded as in any way final

Iodides as Antidotes in Thallium Poisoning

IN the course of some investigations at the Brno Veterinary School upon the action of thallium acetate on rats, Prof O V Hykeš and Dr F A Diakov have found that iodides administered subcutaneously greatly reduce the toxic and other effects of thallium (*Biologické Spisy Vysoké Školy Zvérolékařské*, 15, pp 29–45) Six groups of rats were dieted for 32 days with an addition of 0 3 mgm of thallium acetate and then for 6 days with 0 4 mgm per hundred grams of body weight Four of the groups were given daily injections of 0 5 c c of solutions of the iodides of lithium, potassium, sodium, and magnesium containing 20 mgm iodine per c c, respectively Animals of the fifth group were treated with calcium iodide, but they soon showed signs of dermatitis due to the calcium, and they were afterwards given injections of sodium iodide The sixth group, serving as a control, were given the thallium acetate with their diet but without the iodide injections They quickly developed symptoms of acute thallium poisoning, and the acetate had to be omitted periodically from their diet A seventh control group received no chemical treatment and the animals grew normally, the females having litters All the animals treated with lithium, potassium or sodium iodide looked healthy, and increased in weight and preserved their coats Rats injected with magnesium iodide looked healthy, but had lost much hair Those of the sixth group had lost almost all hair and even the feelers were affected After 35–40 days they developed eye cataracts, but no indication of this was observed with animals subjected to iodide injection Administration of iodides is thus shown to reduce very considerably the toxicity and loss of hair due to thallium salts, and the authors conclude that this antidotal effect is brought about in a physico chemical manner It would appear that the action of thallium acetate is direct and does not pass through the endocrine or endocrine sympathetic system

Phyllopod Crustacea

PAUL MATHIAS has published a most useful general memoir entitled "Phyllopoda Biologie des Crustacées phyllopodes" (Actualités scientifiques et industrielles, 447 Paris Hermann et Cie 1937) This is a good account of the group by one who has worked at it to a considerable extent All interested in these small Crustacea should possess it General characters, conditions of life, movement, respiration, alimentation, reproduction, eggs, growth and duration of life, regeneration, enemies, uses, distribution both recent and fossil, all have their fair share of attention This is an ancient group, and some of the oldest fossils known show a structure very similar to recent forms The earliest Phyllopods are found in marine deposits, but from Cambrian times freshwater forms are well characterized The author draws largely on his individual store of knowledge, especially in experimental work, making the essay specially valuable There is a good and full bibliography

Greenkeeping Research

THE latest issue of the *Journal of the Board of Greenkeeping Research* (5, No 18, 1938 *3s 6d*) contains an article on the effects of sulphur in improving the physical condition of clay soils Results from experiments suggest that surface application of sulphur increases the porosity of heavy soil, but readers are recommended to approach the St Ives Research Station, Bingley, Yorks, for advice before making trials themselves Although compost sterilization to destroy weed seeds, eelworm, etc, has been used for some years, more efficient methods are always being sought, and an article in this number of the *Journal* describes the latest steaming and electric plants designed for this purpose Interesting accounts are also given of the problems of greenkeeping research in New Zealand and the differences between greenkeeping conditions in the United States and Great Britain Particulars are supplied of the third course of instruction for greenkeepers which it is proposed to hold in the autumn provided the demand is sufficient, and attention directed to the fact that the principal makes of mower and other implements may be inspected at the Permanent Implement Exhibition at the Station

‘Stripe’ Disease of Narcissus

AT a meeting on August 22 of Section K (Botany) of the British Association, Dr J Caldwell discussed certain aspects of this disease The disease has been recognized by growers and others for a very long time, and there is evidence that it is spreading rapidly in the field In some instances in commercial stocks every plant has been found to be infected It must be noted, however that some varieties show a high degree of tolerance to the disease, even though they are highly susceptible The varietal response to the disease differs markedly, and while the symptom complexes can be grouped into various categories, it is not possible as yet to determine beforehand which types of symptoms are to be expected in any new variety The symptoms found in plants infected with stripe’ fall into three main groups (*a*) a more or less simple mosaic characterized by the appearance of small chlorotic areas on the leaves and flower stalks of the plants, with some break in the petals and coronas of varieties with coloured flowers, (*b*) severe mosaics characterized by the occurrence of large highly chlorotic areas on the leaves, and (*c*) proliferation and overgrowth of tissue on the leaves and flower stalks as in Czarina and Weardale Perfection There is probably a fourth group in which there is marked distortion in the plants, but it is not yet clear how far this differs fundamentally from the symptoms in group (*c*) The examination of a very large number of wild species of *Narcissus* growing under natural conditions has so far yielded no evidence that any of these symptoms are found in the wild *Narcissus* (*N Pseudo Narcissus*) There is no evidence that the disease is seed borne in the cultivated varieties No vector has yet been found by any of the investigators of the disease and there is little detailed published evidence that the disease is experimentally transmissible It has been found that the juice of infected bulbs is infective after passage through Pasteur Chamberland *L*3 candles and that the agent reacts in a manner typical of a virus The method of inoculation found to be most effective was by hypodermic needle with subsequent damage to the leaf tissue at the base of the leaves In the main, inoculations made in the early part of the season are more effective than those made later The histological changes in the tissues associated with the disease are also considered

Curvature of Columnar Jointing in Volcanic Necks

THE mechanics of the columnar jointing of basaltic lava is already well understood C B Hunt has now attempted to explain the characteristic curving of such joints in volcanic necks (*Amer J Sci*, 142, 1938) The joints that first form are at the surface and stand in a vertical position The heat loss in a vertical direction from a pipe diminishes with depth, whereas the heat loss laterally diminishes inwards from the sides From an analysis of the contraction stress ratios and of the incipient fractures dependent on the variable rates of cooling, it is found that the fractures progressively change from a practically vertical position at the top to a practically horizontal position in depth At any given point, fracturing may be along either of two sets of planes, one dipping outward towards the sides of the pipe, the other dipping inward. The set dipping outward is favoured by cracks extending downward from the surface, because contraction is greater towards the sides than towards the middle of the pipe The analysis is illustrated by reference to the numerous volcanic necks of the Mount Taylor region of New Mexico (For a British example, see S I Tomkeieff The Dolerite Plug at Balleygalley Head Co Antrim" *Irish Nat J* July 1935)

Chromatographic Separation of *Cis*- and *Trans*-Azobenzene

AN interesting application of chromatographic analysis has been made recently (Zechmeister, Frehden and Jorgensen *Naturwiss* 26 495, 1938), the process having been employed for the separation of *cis* and *trans* isomerides G S Hartley (NATURE, 140 281, 1938) discovered that azobenzene (m p 68°) suffered a partial transformation into the *cis* form (m p 71°–72°) on exposure to sunlight The heterogeneity of the product can readily be shown by chromatography The solution of the mixture of the *cis* and *trans* forms of azobenzene in benzene or benzine is passed through a long tube filled with specially selected aluminium oxide Benzene is also used as developer The adsorbent shows two intense yellow zones separated by a broad white layer After elution with ice cold ether the crystalline *cis* compound was obtained, the properties of which were identical with those of the compound described by Hartley The absorption affinity of the *cis* isomeride is considerably greater than that of the *trans* form It would be possible to use the method to discover whether the spontaneous isomerization of lycopene (Zechmeister and Tuzson NATURE 141 249, 1938) is a *cis trans* isomerization

Inclination of Spiral Nebulæ to the Line of Sight

IN January 1938 Mr F G Brown published a paper in which he showed from his calculations of the inclinations to the line of sight of the planes of the extra galactic nebulæ of more than 2 in diameter in Reinmuth s catalogue that the preponderance of small inclinations could not be accounted for by observational selection but was apparently due to a systematic orientation of the planes in space (*Mon Not Roy Astro Soc* 98 3 1938) A notice of this paper appeared in NATURE of April 30 p 796 Dr. H Knox Shaw considers Mr Brown s conclusions are so inherently improbable that he felt it worth while to investigate the matter further (*Mon Not. Roy Astro Soc*, 98, 7, May 1938) He has made a calculation similar to that of Mr Brown using the objects in the Shapley Ames catalogue given in the *Harvard Annals* (88 2, 1932), but adopting the revised dimensions and descriptions for 448 of the nebulæ given in Part 4 of the same volume of the *Harvard Annals* As this catalogue covers the whole sky and the dimensions of the nebulæ contained therein are taken from a number of sources, it affords the best material for testing the matter under discussion The Heidelberg catalogue used by Brown goes down to declination −20° only and for this reason probably contains a larger proportion of nebulæ from the polar cap than the Harvard catalogue, which shows that about one third of its objects are within 30° of the north galactic pole The elongated spirals are a little more frequent in this region than elsewhere and the large proportion of elongated objects found by Brown may be due to the preponderating influence of the rich polar cap In any event, the difference between the results from the two catalogues suggests that selection has an important effect on the figures obtained, and the planes of the spirals are probably distributed in a random manner, contrary to the view advocated by Brown

The Mathematics of Experimentation

THE first morning of the British Association meeting at Cambridge saw a discussion in Section A* (Mathematics), of exceptionally wide interest to workers in experimental science The five speakers, three American and two English, had all in recent years engaged in the study of the combinatorial problems underlying modern types of experimental design, aimed at eliminating errors due to heterogeneity of material, and at founding inferences on valid tests of significance

On one side, the experimental importance of designs such as the Latin square, now widely adopted has led mathematicians to a more serious study of old problems of which the previous treatment in the mathematical literature has been discontinuous and desultory, on the other, fresh combinatorial possibilities are being explored, capable of meeting the peculiar experimental difficulties encountered in fields at present ill supplied with effective experimental designs

Prof C C Craig, of Ann Arbor, Michigan, opened the discussion with an account of tests of significance from which the customary basis of the theory of errors, the normality of residual deviations, is completely eliminated Such tests, using the ancillary information supplied by the data themselves, have been the subject of several recent mathematical papers Their logical cogency is unquestionable, but their use is limited by their being certainly laborious, and usually believed to be less sensitive than the simpler tests in common use Prof Craig exhibited a theoretical approach to the problem of sensitivity, and showed that this is more nearly comparable than is often supposed with that of the ordinary tests based on the theory of errors

In discussing the enumeration of the Latin and Græco-Latin squares of side 7, Dr Horace W Norton, of the Galton Laboratory, London, gave a most interesting account of the transformation sets into which these can be grouped As has long been recognized, an aggregate of 7! × 6! (3,628,800) Latin square solutions may be represented by a single standard square, having the letters of the first row and column in standard order By the process of intramutation, the six letters other than the corner element, *A*, are permuted, and the rows and columns rearranged to the standard order Thereby sets up to 720 standard squares may be generated, such sets having an invariant diagonal structure, by which possible identifications can be recognized Choice among the 49 possible corner elements then gives a transformation set of possibly 35,780 standard squares Finally, permutation of the three categories, rows, columns and letters, may yield 6 adjugate sets, or 211,680 standard squares in all In the less degenerate sets, recognition of possible identities among corner elements, and among categories, is easily accomplished by mapping the positions of the 2 × 2 Latin squares, of which usually, but not always, there are a number intercalated in any square under investigation These big sets are sufficiently large to be useful in enumerating the entire family of 7 × 7 Latin squares, which do not perhaps exceed 25 million in number The essence of the procedure is that we should be able to test expeditiously whether any given square is a member of a set already known, or whether a new set has been discovered

The reversal of an intercalated 2 × 2 square will generate a new square, not usually belonging to the original set Most of the sets so far known (about 100) have been discovered in this way, and it is not impossible that all sets having intercalates form one connected system The process cannot, however, lead to any set which lacks intercalates altogether, and Dr Norton made a fruitful suggestion in pointing out that reversal may also be applied to intercalated 2 × 3 rectangles, which may lead to such sets The sets lacking intercalates so far discovered are, however, all involved in Græco Latin squares, in which the permutation of four categories may generate 24 different adjugate sets having, as Latin squares, four different aspects The five known Græco Latin sets all involve in some aspect squares orthogonal to the very degenerate group known as cyclic squares, which, as Jacob had shown, are only 120 in number The number of Græco solutions of these squares, running into hundreds, contrasts strikingly with the rarity of Græco solutions among the ordinary sets of Latin squares During the year, Dr Norton has enumerated about 12 million standard squares, and has incidentally brought to light a structural system of relationship, more important perhaps for our general knowledge of Latin and higher squares, than the simple problem of complete enumeration

The bearing of such combinatorial researches on practical experimentation was well brought out by the two following speakers, Dr W J Youden, of the Boyce Thompson Institute, New York, and Mr Frank Yates, of Rothamsted Experimental Station Dr Youden discussed problems confronting the plant physiologist or plant pathologist using as experimental material the successive leaves of a number of different experimental plants He gave data to explain his experience that both the individuality of the plant and the ordinal value of the leaf very largely affect the reaction observed Precision is greatly increased if both these factors can be simultaneously eliminated, as in the Latin square The number of substances or dilutions which it is necessary to test simultaneously, is, however, often greater than the number of leaves on each plant In such cases, the elimination of plant individuality may be effected by Yates's method of incomplete randomized blocks, in which although all treatments cannot be applied to any one plant, every treatment is tested in the aggregate on the same plants with one or more complete replications of the alternative treatments In other words, every *pair* of treatments occurs equally frequently on the same plant Youden showed that this advantage may be combined, as in the Latin square, with having one complete replication at each leaf level

Those solutions of the problem of incomplete blocks, of which tables have now been published, in which the number of replications is equal to the number of elements in a block, furnish the basis for the formation of Youden's squares In these the rows and columns are equal in number to the treatments, or to the plants, while the letters are only as numerous as the number of replications, or of leaves on each plant Every row and column must contain all letters once, the remaining spaces being unoccupied Further, every pair of rows (or columns) must be occupied simultaneously in the same number of columns (or rows) When the incomplete block solution is known, little difficulty has been found in completing the square The non existence of an incomplete block solution is, however, a difficult matter to establish, and Dr Youden indicated that nearly exhaustive trials so far suggested the non existence of the (arithmetically) possible 22 × 22 square having seven letters

It was gratifying to observe that a large and predominantly mathematical audience showed the greatest interest in Dr Youden's account of practical experimental requirements, and in the variety of applications which the known solutions open up in biological material

In the short time available, Mr Yates, whose work in this field is widely known, confined himself to explaining the logical genesis of the very beautiful Lattice square, commencing from the simple, triple or multiple lattice This whole group of designs is adapted to the requirements of the plant breeder who may need to test two hundred or more varieties in a single year If the number of varieties is a perfect square, they may be cross classified in a square lattice, of which the rows and columns supply the block contents in two contrasted types of replication The block size is thus reduced to the square root of the number of varieties In a triple lattice a third type of replication is supplied by choosing for the same block varieties having the same letter of a Latin square, which may always be found Squares, the side of which is an odd number, or a multiple of 4, will also always yield a fourth type of replication, making a quadruple lattice For prime numbers, and, as appeared later in the discussion, for all powers of primes, a complete set of mutually orthogonal classifications is possible, leading, if one replication of each type is used, to one of the known solutions of the problem of randomized incomplete blocks We have, however, free choice in the topographical arrangement of the plots, and if the number of varieties is the square of an odd number, such as 11, we may halve the number of complete replications by superimposing pairs of these in a Latin square, so that six 11 × 11 squares will suffice to give equal precision to all comparisons This considerable advantage, combined with the high precision to be expected in Latin square designs, makes the scheme as attractive experimentally as it is mathematically elegant

Mr W L Stevens, of the Galton Laboratory, had a surprise in store, in the form of a demonstration of the fact that for any power of a prime a completely orthogonal square exists The converse had been asserted, on the basis of an erroneous proof by Wernicke in 1910, but the theorem had appeared to be probably true from the construction in 1936 of completely orthogonalized squares of sides 8 and 9, by Yates and Fisher respectively It was known to his associates that Mr Stevens had already established a demonstration for the square of any prime number, but the very simple generalization which he gave had only occurred to him during the week

Based on the theorem that if s is a power of a prime, a field of s symbols with the corresponding operations of addition, subtraction, multiplication and division can be defined so that the results of these operations fall within the field and are unique, we may define a Latin square by the equation

$$u_L = u_\lambda u_R + u_C \qquad u_\lambda \neq 0_C$$

where u_R, u_C and u_L designate the row, column and letter of any element, and u_λ is arbitrary apart from the restriction that it may not be zero

Assigning its $s-1$ possible values to u_λ generates $s-1$ Latin squares, and the uniqueness of the solution of the equations, regarded as simultaneous in u_R and u_C

$$u_i = u_\lambda u_R + u_C$$
$$u_j = u_\mu u_R + u_C$$

shows that the element having a given letter i in the first square, and a given letter j in the second, is uniquely determined in row and column Thus any two Latin squares of the set are orthogonal, and the whole constitutes a completely orthogonalized square

It was interesting to learn that the 9 × 9 squares obtained in this way are different from one previously given by Yates, so that for the larger squares a multiplicity of completely orthogonal solutions is to be anticipated

It is much to be regretted that the programme allowed no time for discussion We should have liked to hear the reaction of many mathematicians in the audience which remained to the end closely interested

R A FISHER

Plant Growth Substances

FOLLOWING a project first put forward in 1925, the Committee on Intellectual Cooperation of the League of Nations and the International Council of Scientific Unions have agreed to collaborate in the calling of occasional conferences on well defined fields The first of these, on the plant growth substances, or phytohormones, was held in Paris on October 1–2, 1937, under the joint auspices of the CIC and the International Union of Biological Societies

The report of the conference,* which has just been issued, contains eight contributed papers and discussion Prof Kögl (Utrecht) describes the determination of the chemical nature of auxins a and b and the isolation of biotin Dr Niels Nielsen (Copenhagen) discusses the substances promoting growth in the fungi, and the difficulties introduced by the varying abilities of organisms to synthesize different members of the group of active substances The evidence associating the formation and action of auxins with oxidative metabolism is reviewed by Prof Koningsberger (Utrecht), the phenomenon of bud inhibition and other correlations by Prof Dostál (Brno) and the relation between the phytohormones and plant tropisms by the chairman, Prof Boysen

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* Études et Recherches sur les Phytohormones Première Réunion organisée en collaboration avec l Union Internationale des Sciences Biologiques, Paris, 1 et 2 Octobre, 1937 Pp xiv+125 (Paris Institut International de Coopération Intellectuelle)

Jensen (Copenhagen) Prof G S Avery (New London, U S A) makes a plea for the consideration of the auxins as protoplasm irritants or evocators Prof Bouillenne (Liège) discusses the action of auxins on cell division and root formation and expresses the rather surprising opinion that although promotion of cambial division and inhibition of lateral bud development occur on applying pure auxins at concentrations within the physiological range, to a variety of plants nevertheless under natural conditions the auxins do not have these effects Finally Mlle Zollikofer (Zurich) reviews the rather unsatisfactory state of the work on the effect of animal hormones on plant growth It seems unfortunate that Prof Němeč who (according to the preface) proposed the conference and who has long been active in the closely related field of regeneration should not have been present

As is natural in a field which is developing so rapidly, there are many matters of dispute and most of the papers stress points of uncertainty rather than the well established facts The very extensive material presented however makes clear how impressive has been the progress in the last few years towards an understanding of the control of growth in plants Perhaps the most interesting parts of the book are the discussions which are reported in full Naturally a conversation between half a dozen men who are really familiar with the field is of much greater value than the usual questions at a large meeting

The fact that many substances which are probably not present in plant tissues have physiological effects almost indistinguishable from those of the naturally occurring auxins raised much discussion Animal hormones present parallel cases The difficulty centred partly on nomenclature and partly on the applicability of results obtained with these synthetic substances to the interpretation of natural processes As to the former an agreement was reached according to which two groups of growth substances are distinguished (*a*) the auxins (*b*) the bios group The auxins comprise those actually present in plants (phytohormones proper) and those not present but exerting similar effects The bios group includes aneurin biotin oestrin etc known to be present in plants and a group of substances designated specific nutrients such as mesoinositol β alanine leucine and pyruvic and gluconic acids The grouping of these latter under bios a term which up to now has had a rather specific meaning seems wholly unjustified both because specific nutrients are difficult to define and because such a large and heterogeneous group of compounds is involved

Another question raised was whether the action of auxins constitutes irritability or not However this was soon found to be unprofitable for lack of a clear statement of the rather old fashioned concept of irritability or stimulus and the related one of stimulus substances (*Reizstoffe*)

At the close of the conference Prof Boysen Jensen invited the members to meet again in Copenhagen in September 1939 The success of this first venture would seem to justify further extension of these small conferences between specialists in definite fields of scientific activity

KENNETH V THIMANN

Contributions of Engineering to Physics

PROF M L E OLIPHANT of the University of Birmingham took as the subject of his evening discourse to the British Association delivered at Cambridge on August 22 the contributions of engineers more especially electrical engineers to the science of physics To cover the whole field in a single lecture would be impossible and so he confined himself to a few only of the technical contributions made by electrical engineers to physics He began by making a quotation from a dinner speech of Lord Rutherford

> For the greater part of my life I have been engaged in investigations to try to obtain a clearer idea of the relations between electricity and matter and the all important part that electrical charges play in the structure of the atoms of our material world Yet I would find it difficult to tell you what electricity is It is so fundamental an entity in Nature that explanation is impossible Yet our knowledge of the laws which electricity obeys is now so complete that we are able to predict with considerable confidence the performance of any piece of electrical machinery—provided of course it is large compared to the atom

As Prof Oliphant was a pupil of Lord Rutherford and naturally the inspiration which he gave to all who worked with him in his famous laboratory has coloured his outlook, he wisely contented himself by illustrating his lecture by examples taken from the Cavendish Laboratory and the work carried out there, going back to the time when sealing wax and string were practically the only essentials of a piece of apparatus for physical research Many physicists regret the passing of that direct simplicity of approach They recognize that the physicist can no longer be self sufficient The time is therefore ripe for a review of the situation which may help us to see how the interactions of engineering and physics may best be employed to their mutual advancement

Electrical engineering by the provision of technical equipment and facilities and by nurturing physical research in its own laboratories has made the greatest contribution to the advancement of physics Prof Oliphant pointed out that when Faraday in 1831 made fundamental experiments on the magnetic induction in an iron ring he had to make his own insulated conductors by winding laboriously twine and wire together over layers of calico

Probably the greatest contribution made by electrical engineering to the physical sciences is the provision of an abundant and steady supply of electricity for laboratory purposes Prof Oliphant recalled the time when a small gas engine used to drive a dynamo and this in turn was used to charge accumulators The supply of electricity to a class was therefore limited and the voltage drop made the experiments very difficult Rutherford used to tell of the trouble of preparing each morning a number of Grove cells and how these used often to fail badly in the course of the day's work In these days also the only voltmeter in the Cavendish Laboratory was a Cardew hot wire instrument which was very sluggish in its action and took a large current, so that in measuring the voltage of a small accumulator, great care had to be taken to prevent the accumulator being run down completely Nowadays, ammeters and voltmeters of precision are available at low prices for laboratory work This is due to the great demand for them by the wireless industry

When electricians agreed to make alternating current supply the standard many laboratories found themselves in considerable difficulties, as a steady direct current is needed for many fundamental experiments Luckily the copper oxide rectifier developed by the Westinghouse Company in the United States converts the alternating current into direct current most satisfactorily These efficient and apparently everlasting little pieces of apparatus have saved physical laboratories large sums of money and have proved of immense help The copper oxide rectifier when exposed to light is found to generate an electric current It is therefore possible to use it in photometry and for measuring the density of photographic blackening

Prof Oliphant pointed out how the work of Cockcroft, Lawrence and Kapitza has revolutionized the apparatus required for a physical laboratory With the help of the Metropolitan Vickers Electrical Co Ltd a 50 cycle 2 000 kw A C generator has been constructed the nominal rating of which is 2 000 kw but when short circuited for half a cycle develops a power of 55 000 kw Magnetic fields were generated of considerable volume under a magnetic force of 300,000 gauss Dr T E Allibone s valuable work on the problem of applying high electric potentials to evacuate insulating vessels is of great importance Before he left the Cavendish Laboratory he had succeeded in producing considerable beams of artificial β rays

Dr C R Burch of Metropolitan Vickers found that it is possible to produce by vacuum distillation of mineral oils, residual oils with very low vapour pressure These oils can be distilled unchanged in a vacuum of a fraction of a millimetre The apparatus of Cockcroft and Walton was an unqualified success and with it they showed for the first time that accelerated particles of hydrogen can penetrate the nucleus of certain atoms and produce profound changes in them This and the discovery of the neutron stimulated research into these problems all over the world

At the same time that Cockcroft and Walton were developing the high voltage method for accelerating particles Prof E O Lawrence of Berkeley, California was experimenting with indirect methods which do not require large voltages He was successful in developing the cyclotron by means of which he accelerated particles to energies corresponding with nine million volts The cyclotron has proved of immense utility to nuclear research Unfortunately it is very expensive The magnets of the cyclotrons at Liverpool and Cambridge weigh 50 tons each of which seven tons is copper and they produce a field of 19 000 gauss over a gap 90 cm in diameter

The new branches of physics are by far the most fundamental of any as they touch the ultimate constitution of matter itself They can only be attacked successfully by very highly skilled teams of workers as the number of pieces of intricate apparatus which has to function simultaneously is very large New effects are being continually observed and it is necessary to explain them and correlate them with existing knowledge

Rutherford and Geiger were able to detect and count for the first time the number of α particles emitted by a gram of radium but the method has several defects and is exceedingly difficult to apply The method now used is to amplify the current produced in a small ionization chamber by the pulse of ions due to each α particle This is heard as a loud click in a speaker attached to the amplifier

Prof Oliphant concluded by giving a quotation from Bacon frequently used by Rutherford Human knowledge and human power are co extensive for ignorance of causes prevents us from producing effects Nature can only be ruled by being obeyed for the causes which theory discovers give the rules which practice applies

Radio Exhibition, Olympia

THE annual exhibition of wireless apparatus organized by the Radio Manufacturers Association was held at Olympia on August 24 until September 3, and it was notable for such features as the replacement of the B B C Radio Theatre by a glass walled television studio in operation, the first large display of television receivers in actual operation on exhibitors stands, and the complete demonstration of sound broadcasting receivers for the first time On previous occasions the stands were supplied inside the exhibition with audio frequency programme current, so that no demonstration of the radio frequency portion of receivers could be given This year, arrangements were made for all stands to be supplied with radio frequency signals so that the various receivers could be demonstrated as a whole

On the technical side, sound broadcasting receivers appear to have settled down to fairly standard types of design, and with the steady improvement of detail which has resulted in methods of lay out and manufacture during recent years, the modern receiver is very efficient and supplies the needs of the majority of listeners The chief novel feature among this year s sets is the incorporation of some form of automatic tuning by means of which a certain number of broadcasting stations can be selected at will by operating switches on the front of the receiver To what extent this feature was really required by the listener time will tell, but it would appear to be consistent with the demands of the age and to have advantages comparable with those of the automatic telephone and the pre selector gear on motor cars The automatically tuned receiver is provided with a series of about six push buttons in addition to the usual on and off switch, by pressing one of these buttons, the receiver is automatically adjusted to receive the programme from a certain station In some cases the actual stations made available to the press button control can be altered by carrying out certain more or less simple adjustments on the receiver The manner of achieving this automatic tuning varies among the manufacturers and has called forth a considerable amount of mechanical ingenuity in some cases The methods vary from the switching in of one of a series of fixed condensers across each tuned circuit of the receiver, to the use of a motor driving the main ganged variable condenser in conjunction with an electrical method of obtaining accurate synchronism with the incoming signals In all cases, the purchaser is assured that the addition of this automatic device in no way reduces the efficiency of the receiver as a whole or affects the ability to operate it manually

On the television side, the large display of receivers in operation on the various stands demonstrated admirably that this phase of the art is now on a commercial production basis, and made the visitor prone to forget that the potential market at present is limited to those who reside within about thirty miles of Alexandra Palace It is well known that reception of television has been successfully accomplished at much greater distances, but the above represents the reliable service range at present A determined effort has been made by manufacturers to reduce the cost of television receivers to the minimum, and by the use of smaller cathode ray tubes, giving good results with a picture size of about 4½ in by 4 in, complete sound and vision receivers are now available at from a little more than twenty pounds At least one manufacturer has realized also that many listeners are already adequately provided with a normal sound broadcasting receiver, for there is now available a set for television reception only, but including the sound programme appropriate thereto One of these sets gives a satisfactory picture of size 7½ in by 6 in, and the price shows a saving of one third over that of a similar model giving all wave broadcast reception in addition to the television In many cases the previous version of the domestic television receiver giving a larger picture of size 10 in by 8 in has been retained, but it is naturally more expensive Some firms provide more elaborate equipment which, by projection on to a small cinema screen, gives a picture of the order of 24 in by 20 in in size, and this provides comfortable viewing for a score or so of persons In some cases this large picture is obtained by projection from a comparatively small image produced on the screen of a cathode ray tube of 3 in or 4 in diameter In one case, however, the scanning was carried out mechanically by special forms of mirror drum, and the satisfactory demonstration given testified to the success which has been achieved in the development of the high and low speed motor driven scanners employed in this system

The remainder of the exhibition was devoted largely to the miscellaneous components and accessories utilized by the radio receiver industry Loudspeakers and public address equipment, test and service apparatus, special condensers, switches and other components were displayed in all their variety The Post Office exhibit showed the various methods and devices adopted to mitigate the interference nuisance, and some firms displayed apparatus and devices for measuring and reducing this interference Lastly, and by no means least, that most important component, the thermionic valve, was shown still to be making steady progress in the direction of increased efficiency in meeting the varied demands now made upon it While it is perhaps regrettable that this development has resulted in an increase in the number of types of valves and also in the valve bases, some consolation is perhaps to be drawn from the fact that reductions in price of the order of 20 per cent on many types were announced by several manufacturers just prior to the opening of the exhibition R L S-R

Science News a Century Ago

Ascent of Mont Blanc by a Lady

'A FRENCH lady named Dangeville ascended to the summit of Mont Blanc on the 4th inst [September 1838] She quitted the valley of Chamonix on the 3rd, at an early hour in the morning, slept at the Grand Mulets, and reached her perilous destination at 12 o'clock on the 4th She remained on the summit of the mountain for about an hour, wrote some notes, and drank a health to the Count de Paris The guides by whom she was accompanied spoke in the highest terms of her courage, perseverance and presence of mind Previous to this successful trip, the feat had been accomplished by only one female, a peasant of Chamonix, who, on reaching the grand plateau became exhausted with fatigue and was carried by force to the summit Mademoiselle Dangeville on her return to the Chamonix on the morning of the 5th inst, was received with the utmost enthusiasm by the inhabitants, who proceeded to meet her, and fired salutes of cannon in honour of her exploit (Annual Register, 1838)

Lyell at the Athenæum

WRITING on September 8, 1838, to Darwin, Lyell said 'I am very glad to hear you like the Athenæum I used to make one mistake when first I went there When anxious to push on with my book, after a two hours' spell', I went there by way of a lounge and instead of that, worked my head very hard, being excited by meeting with clever people, who would often talk to me, very much to my profit, on the very subject on which I was writing, or I fell in with a Review or Magazine relating to geology Now this was all very well, but I used to forget that this ought to count for work, although nothing had been written, and that I ought consequently to give up my second 'two hours spell As your eyes are strong, you can afford to read the light articles and newspaper gossip, which I could never indulge in much with impunity'

Colours of Thin Plates

THE *Mechanic's Magazine* of September 8, 1838, contained a contribution from Charles Tomlinson (1808–1897) on Experiments and Observations on the Colours of Thin Plates" Prefacing his remarks by a note on the various modes of obtaining Newton's rings and the colours of thin plates which were generally known, he offered to scientific men some new facts Some of his experiments had been made with spirit of turpentine and balsam of Peru 'When a drop of balsam of Peru," he wrote, "is allowed to fall upon the surface of water we instantly get a magnificent display of coloured rings . on applying vapour of ether, ammonia, etc , to any part of the film, its thickness is instantly reduced, so that the colour belonging to one order of Newton's rings is instantly exchanged for the colour of one of the series above it

"A magnet seems also to have an action upon the film, the North pole tending to repel it, and the South pole to attract it."

Tomlinson, who was elected F R S in 1872, made important discoveries concerning surface tension in liquids.

Societies and Academies

Paris

Academy of Sciences (207, 7–100, July 4 1938)

H DESLANDRES Universal constant of band spectra Attribution of the lines of the band to causes other than the rotation of the molecule A simple relation is found between the frequencies of the molecule and the activated electrons of its atoms

R FOSSE, R DE LARAMBERGUE and J GAIDDON Synthesis of cyanamide by the action of silver oxide on formaldehyde and ammonia

R ESNAULT PELTERIE The output of [air]screws

P FOURMARIER The reciprocal relation between the discontinuities in the fold zone of Cornwall (England)

L COUFFIGNAL The operations of pure mathematics are all mechanical functions

H LAUGIER and MLLE D WEINBERG Analysis of the spread [about a mean] of the total marks in the examination for the *baccalauréat*

J DIEUDONNÉ Complete uniform spaces

R POTIER Spaces with affine connexion and generalized Riemannian spaces

L I GAMA Additivity of the contingent

A BERMANT Remark on Schwarz s lemma

J GALIBOURG and P Laurent Subpermanent deformations [of a body]

R DUCHÊNE New method for measuring gas supplies The principle used is to inject a bubble of a foreign gas into the gas main and to ascertain the time it takes to reach a point at a known distance downstream

L VIAUD Study in a wind tunnel of the aerodynamic characteristics of [wings fitted with] *dispositifs hypersustentateurs* placed near the ground

G BADARAU Passage of corpuscles across spherical potential barriers

A VÉRONNET Mechanical determination of the constitution of atomic nuclei

T PECZALSKI Statistical interpretation of the reactions between solids at high temperature

R MÉRIGOUX Different structures of the mist deposited by blowing on certain [chemically] fatty substances

P TONGAS Calculation of the gas constant for steam from the experimental results adopted by the International Conference of Steam Tables The mean value for R is 47 062

Y LE GRAND A logarithmic galvanometer

V P MIHU Absorption of energy by high frequency currents in Geissler tubes

T V IONESCU New observations on ionized gas oscillators in a magnetic field

S GORODETZKY An arrangement for improving the functioning of multiple coincidence detectors

R CHEVALLIER and MLLE S MATHIEU Magnetic contribution of the constituents of iron hydroxide in an alkaline medium

A GUILLET Control and measurement with the aid of images obtained by multiple reflections

MME A VASSY and E VASSY Absorption of light by the lower atmosphere

MME J GAVORET Adsorption and swelling of α cellulose

E MOLES and A ESCRIBANO Limiting density of the gases O_2 and CO_2 Atomic weight of carbon The most probable value for the latter is given as 12 007

MLLE S THÉVENET Influence of electrolytes on the viscosity of an iron hydroxide sol

P CHEVENARD and A PORTEVIN New method for the study of metallic diffusion The curve of magnetization against temperature gives a series of Curie points for the various concentrations and also gives extreme concentrations

M BACKÈS Constitution of aldol and ethanal

V FROLOW Analysis of the annual maximum of the Dnieper

MLLE Y BOISSE DE BLACK Glacial deposits of the basin of Condat (Cantal)

G DÉJARDIN and R BERNARD The height of the layer in the atmosphere from which the D lines are emitted and the origin of sodium atoms in this layer

L PLANTEFOL Generality of extrinsic oxidations Extrinsic oxidations appear to take an important part in gaseous exchanges and can under various physiological conditions, constitute an appreciable part of respiration

M SIMONET R CHOPINET and G SOUILIJAERT Obtaining a tetraploid *Linum usitatissimum* L by the application of colchicine The seeds were immersed in aqueous solutions of colchicine

A PEYRON and H LIMOUSIN The development, inside the veins in multiple *tumeurs à tissus* of the human testicle of polyembryonic parthenogenic embryos

MLLE S BELLUC J CHAUSSIN H LAUGIER and MME T RANSON Variations in the elimination of the principal substances of [human] urine

MME A DRILHON and R G BUSNEL Quantity and distribution of flavin in the Lepidoptera

M DELAVILLE Effect of injections of morphine hydrochloride on the hepatic and cerebral lecithins of the guinea pig

M PIETTRE Cold ultracentrifugation and the stabilization and sterilization of biological media

C CHAMPY and J P LAVEDAN Production of tumours by sustained regeneration in the testicles of birds

Moscow

Academy of Sciences (*C R* 19 No 4 1938)

A ALEXANDROV A general equation for closed plane surfaces

N LUSIN Existence of algebraic surfaces without a continuous connected grid (3) (4)

J KHURGIN Upper limit of ion energy obtainable by means of the cyclotron

L V GROŠEV and I M FRANK Nuclear impulse in pair formation

V ČERNIAEV Influence of noble gases on the intensity of the lines of the hydrogen and the deuterium Balmer series

I K KIKOIN and S V GOOBAR Gyromagnetic effect in superconductors

I D BORNEMAN STARINKEVITCH Some isomorphic substitutions in apatite

S A BOROVIK and S K KALININ Spectroscopic analysis of the products of lead and zinc plants

A V PEIVE Carboniferous gypsums and the Devonian red sandstones of Tian Shan

L LUNGERHAUSEN (1) The terraces of the Dniester (2) Pliocene hydrography of the South Ukraine

A F FERSMAN The number of mineral species

L A Kossoy Intergrowth of quartz and feld spars from the pegmatite veins of Karelia

R A Masing Genetical and cytological analysis of lethals in *Drosophila* occurring in Nature

L N Kokhanovskaya Physiological sterility in the cultivated Columbian potato *Solanum rybinii* Juz and Buk

V I Patrushev Inheritance of biochemical characters in animals in connexion with growth (3) On some indices of the blood composition of the hybrids between Bactrian camels and dromedaries in connexion with heterosis (4) Differences in the composition of blood in horses asses and mules

G S Žukova Influence of light upon the development of pollen of barley

N N Medvedev Contributory effect of heat with irradiation in the production of mutations

M Ch Chajlachjan and L P Ždanova Role of growth hormones in form building processes (3) Effect of hetero auxin treatment of seeds upon growth and development of plants

S M Mashtakov Qualitative changes of rubber in the kok saghyz roots in the course of plant development

A A Nichiporovich and V N Bourovaya Rubber accumulation in kok saghyz as a function of its biological process of maturation

Ch S Koshtoyanz Mechanism of formation of the chemical mediators of nerve impulses

Z G Ščedrina The distribution of Foraminifera in the Kara Sea

J Rali Notes on the ecology of *Diplomesodon pulchellum pulchellum* Licht in the Volga Ural sandy regions

N L Gerbilsky (1) Effect of cranial injections of hypophysis suspensions in teleosteans (2) The influence of the gonadotropic agent of the hypophysis on the spawning in *Acipenser stellatus*

Tokyo

Imperial Academy (*Proc*, **14**, No 6 June 1938)

Tatsuo Kawata A theorem concerning the non vanishing of functions

Tosio Kitagawa Characterizations of the fundamental operations by means of the operational equations

Kôsaku Yosida On the fundamental theorem of the tensor calculus

Shigehiko Sugasawa and Kiichiro Kakemi Studies on the synthesis of dibenzopyridocoline derivatives (1) A synthesis of 5, 18, 9, 14 (2, 3, 11, 12 tetramethoxy) dibenzo 6, 7, 15, 16 tetrahydro pyridocoline

Hisashi Kuno (1) Hypersthene from Odawara mati, Japan (2) The occurrence of a primary cummingtonitic hornblende in some dacites from Japan

Syozi Iziri : On the embryonic tooth M_2 (= m_2) and the os sacculi dentis of *Desmostylus japonicus*

Masuzo Uéno Stratification of *Noctiluca* in a brackish water lake of Hokkaido, Japan

Yoshitarô Katô The relation of the anterior pituitary of the fowl to the production of the gonad stimulating hormone Castration causes an increase in the potency of the pituitary body The basophilic cells are responsible for the production of the gonad-stimulating hormone

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Principal of the Sunderland Technical College—The Director of Education Education Offices 15 John Street Sunderland (September 12)

Junior Scientific Officers at the Road Research Laboratory, Harmondsworth Middlesex—The Establishment Officer Department of Scientific and Industrial Research 16 Old Queen Street Westminster S W 1 (September 13 Quote ref *J*/38/10)

Assistant (Grade III) in the External Ballistics Department of the Ordnance Committee Woolwich—The Secretary Ordnance Committee Royal Arsenal Woolwich S E 18 (September 16)

Scientific Officers in the Air Ministry Scientific Research Pool (radio communication problems)—The Chief Superintendent Royal Aircraft Establishment South Farnborough Hants (September 16 Quote ref No 604/O)

Junior Scientific Officer (physicist) at the Fuel Research Station East Greenwich—The Establishment Officer, D S I R, 16 Old Queen Street Westminster S W 1 (September 20 Quote *J* 38/11)

Superintendent of the Marine Division of the Meteorological Office—The Under Secretary of State (S 2 A) Air Ministry Adastral House Kingsway London W C 2 (September 30)

Examiner (physicist) in the A I D Test House Kidbrooke S E 3—Under Secretary of State Air Ministry Kingsway London W C 2 (Quote ref No I G 17)

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Museum (Natural History) John Murray Expedition 1933 34 Scientific Reports Vol 5 No 7 The Flabellid and Turbinolid Corals By J Stanley Gardiner and Peggy Waugh Pp 167 202+7 plates (London British Museum (Natural History)) 5*s* [168

Strangeways Research Laboratory Cambridge Report for 1937 Pp 23 (Cambridge Strangeways Research Laboratory) [178

Other Countries

Proceedings of the United States National Museum Vol 85 No 3037 A New Genus and Two New Species of the Dipterous Family Phoridæ By Charles T Greene Pp 181 186 (Washington D C Government Printing Office) [158

Division of Fish and Game of California Bureau of Marine Fisheries Fish Bulletin No 51 The High Seas Tuna Fishery of California By H C Godsil Pp 41 (Terminal Island Calif California State Fisheries Laboratory) Free [158

Kungl Svenska Vetenskapsakademiens Handlingar Serien 3 Band 16 No 5 The Alcyonarian Genus Bathyalcyon By Sixten Bock Pp 54+2 plates (Stockholm Almquist and Wiksells Boktryckeri A B London H K Lewis and Co Ltd) [158

League of Nations Child Welfare Information Centre Summary of Annual Reports received from Governments between the Close of the First Session and the Close of the Second Session of the Advisory Committee on Social Questions (May 1st, 1937 May 5th 1938) (Official No C 81 M 36 1938 IV) Pp 160 (Geneva League of Nations London George Allen and Unwin Ltd) 3*s* [168

Nyasaland Protectorate Annual Report of the Forestry Department for the Year ended 31st December 1937 Pp 27 (Zomba Government Printer) 1*s* [168

Rubber Research Institute of Malaya Annual Report 1937 Pp ii+211+2 plates (Kuala Lumpur Rubber Research Institute) 1 dollar [168

Colony and Protectorate of Kenya Forest Department, Annual Report 1937 Pp 29 (Nairobi Government Printer) 1*s* [168

Report of the Kodaikanal Observatory for the Year 1937 Pp 4 (Delhi Manager of Publications) 3 annas 4*d* [168

Indian Central Cotton Committee Technological Laboratory Technological Bulletin Series A No 42 Empirical Relationships between Count Lea Strength and Staple Length of Indian Cottons By V Venkataraman and Dr Nazir Ahmad Pp ii+16 (Bombay Indian Central Cotton Committee) 8 annas [168

Hokkaidô Imperial University Calendar, 1937 1938 Pp iii+22" (Sapporo Hokkaidô Imperial University) [168

Carnegie Institute of Washington Catalogue of Publications Pp iv+146 (Washington D C Carnegie Institution) [168

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 90 The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis New Mexico Part 6 Report on Field Season of 1937 By J L Cotter Pp. 113–118 Part 7 Pleistocene Mollusks from the Clovis Gravel Pit and Vicinity By William T Clarke Jr Pp 119–122 On the Relationship of the Nearctic Genus Dracotettix (Orthoptera Acrididæ) By James A G Rehn Pp 123–132 (Philadelphia Academy of Natural Sciences) [178

U S Department of the Interior Office of Education Bulletin 1937 No. 30 Occupational Experiences for Handicapped Adolescents in Day Schools By Elise H Martens Pp iv+61 (Washington D C Government Printing Office) 15 cents [178

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Native Problems in Northern Rhodesia*

THE native question as it manifests itself in Northern Rhodesia illustrates forcibly the fallacy of applying a general proposition indiscriminately to any specific group of tribal conditions among African and more especially Bantu peoples when an attempt is made to solve the difficulties which arise out of the cultural contacts of white and black Throughout the greater part of British Africa indirect rule has now been accepted as the fundamental principle of policy in administering native affairs It was adopted in Northern Rhodesia in part by an ordinance of 1929 and more fully in an ordinance of 1936 Although it would be more than hazardous to attempt to formulate a final judgment after so brief a period of trial there are indications that any measure of success that has been achieved by the introduction of this system is of so qualified a character as to raise question whether it is fully suited to the temperament of the people and the development of their institutions

This view receives support from the recently published report by Sir Alan W Pim and Mr S Milligan on the financial and economic position in Northern Rhodesia The conditions among the native population there described are such as would certainly seem to call for a considerable modification of administrative methods in the light of a more intensive study of circumstances than they have received

It is perhaps scarcely necessary to recall that indirect rule has for its objectives first to secure that administration of the affairs of a native people should be fully in accord with native ideas and institutions and secondly to foster the development of those institutions while ensuring that the initiative and sense of responsibility which are essential to cultural advancement shall not be undermined by too great dependence upon the paternal offices of white administration Conditions in Northern Rhodesia are adverse to the attainment of both these objects Among the seventy three different tribes in the territory tribal organization has disintegrated almost completely Tribal boundaries are sometimes ill defined or have been disregarded while in some instances the paramount chief of a tribal unit lying partly within British jurisdiction himself lives outside the political boundary under another power Intermarriage has blurred tribal distinctions while some tribes form too small a unit to warrant a separate organization Yet tribal distinctions cannot be ignored even though they are confused The tribes are too heterogeneous in origin to make fusion a practicable solution Even in Barotseland it is only the political dominance of one racial group the Barotse over all the others of the Barotseland plain which has made possible the organization of a system of native rule

Further under the system of direct rule which has obtained for many years the tribesmen have lost the habit of self government the initiative and the self reliance which indirect rule demands Nor are the pecuniary inducements now offered adequate to take the place of tribal interests as incentives to the performance of the functions of tribal administration while the recently instituted native treasuries are inadequately financed Hence expenditure within the native reserves is limited and what may be regarded as public works so far as that term is appropriate to tribal conditions which have aroused the interest of the native and reconciled him in some measure to taxation elsewhere in Northern Rhodesia are ineffective as a means of stimulating participation in self rule

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* Report of the Commission Appointed to Enquire into the Financial and Economic Position of Northern Rhodesia Pp xi+366. London H.M Stationery Office 1938) 7s net

Some of these defects might be remedied A more adequate financial provision is not beyond the bounds of possibility now that the economic position holds out hope of improvement Such a measure however involves the somewhat doubtful assumption that the disintegration of the tribal system has not gone too far and that the disinclination or disability to undertake responsibility for tribal control can be overcome It is a question whether in Northern Rhodesia geographical social and economic conditions combined with native tradition in mode of life do not demand a more drastic system of tutelage than can be exercised through a system which depends upon native institutions and trusts to a lightly regulated native culture to work out its own salvation

In Northern Rhodesia while an immense tract of land is potentially arable the amount which is naturally fertile is relatively small The native reserves are overcrowded in some parts there are no inhabitants at all while in others the density of population may rise to 60 per square mile or in fishing areas to so much as 80 per square mile The ill effects of this irregularity of distribution and overcrowding are aggravated by the native mode of life Except in Barotseland the people are not as a rule keepers of cattle They live by agriculture or by fishing The rivers and lakes are in danger of being over fished and the methods of agriculture are both destructive and wasteful Frequently shifting plots are fertilized by burning off the bush and forest This combined with the inroads on forest trees made by the unregulated demands for timber of the mines and sawmills has led to serious deterioration of the soil and forest resources of the country In parts sixty years will be required for recovery

Since agriculture rises to no more than subsistence level the imposition of taxation has forced the native to sell his one commodity—his labour This has given rise to other and no less serious problems Within Northern Rhodesia virtually the only industries employing labour in any numbers are mining and the sawmill both these industries more especially mining have encouraged the native to settle with his wife and family near his work creating a population of urbanized and detribalized individuals who are ill housed for whom the provision of educational facilities and medical attention is inadequate and for whom in short there is an almost complete lack of social services and a more serious omission towards whom there is no settled policy At the same time the labourer who seeks employment outside the territory suffers disabilities owing to the lack of a properly organized system of recruiting with provision for conservation of pay and of arrangements for transport and its cost

Of the wise and on the whole moderate recommendations of the Commission the most fundamental and far reaching is the suggestion that the native reserves should be enlarged and a Native Lands Trust created on the lines which have been followed elsewhere This measure would permit of future expansion as necessary and would interfere little if at all with any prospects of white settlement It is evident however that for a generation or more advancement must be limited to the building up of a self supporting and ultimately locally administered agricultural community

Taking all these factors into account—the lack of tribal organization the unsuitability of native culture or mode of life without stringent regulation and much training to the geographical and economic conditions of the country and the consequent lack of opportunity for the development of native culture along its own lines coupled with the dangers of urbanization—question must arise whether indirect rule undiluted provides the most suitable machinery for the prolonged period of tutelage with which the administration of native affairs would seem to be faced Reactionary as it may be in the eyes of those who whole heartedly support the introduction of indirect rule as the sanest and most advantageous system for the well being of the native of Africa—as it undoubtedly is in most instances—it is a question for serious consideration whether it would not be to the advantage of the native and of the future of Northern Rhodesia if a measure of direct control were reintroduced with a staff of white officers trained in an understanding of the institutions of backward peoples and their ways of thought whose duties in addition to supervision and discipline should include the guidance of their wards along the lines of a policy of advancement framed in accordance with their mentality and cultural outlook

The field of the Pim Commission on Northern Rhodesia being limited by its terms of reference to the financial and economic position the policy of native administration as such is not within the scope of its report Lest, however, it should be thought that the view here taken of the implication of the facts recorded by the Commission is unduly pessimistic, it may be mentioned that after these comments had been written, there came to hand a brief report of Sir Alan Pim's opening remarks in a discussion at the Royal Anthropological Institute on indirect rule in Northern Rhodesia The view of the tribal situation, as it affects administration, then taken by Sir Alan is in substantial agreement with that here expressed He appears, however, to contemplate the possibility of modifying the system in such a manner as to meet the administrative difficulties He poses four questions for the consideration of the anthropologist, in which he asks how indirect rule can best be made to subserve the ideals of native development and of modern government, in view of the rapid changes in native custom that are taking place and the mixed populations growing up in industrial areas

Sir Alan's questions are framed in terms which raise issues far wider in application than to Northern Rhodesia alone In effect, he asks for a scheme of present and future policy, affecting the whole of British Africa in which indirect rule is now applied based upon an intensive scientific study of native tribal culture and institutions Is anthropology prepared with a reply ?

Medieval Calendars

Le Nombre d'Or:
Etude de Chronologie Technique suivie du Texte de la Massa Compoti d'Alexandre de Villedieu Avec Traduction et Commentaire par W E Van Wijk Pp x + 158 + 11 plates (La Haye Martinus Nijhoff, 1936) 10 florins

ALEXANDER OF VILLEDIEU in Normandy was born at that town about 1170 , at the time of his death at some unknown date he was canon of a church at Avranches As an educator of the young he adopted an original method This consisted in reducing all rules to a metrical form which the pupil was required to commit to memory A Latin grammar the *doctrinale* of about 1199, had a great vogue and was followed by an encyclopædic work, the *ecclesiale* on the same metrical lines The "Massa Compoti", a work on the calendar, runs to 509 lines and dates from 1200

This is a passage (65–69) which has a familiar parallel in all languages

Junius, Aprilis, September necne November
terdenos numerant continuantque dies ,
praeter quos omnes uno retinent sibi plures
Sed tenet in numero viginti Februus octo,
cui, si bissextus fuerit, superadditur unus

In a note on this passage, it is mentioned that the equally familiar legend, according to which this distribution of days is due to the interference of Augustus, from motives of jealousy, with the original assignment of Julius Cæsar, has no known classical authority It is attributed to the invention of Sacrobosco

These lines (49–52) may serve as a definition of the Golden Number

Ignorans numerum qui lunae praedicat ortum
per denos nonos Domini dispertiat annos
adjungens unum quicquid superest notat illum
quando nil restat decimum nonum fore constat

It might have seemed simpler to add the unit to the remainder instead of adding it to the date

The Massa Compoti owes its importance to the fact that it contains the first mention of the *aureus numerus* which supersedes the epacts and other contrivances in earlier use for the calculation of the ecclesiastical new moon The Latin text here reproduced is based on a collation of eighteen MSS , two at Utrecht two in the Bodleian, four at Paris and the rest at Erfurt It is followed by critical notes, a French translation and a detailed commentary

This work of scholarship is preceded by a discussion of the earlier history of the problem of adapting dates defined in terms of lunar months to the Julian calendar for this is what the fixing of Easter required In a rather vague and ineffective minute addressed to Alexandria, the Nicene Council of 325 enjoined the practice of that church But the use followed at Rome depended on a luni solar cycle of 84 years which has nothing in accuracy to compensate for its inconvenient length , this continued until the sixth century at Rome, until the eighth in England, and found its last refuge in Ireland For the practice at Alexandria a conjectural reconstruction is necessary According to that offered here, the Metonic cycle of 19 years equal to 235 lunations, was adopted, embracing an alternation of eight years (long familiar to the Greeks) with eleven years The Egyptian solar calendar of civil life comprised twelve months of thirty days followed by five (or six) additional days Naturally the adaptation of the two systems to one another was a complicated business owing to these extra days unequal lunar months of 29 or 30 days and the months (embolisms) intercalated in the cycle

In spite of the recommendation of the Nicene Council two centuries elapsed before a uniform practice in fixing the date of Easter at Rome and at Alexandria was brought about This was the work of a Scythian monk Dionysius Exiguus or Denis le Petit who produced his pascal table in 525 As early as 457 Victorius had made a similar attempt which met with some acceptance elsewhere than in Rome as an improvement on the 84 year cycle But his scheme failed to reproduce the Egyptian dates of Easter The success of Denis was ultimately complete until the introduction of the Gregorian calendar For this there are two reasons He was content to make a faithful adaptation of the Egyptian system to the Julian calendar Thereby he started with a strong body of support from Alexandria But his diplomacy was fully equal to his skill in computation He quoted the authority of the Council of Nicea and if further authority were wanted he produced documents with which he may have tampered always be it understood in the interest of harmony within the Church Opponents no more scrupulous in their methods than himself were not wanting but without receiving official adoption at Rome the calendar of Dionysius came finally into universal use It was a triumph of modesty and diplomatic skill

The lunar cycle of nineteen years was so exact as to be regarded as miraculous Nevertheless it accumulates an error amounting to a day in three Julian centuries Bede was aware of this growing discrepancy but he accepted the Nicene authority as a rule of the Church He therefore constructed a perpetual calendar which differs in form from that of Dionysius but gives equivalent results The main difference is that his cycle begins in January whereas the epacts of Dionysius begin with September The Massa Compoti gives the rules followed by Dionysius and by Bede and explains the relations between the two systems it is here considered to contain the most exact description of them

While the ecclesiastical rules thus evolved and adopted served their limited purpose in securing uniform practice the departure of the actual moon from the age assigned to it in the perpetual calendar became increasingly apparent One of the earliest attempts to introduce an improvement was made by Robert Grossetete bishop of Lincoln By a gradual evolution through the works of Regiomontanus Stoeffler and others this led to the modern lunar ephemeris But this phase belongs to the history of astronomy In view of the complexities local divergences and ultimate compromises for the sake of uniformity which attached to the ecclesiastical calendar in early days it becomes difficult to see that a valid objection to a fixed Easter can be sustained on doctrinal grounds H C P

Natural Selection of Human Societies

Darwin s Theory Applied to Mankind
By Alfred Machin Pp xxiv + 284 (London New York and Toronto Longmans Green and Co Ltd 1937) 7*s* 6*d* net

IF natural selection as the regulating principle of the evolution of the innumerable kinds of animals and consequently of man be true then it must be operative in the present as in the past and will continue to act Mr Machin goes a step further and logically argues that this selection must determine the social as well as the physical life of man An understanding of the process of evolution must show man why he is what he is and also why he is a member of a society which has such a distinctive structure Mr Machin traces the following sequence in the social evolution of man

The successful fighter of men and beasts our stone age ancestor had inbred selfish instincts and self preservation led him to take safety in flight he knew only the law of force hatred to others of his own kind but knowing instinctive love in relation to his family If man in his first state lived a solitary family life for long ages there would result an ineradicable feeling of hostility towards his fellow men This solitary life is by no means universally accepted by students though strongly supported by Mr Machin When the hunting grounds were eventually fully occupied men formed societies in order to win and keep a common hunting ground a purpose that needed the co operation of intelligence and morality Certain native instincts must be overcome if a hunting tribe is to survive The brave must be willing to sacrifice himself in battle that his tribe may live he must conform to tribal rules and respect the rights of others The survival values of the first social state were that he should be a good hunter warrior and patriot good husband and parent devoted to his tribe and adopting the law of vengeance as a religious duty

No civilization can develop apart from agriculture Hunting peoples do not voluntarily depart from their accustomed mode of life and they manifest violent aversion from the drudgeries of agriculture How was that transition effected ? Mr Machin draws what he terms an inevitable deduction which is that as all ancient civilizations have been based on slavery the agricultural stage began when conquered men were made slaves and set to work in the fields Hunting peoples have in most cases some knowledge of agriculture and the women grow snatch crops of certain foods which supplement the subsistence The idea might then well have occurred to them that prisoners could be profitably employed in supplementing the labour of the women

This hypothesis does not take into account the very numerous primitive peoples who till their own gardens without slave labour and is there any reason to believe that the Danubian peasants of neolithic times were owners of slaves ? Hunters can live only in small groups but if a large auxiliary sustenance from agriculture were available this restriction on numbers would disappear Mr Machin jumps from a hunting stage to an agricultural civilization and ignores the possibility of a prolonged period of small family or local groups gradually domesticating wild plants and animals and thus forming the basis for settled societies He definitely states that Men would not become cultivators of the soil save under iron compulsion That compulsion was supplied by other men the conquering class The conquerors had to defend their property and to drive the slaves to their work

It was this new type of society agricultural societies with a dual structure of conquerors and slaves which proved to be dominant and all conquering in the evolution of mankind ultimately displacing and replacing hunters and herdsmen in all the regions of the world which were suitable for agriculture A civilized country represented a rich estate such estates attracted enemies but war and conquest did not mean the destruction of civilization it simply meant that the estate changed hands

In the solitary hunting state men were governed by their instincts but in the social hunting state these instincts had to be subordinated to the rule of a morality The conduct which made for success in organized warfare was governed by the rules and principles which constituted this morality This morality was obviously the survival value of hunting societies in a world filled with societies of that type The recognition of the common need led to the formation of public opinion which maintained the laws upheld the religions and governed the reputation values applied to individuals

When we come to civilization we see an entirely new morality The virtues inculcated are not those of war but of peace honesty industry love and righteousness are the new virtues and the instinct for revenge has to be eradicated The glory of the man who can defy pain and treat death with contempt has to be replaced by the humbler virtues of patient toil thrift frugality temperance and love By all analogy with the first morality with the history of mankind and the evolution of all life we shall at once suspect that the new morality has come into being by virtue of its survival value The general presumption must therefore be that the new rules are the product of that natural selection of the fittest which has governed all evolution The whole force of the new morality is directed to secure the continuance of peaceful prosperity in the society War appears intermittently but with most decisive effects in the life of societies and whenever war appears man falls back on the ancient morality which has always maintained its sway in its original integrity

The dual structure of civilized society at last relapsed into a simpler type where the workers themselves became the defenders and rulers of the estate all men had a natural motive for exertion in the revival of the ancient rule that all men shall enjoy the fruit of their own labours With this renewed stimulus to exertion civilized prosperity has progressed by leaps and bounds

The three great positive factors in survival are wealth honestly won and widely spent a successful and fruitful marriage patriotism Man must continually be able to repress many ancient impulses and must constantly subject himself to a series of constraints and restraints His real problem is thus how to get enough happiness to make life bearable

Nature will continue to select men in accordance with their fitness to live in the world as it is and the power to adapt their inherited nature to cope with the new problems of life Natural selection will see to it that the progress of man goes on

This mainly in his own words is the gist of Mr Machin s thesis Probably it would be generally admitted that the whole matter is more complicated than is set forth in this small book and there are other factors of an immaterial nature that are not mentioned or but barely alluded to due perhaps to a desire to keep the book as small as possible There are certain statements which need correction to take one glaring instance About 2000 B C the Aryans entered India conquered and enslaved the native races there and started a civilisation in that country (p 103) As Sir Arthur Keith points out in his foreword undue weight is given to wealth and there are other points which are open to discussion Mr Machin has written an interesting and suggestive book however which should appeal to a wide range of readers A C HADDON

Land Utilization in China

Land Utilization in China
a Study of 16 786 Farms in 168 Localities and 38 256 Farm Families in twenty two Provinces in China 1929–1933 By Prof John Lossing Buck Pp xxxii + 494 + 28 plates 21*s* net Atlas Pp xii + 146 21*s* net Statistics Pp xv + 474 42*s* net (Nanking University of Nanking London Oxford University Press 1937) 63*s* the set

A SURVEY of the use which one fifth of the world s population makes of its land must be a stupendous undertaking by any standard Where in addition there are few trustworthy statistical data to hand and where land utilization has been subjected for hundreds and in places for thousands of years to the complex influences of unrecorded history the difficulties of completing such an undertaking within reasonable time appear almost insuperable Whatever may be the ultimate judgment on the value of Prof J L Buck s survey one cannot but admire the courage with which he has carried out the work and the thoroughness with which the statistical data have been collected and sifted

The survey was planned and administered by the Department of Agricultural Economics of the University of Nanking and financed chiefly by the Institute of Pacific Relations from funds given by the Rockefeller Foundation It involved four years intensive work by a large number of specially trained observers There was a threefold purpose in the project first to train students in the methods of research in land utilization second to make available knowledge of China s agriculture for its improvement as a basis of national agricultural policies and third to make available to people in other countries certain elementary information about land utilization food and population in China The knowledge which the survey has made available is presented in map and tabular form in volumes 2 and 3 the text volume 1 attempts the essential task of synthesizing the enormous mass of collected data into a series of intelligible pictures

Probably the first of the three purposes outlined above has been the most successfully achieved The project may be regarded as an experiment in land utilization survey to test the value of the straightforward numerical and economic criteria used with considerable success in new countries like the United States under the infinitely more complex conditions obtaining in one of the oldest civilizations extant The area surveyed (about 2 000 000 square miles) is divided according to the dominant crops grown into eight agricultural areas —three in the northern Wheat Region and five in the southern Rice Region These Areas are regarded as more or less distinct entities and the agricultural social and economic data are computed for each Area separately The data were collected from a hundred farms carefully selected in each of 168 localities and relate to crop acreages and yields numbers and use of animals size of farm employment of labour prices and taxation transport and marketing facilities population nutrition and sundry indexes to the standard of living Chapters on the natural features of the Chinese landscape the climate and the soils are contributed by well known specialists in these subjects Natural regions according to soils climate etc do not generally correspond with the arbitrarily defined agricultural regions but the use of the latter as survey units has the advantage of throwing into correct perspective certain apparent anomalies in Chinese land utilization such as the extraordinarily low percentage (1 1) of farm land in grass taking the country as a whole The pasture areas in the separate regions vary however from 12 2 per cent in the Szechwan Rice Area to 0 3 per cent in the Spring Wheat Area

Similar kinds of data are commonly used in land utilization studies in the United States but it must be admitted that when applied to China they seem much less useful as indexes to anything real than when applied to the United States America is a young country the aspirations of which like those of a young man can be expressed in terms of material advancement China is very old and like an old man seeks security in its declining years rather than the amassing of wealth and the exploitation of opportunity The young West sees visions of a great and prosperous Chinese agriculture equipped with all the aids of science while the old East dreams dreams of a peace undisturbed by Occidental efficiency The young West seeks to discover how the outward show of youth might be restored to the old East but its recommendations and advice are likely to fall upon deaf ears

The difficulties which the author and his collaborators have obviously experienced in synthesizing their data and in formulating practical proposals for the improvement of agriculture indicate the inadequacy of the data for the second purpose of the survey One feels that many of the recommendations could have been made without reference to the results of the survey some recommendations for example that more attention needs to be given to proper ventilation and lighting of the interior rooms in the millions of primitive cave dwellings in the loess cliffs might have been omitted without detracting from the book s practical value The lesson—and it is a very important one—which the experience gained in this survey can teach is that land utilization studies in China should be approached from some other point of view than the economic

The pivotal point in Chinese agricultural policy must apparently always be the control of the twin demons of flood and soil erosion—the inevitable consequences of prolonged land utilization in a topographically immature country The perpetual menace of China s two mighty and turbulent rivers flowing above the densely populated plains overshadows all other questions of land utilization as current events have once again tragically demonstrated Flood and its companion famine disturb the serenity of China s old age far more than do wars and poverty Their treatment demands the skill of the engineer rather than of the economist or even of the farmer or forester for the adequate regulation of land use which is the rational basis of flood control in America is a political and social impossibility in China Prof Buck recognizes the imminent threat to China s agriculture and very existence from the unruly Hwang ho and Yangtse Rivers and by emphasizing it he fulfils the third purpose of his survey

Conservation of soil and water is given first place in the list of policies suggested by the study and might be accepted by the Chinese as an essential measure of self preservation The other policies suggested desirable as they may appear would involve the virtual westernization of China

The weakness of volume 1 is that it fails inevitably to summarize adequately the monumental collection of data presented in the atlas and statistical volume It is manifestly impossible to review the contents of the latter—nearly 500 closely printed folio pages of tables The feast presented should satisfy the hungriest statistician the atlas will equally satisfy those who prefer generalization to detail G V JACKS

Crystals, Molecules and Atoms

The Fine Structure of Matter
the Bearing of Recent Work on Crystal Structure Polarization and Line Spectra Being Vol 2 of a Comprehensive Treatise of Atomic and Molecular Structure By Dr C H Douglas Clark Part 1 X Rays and the Structure of Matter Pp xxxvi + 216 + xxxvii lxxii Part 2 Molecular Polarization Pp xxxvi + 217–458 + xxxvii + lxii Part 3 The Quantum Theory and Line Spectra Pp lxxii + 459–643 + 2 plates (London Chapman and Hall Ltd 1937–1938) 15s net each

IF one is permitted to compare the exploration of a scientific subject with that of a strange country the present work is equivalent not to the thrilling account of a polar expedition or the artistic description of Italy s attractions but roughly to a guidebook a Baedeker containing useful advice for finding one s way and many well arranged facts and data Seen from this point of view Dr Douglas Clark s work is a valuable contribution to scientific literature Its main features are extended lists of publications well ordered tables and many figures some of which are excellent

It consists of three parts each contained in a separate volume The first part deals with X Rays and the Structure of Matter the second with Molecular Polarization the third with The Quantum Theory of Line Spectra The methods of investigating crystal structures with the help of X rays are treated on 2½ pages only which shows that it would not be advisable for a beginner to use this volume as a text book But as all possible methods and the names of their inventors are mentioned with references to the literature the book can serve well as a guide for the research worker He will find statements not explanations As an example of the style this sentence may be picked out from the section on Bravais lattices

It is found that 5 cases must be distinguished within the Cubic system leading to 5 Classes The reader who wishes to know how this has been found is referred to the original papers The method of classification of the lattice structures is that suggested by Ewald and Hermann in their well known Strukturbericht The structures are described and illustrated by drawings which appeal to the intuition they represent frequently not only one cell as is usual but also a great number of neighbouring cells as for example in the case of the diamond For each type of structure there is a table containing the substances belonging to this type Chapters vii and viii give an account of the investigations on colloids amorphous substances liquids liquid crystals alloys solid solutions The last chapter reports on the relation of crystal structure to molecular constitution

The second volume is of the same character Debye s theory of molecular dipoles forms the starting point for a systematic survey of experimental investigations Theoretical ideas are mentioned formulæ quoted but not derived (with a few exceptions collected in an appendix) No objection would be taken to this procedure if the theoretical background appeared in a clear outline but this is not everywhere the case A reader not acquainted with the subject would scarcely be able to recognize the really leading ideas and leading man among the endless series of papers and names quoted The method of Baedeker to mark outstanding objects with one two or three stars according to their importance might be adopted also by scientific guide books like the present one

More serious objections must be raised against the third volume which deals with the structure of atoms They are treated from the point of view of the old quantum theory of Bohr Wave mechanics is mentioned electron waves shortly described but the whole development of quantum theory since 1925 completely neglected Even the appendix is essentially based on classical physics

In spite of a number of well ordered tables and clearly drawn figures dealing with the periodic system multiplets etc I should be reluctant to recommend the book to students lest they should get a wrong impression of the present state of the theoretical development But as the tables and figures containing experimental results are not liable to become out of date the careful work which the author has done in collecting them will bear fruit M B

Elastic Properties of Non-Ferrous Metals and Alloys

Elastic Properties of Non ferrous Metals and Alloys
Collected Data By Dr J McKeown and E D Ward (British Non ferrous Metals Research Association Research Reports Association Series No 473) Pp 35 (London British Non ferrous Metals Research Association 1938) 6s

A VERY necessary task has been undertaken by the British Non Ferrous Metals Research Association in the compilation of this report of the authors research into the large mass of published information with respect to the non ferrous metals and their alloys The wide range of technical literature over which this information is spread the incomplete nature of much of it and the lack of means of checking it have combined to make it most difficult for the designer to formulate from such sources a clear opinion as to the relative merits of these different products It is therefore of the highest value that all such data should have been subjected to a critical survey by independent specialists and accepted only when found to reach a high standard of reliability Before admitting any data the authors have insisted upon having the fullest details as to the composition of the material its condition when tested the method of its production and the degree of sensitivity of the strain measuring instruments used at the test

The information—most of it is presented in tabular form though in a few instances graphical representation has been adopted as more convenient—consists almost entirely of the results of tensile tests elastic properties derived from bending and torsion tests have not been inserted The particulars given include the composition the treatment limit of proportionality elastic limit modulus of elasticity and proof stress of altogether 219 metals and alloys while in a number of cases the values of the ultimate tensile strength and the percentage elongation have been added

The materials dealt with in this comprehensive research include copper and six groups of its alloys nickel and four alloys three groups of the light metals and alloys and finally the gold silver and platinum group metals Such an authoritative presentation of the complete elastic properties of a class of materials of rapidly increasing importance is most timely and will be greatly appreciated by reason of the reliability of all the figures given

An Introduction to Biology

By E J Hatfield Pp 540 (Oxford Clarendon Press, London Oxford University Press 1938) 6s 6d

MRS HATFIELD is the senior biology mistress in a well known London school, and it is clear from this well produced book that she knows her subject thoroughly, and also how to present it to beginners She treats the subject as one of immense value to all students and not only to those very few among students who may show promise as future professional biologists

The subject matter of the book is divided into the following parts introductory, food and its manufacture food of animals, sensitivity and co ordination, food as a source of energy excretion growth, and reproduction Now to follow out this schema the author has practically revolutionized the ordinary courses as taken by School Certificate students, and introduced numerous innovations For example she has had the courage to discard the type system This is a great help to the teacher but is an added burden to the author , yet this author has succeeded in giving us a true elementary biology Here we have no dry course divided into botany and zoology, themselves subdivided into types with a half hearted attempt now and then to show the interrelations of plant and animal but a coherent, though elementary, study of life as it should be understood Ecology, for example, is not relegated to a section at the end , but, wherever it may be mentioned it is (chiefly, as is correct, from the point of view of the physiology of form and adaptation), though a short appendix deals with certain well known habitats as a guide to field work

This book is a review of the broader concepts in biology, though the School Certificate syllabuses are substantially covered Experimental method is emphasized throughout by practical directions, and to add to the interest of the subject, man as an animal and the importance of plants and other animals to man are given full consideration

There are naturally very divergent views on the teaching of biology in schools ; but no one would deny that there is room for improvement in the present syllabuses and method Mrs Hatfield s book points the right way to substantial improvement, and there is no doubt that teachers using it would find their work more interesting yet less difficult

Organic Syntheses

an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals Vol 18 Pp v+103 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd 1938) 8s 6d net

RELIABLE methods are given in this useful volume for the preparation of a further selection of twenty nine organic compounds Each of the main structural divisions of organic chemistry is interestingly represented in the list Among the aliphatic substances are acetylenedicarboxylic acid, from fumaric acid via αβ dibromosuccinic acid , allylamine, from allyl isothiocyanate , taurine, from ethanolamine, via β-bromoethylamine hydrobromide ; and betaine hydrazide hydrochloride (Girard s reagent) The introduction of two of the less familiar elements into aromatic molecules is exemplified by the preparation of 4 4′ difluorobiphenyl, from benzidine , and of diphenyl selenide diphenylselenium dichloride and triphenylselenonium chloride starting from diazotized aniline and potassium selenide The condensation of γ phenylbutyric ester with oxalic ester, followed by cyclization, yields 3,4 dihydro 1 2 naphthalic anhydride, which is then dehydrogenated with sulphur at 230–250°, yielding 1,2 naphthalic anhydride

Another *interesting condensation is that of* benzyl cyanide with ethyl acetate the resulting α phenylacetoacetonitrile yields phenylacetone upon hydrolysis α Hydrindone (from indene), protocatechuic aldehyde (from piperonal), and *p* nitrobenzaldehyde (from *p* nitrotoluene) also figure among the aromatic substances The heterocyclic representatives include 2 acetothienone (from thiophen) phenoxthin (from phenyl ether) 2 phenylpyridine (from pyridine and phenyl lithium) and *l* histidine monohydrochloride (from blood proteins)

The subject index covers vols 10 to 18 There is also an appendix containing additions and corrections for preceding volumes In all respects this latest member of the series maintains the high standard of its predecessors J R

Animal Biology

By Prof Lorande Loss Woodruff Second edition Pp xiv+535 (New York The Macmillan Company, 1938) 16s net

HERE is a course in animal biology in which plants are considered only incidental in their relations with animals Being a study in biology, in contradistinction to the more academic zoology based on the type system as in the university elementary courses in Great Britain, function is considered predominantly, and thus plants cannot be ignored altogether Such general headings as nutrition, respiration, excretion, reproduction, co ordination origin and continuity of life, etc , show how deliberately the author has discarded the familiar type system in order to give his readers a clearer conception of animal life

More than a third of the book is devoted to the impact of animal life on other modes of life especially that of man, as exemplified by the following general headings organic adaptation descent with change, biology and human welfare, the human background A generous and fascinating account of the development of biology concludes the text This is followed by an extensive bibliography and a glossary

Most students reading for a first university examination in biology demand a comprehensive text book embracing plants and animals, and those reading zoology prefer one based, chapter for chapter, on types' But to both, the subject would be enlivened and made much more interesting if they supplemented their reading with such a book as this , and teachers of biology would find it an invaluable source of information and inspiration

Oil from Coal*

THERE is a remarkable agreement on technical points between the report of the Labour Party's Advisory Committee on Oil from Coal and that of the Falmouth Committee† The latter being an official committee doubtless had access to a great deal of important material already collated and to oral information from Government officials The Labour Party the inquiries of which were completed before the publication of the Falmouth report and to which such official assistance would not be available must have had a very arduous task in collecting and sifting so comprehensive a mass of material The conclusions are, however all the more valuable from having been arrived at independently since although we are constantly being reminded that they are not infallible there is a tendency to accept official views at their face value The general agreement between two groups with such widely different outlooks will raise the technical and economic side of the problem of producing oil from coal out of the controversial field and enable policies to be formulated in the light of established facts

Both Committees agree that the cost of making oil from coal involving as it does expensive mining and conversion costs will be greater than that of importing a product freely bestowed by Nature as a reward for drilling a simple bore hole in the ground , but both sides also express qualms as to how long such bounties may be expected to continue

A difference of outlook is evident throughout the two reports This is typified by the terms of reference, which for the Falmouth Committee were to consider and examine the various processes for the production of oil from coal and certain other materials indigenous to this country, and to report on their economic possibilities and on the advantages to be obtained by way of security of oil supplies in emergency" The Labour Party claims to have taken a wider view, and the Advisory Committee set before itself the question Is it possible, by the application of science, to convert coal into liquid form and so open up a new market for the greatest of British raw materials ?'

As was only to be expected, the two groups have very different opinions about the steps to be taken in the light of the technical knowledge now available Both however are in agreement that the present preferential duty on home produced motor spirit should be continued for a further period The Chancellor of the Exchequer has already stated that he accepts the suggestion that there should be a guaranteed minimum of 8*d* a gallon for twelve years from 1938 The inference is, therefore, that the user of motor spirit must expect a continuance of a tax on petrol of at least 8*d* a gallon

The Labour Report points out that the coal oil industry cannot be developed except under the shelter of a preference and that it closely affects national defence ' The Labour Party is not prepared to see the Exchequer losing millions of pounds of potential revenue annually unless the State possesses the controlling voice in the coal oil industry As an illustration of what should be avoided the report says We regard as most reprehensible the present arrangements by which Imperial Chemical Industries Ltd enjoying a rebate of over £1,000 000 a year from taxation, is required to disclose technical information to I G Farbenindustrie and therefore to the German Government but is under no obligation to make a similar disclosure to its own Government

The recommendations of the Labour Party include the setting up of a Coal Oil Board to operate State owned plants and to supervise other plants, and that initially, as a large scale economic experiment, there should be established one new hydrogenation plant, six plants for the synthetic process and five low temperature carbonizing plants of different types

The Labour Party has always been a great believer in the value of research, and among the Committee's recommendations is one for providing a capital sum of £250,000 for development of the fuel research organization Further, since it is considered that this organization cannot fulfil its task adequately for less than £250,000 per annum, the Report recommends that its income should be brought up to this level for a period of years These recommendations, although flattering in their implications, might well fail to yield the return anticipated Successful results in research are not to be bought by money alone, and there is a danger that over-ample funds might be applied' largely to work without imagination It seems at least not unreasonable to suggest that, before so large a sum is assigned, its purpose should be determined more precisely than can be gathered from the general expression original research into the utilization of coal

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* Labour's Plan for Oil from Coal Pp 79 (London Labour Publications Department 1938) 1*s*

† Committee of Imperial Defence Sub Committee on Oil from Coal Report (Cmd 5665) Pp. 71 (London H.M. Stationery Office 1938) 1*s* 3*d* net See NATURE 141 632 (April 9 1938)

Neither report places much reliance on the possibilities of natural oil being found in any quantity in Great Britain but recent reports suggest that the position may have changed slightly It should be pointed out that even deposits so limited as to be almost useless for providing a continuous peace time supply might still if held for times of emergency suffice to provide heavy requirements over a limited period The present policy of oil importation does not favour refining and cracking in Great Britain but such considerations might turn the balance and stimulate the erection of refining plants These in times of peace would be worked with imported raw materials but if the necessity arose could be switched over to utilize the indigenous product

C H LANDER

Development and Evolution*

By Prof H H Swinnerton

THOSE whose memories carry them back to student days at the end of the nineteenth century will remember how simple and straight forward the relationship between development and evolution seemed to be The development of the individual we were taught repeated the history of the race The names of Von Baer and Haeckel were in some way mixed up with all this, but we were not very clear what their respective contributions were The difference between them is now much more clearly appreciated and finds expression in a tendency towards the division of thinkers into separate camps On one hand there are those who may be described as the lineal descendants of Von Baer who propounded the view that the young stages in the development of an animal are not like the adult stages of other animals lower down the scale but are like the young stages of those animals On the other hand there are the corresponding descendants of Haeckel who maintained that the adult stages of the ancestors are repeated during the development of the descendants but are crowded back into the earlier stages of ontogeny therefore making the latter an abbreviated repetition of Phylogeny (v de Beer) This is frequently referred to as the Theory of Recapitulation

Year by year students of fossils have discovered an increasing body of facts which seem to them to fit in with and give support to Haeckel s theory of recapitulation Meanwhile students of living forms have as the result of new as well as old methods of inquiry accumulated much additional evidence which seems to give the lie to this principle Thus Garstang whose survey of this field from the biological point of view has proved most helpful wrote in 1921 The idea that form changes in ontogeny were preceded by similar changes in adult ancestry is an illusion A few years later (1929) he reiterated the same opinion in a yet more forceful way saying the theory of adult recapitulation is dead and need no longer limit and warp us in the study of Phylogeny

It should be observed here that the bone of contention is not represented by the word recapitulation but by the word adult

The idea of recapitulation in the sense of summing up is also inherent in Von Baer s as well as in Haeckel s positions The fundamental difference between them and their philosophical descendants is that for the former it is a recapitulation of *juvenile* conditions for the latter it is a recapitulation of *adult* conditions

The main point at issue therefore is whether or no *adult* recapitulation either specific or general does occur

Any consideration of the relationship of development to evolution must deal with the subject from two aspects namely *retrospective* and *prospective* On one hand it must inquire whether the evolutionary changes of the past are reflected in development and if so to what extent On the other hand it must also inquire whether future evolutionary changes of sudden or of sequential character are foreshadowed in development These two aspects are of course very closely interwoven with one another in the developmental record and much confusion which has crept into discussion in recent years is due to a want of appreciation of their fundamental distinctness

RETROSPECTIVE ASPECT

In one form or another the retrospective aspect of the problem of the relationship of development to evolution has attracted the attention of embryologists even in the earliest stages in the growth of their science This is exemplified by the principles enunciated by Von Baer and Haeckel even though the former dates back to the pre-evolution age of biology

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* From the presidential address to Section C (Geology) of the British Association delivered at Cambridge on August 22

THE EVIDENCE OF *ZAPHRENTIS DELANOUEI*

We may proceed to lay a stable foundation for our subsequent thinking by making a detailed analysis of a well established evolutionary series For this purpose no better example can be taken than that provided by the work of R G Carruthers (1910) upon *Zaphrentis delanouei*

This example has the great initial advantage that it nearly fulfils all the requirements of first class evidence In the first place it is based upon a large number of specimens which though they exhibit a wide range of forms make up a continuous series From these Carruthers selected samples typical of various phases in the sequence and called them *Z delanouei* (*s str*) *Z parallela* *Z constricta* *Z disjuncta* (early typical and advanced) respectively Between these types there occurred every gradation of form In the next place these specimens were collected from a succession of known horizons in the Lower Carboniferous rocks of Scotland Though some of these horizons were separated by relatively wide intervals the range of variation exhibited by the specimens collected at different levels overlapped to such an extent that the continuity in the sequence of forms from the bottom to the top was not broken Further the frequency of occurrence of each of the types was recorded and when plotted produced a curve which conformed to the normal unimodal frequency distribution curve When the curves for successive levels were compared it was found that the mode shifted with the passage of time from *Z delanouei* (*s str*) at the bottom to advanced forms of *Z disjuncta* at the top thus showing that the stock was undergoing a corresponding evolutionary change during the period of its existence The evolutionary character of this sequence was further supported by the very close similarity of the developmental stages of the later to those of the earlier types

On examining the development of the individuals representative of the stages in the phylogeny of the *Z delanouei Z disjuncta* gens it at once becomes obvious that the penultimate stage in the growth of *Z parallela* bears a much closer resemblance to the adult of the ancestral species *Z delanouei* (*s str*) than it does to the adult of *Z parallela* In like manner the penultimate stage in the development of *Z constricta* repeats the sum total of the characteristics which distinguish the adult ancestor *Z parallela* whilst the antepenultimate stage exhibits a similarly close resemblance to the ancestral adult *Z delanouei* (*s str*) Here then is an example which fulfils almost if not quite perfectly the requirements of the test imposed by Garstang and proves beyond dispute that specific recapitulation of adult characters does in some circumstances actually take place

Turning now to the later stages in the evolution of this gens it may be observed that two tendencies only faintly indicated in the earlier stages now become more openly manifested One is the tendency towards the establishment of radial symmetry This is expressed feebly in *Z parallela* and more clearly in *Z constricta* by the central narrowing and peripheral widening of the fossula In those later stages which are referred to as *Z disjuncta* a second tendency is rapidly expressed in the shortening of the septa and their withdrawal from the centre a tendency which in the earlier members of the gens had affected only the cardinal septum These tendencies are exhibited in progressive degrees of advancement not only in the late life of successive adult stages but they also pass back into the penultimate and eventually into the antepenultimate developmental stages of the typical and later forms of *Z disjuncta* Thus the principle of specific recapitulation of adult characters holds good also for these two new tendencies

In addition to being new these two tendencies are also out of accord with and may involve a complete reversal and suppression of earlier tendencies Thus the assumption of radial symmetry implies the disappearance of the tetrameral symmetry so characteristic of the typical *Zaphrentis* whilst the shortening of the septa is the reverse of the process of elongation by which each septum in early phases both of development and evolution attained the centre of the coral Thus it comes about that in the later members of the gens there is as it were a conflict between these earlier and later discordant tendencies with the result that the antepenultimate stages exhibit a mixed combination of features made up of the long cardinal of *Z delanouei* (*s str*) the elongated septa of *Z constricta* and the radial arrangement of *Z disjuncta* In these stages therefore there is merely a recapitulation of some of the individual features but not a recapitulation of the combination of features of the adult of any preceding generation It becomes advisable therefore to distinguish between *complete recapitulation* of the whole or part of the adult combination and the *limited recapitulation* of only isolated adult features

Re examination of Mr Carruthers s material however reveals the fact that in the development of the typical *Z disjuncta* a much earlier stage showed only six septa but these were arranged in an almost perfectly radial manner Though the corresponding stage in the other members of this gens was not forthcoming in the material discussed above it has been recognized by other workers in the earliest stages of development not only of other species of *Zaphrentis* but also in other palæozoic genera namely *Lophophyllum* *Cyathaxonia* *Dibunophyllum* *Cyclophyllum* *Streptelasma* *Syringaxon* Duerden sums up his investigations by saying The rugose corals and the zoanthid actinians have both a primary hexamerism

The embryo in this case appears therefore to retain features characteristic only of the embryonic stages in the development of other members of the phylum for as yet no adult coral of earlier date is known to possess them The examination of this very young stage in the development of *Z disjuncta* therefore furnishes confirmation of Von Baer s principle

No doubt in the development of *Zaphrentis* there were as in other Cœlentera yet earlier stages starting with the fertilized egg and passing on to a free swimming larva which of necessity are beyond the ken of the palæontologist Keeping these in mind as well as those discussed above we may distinguish in the life history of this as indeed of other organisms two main phases in development the embryonic and the neanic respectively The former covers a series of changes leading up from a single cell to a condition which has little or no resemblance to the adult but which nevertheless provides the basis out of which the adult may be produced The latter covers that series of changes in the course of which the features which characterize the adult gradually emerge and ultimately attain full expression

In the embryonic phase the combination of characters seems to have attained a state of stability that furnishes a plan of structure which is common to widely separated members of the class It must be regarded as the culmination of a long process of evolution of embryos in which many factors which concerned adult life have played no part but in which factors foundational to adult development have been preserved

In the neanic phase the organism exhibits a combination of less stable characters superposed upon the stable embryonic foundation These undergo with comparative rapidity a course of evolution the stages of which are very completely recapitulated during development The fact must be emphasized that in so far as specific and complete adult recapitulation takes place it seems in the example before us to be limited to the neanic phase

In the controversy briefly referred to at the outset biologists in discussing the problems before us, have based their arguments almost entirely upon embryonic larval or fœtal material Palæontologists on the other hand have rarely had such material at their disposal for such early developmental stages are either not capable of preservation in the fossil state or they are such minute and delicate objects as the prodissoconchs of lamellibranchs the protoconchs of gastropods and cephalopods the protaspids of trilobites which are easily destroyed The palæontologist s evidence therefore is usually drawn from neanic stages which it may be noted make up the major portion of the individual life history and are more abundantly preserved in the fossil stage Inasmuch therefore as these two classes of workers are on the whole dealing with different portions of that life history their observations and the conclusions they draw are not contradictory but supplementary As far as our study of *Zaphrentis* takes us we may say that the embryonic stages of development recapitulate the changes exhibited by corresponding stages of other forms belonging to the same general stock and that the neanic stages recapitulate the adult condition exhibited by the preceding members of the gens to which the species belongs Further within the neanic stages the principle of acceleration or tachygenesis is perfectly exemplified but its action so far as the adult combination of features is concerned does not penetrate back into the transitional and embryonic stages In these latter the rate of acceleration does not remain the same for all features and consequently the adult combination undergoes disruption

In the series *Z delanouei* (*s str*) *Z constricta* the development of the later members runs parallel to but overlaps beyond that of the earlier But with *Z disjuncta* new tendencies enter and though the earlier typical and later members of this species exhibit in their development a like parallelism and overlapping the direction they follow diverges from that of the former members of the gens By acceleration these new tendencies ultimately cut out the older combination almost completely from the developmental record of the advanced members of *Z disjuncta* Here then is a very clear case of skipping of stages or lipopalingenesis of the kind referred to by Trueman as a straightening of ontogeny as opposed to mere shortening of ontogeny which results from tachygenesis It should be noted that in this case the straightening is rendered necessary by the fact that divergent changes had previously set in

(Other examples of the same type of evidence proving the frequent occurrence of adult recapitulation were quoted from various phyla Evidence of a different type was also taken from the development of colonial organisms and from the phenomena described by Jackson as localized stages in development)

PROSPECTIVE ASPECT

Turning now to the prospective aspect of our problem we must inquire into the ways in which evolutionary changes may be foreshadowed during development Though Haeckel s main emphasis was upon recapitulation he realized that certain factors were at work which tended to vitiate the developmental record Among these was the appearance in larvæ and embryos of features which were adaptations to the conditions under which these immature organisms lived He crystallized his observations by introducing the term cœnogenesis for this phenomenon and by distinguishing a cœnogenetic stage in development which he regarded as having no recapitulatory and therefore no phylogenetic significance

Some cœnogenetic characters and the evolutionary changes they undergo are confined wholly to early development and apparently exert no appreciable direct influence upon the later stages This point was indeed stressed by Garstang for certain adaptations to motile life exhibited by larvæ Of these he says the modification of the larva in this way need not affect the organization of the adult

Fossil examples are perhaps less easily demonstrated One clear case however may be quoted from among the ammonoids in which the protoconch underwent evolutionary changes which do not appear to have influenced the later developmental and evolutionary course in any way

Some cœnogenetic characters may possibly have exerted a radical influence upon subsequent growth and evolution though they themselves have undergone no change since their first appearance An outstanding example of this has been claimed by Garstang (1928) from among the gastropods In some of these whilst the organism is still embryonic the visceral hump with its shell rotates rapidly in relation to the rest of the body through nearly 180° in only a few hours but the twisted condition remains throughout life and exerts a marked influence upon the adult anatomy

Consideration of some well known facts among fossils brings to light other possible examples of the cœnogenetic origin of new characters which have influenced subsequent history Thus in the oysters and in forms derived from them the process of cementation of the shell to other objects is confined to early life It must in all probability have originated at about the close of the embryonic phase and remained with varying degrees of persistence into early stages of the neanic phase but rarely if ever into later life Here as with the torsion of the visceral hump of the gastropod the change was cœnogenetic but it has brought in its train or opened the way for series of other changes such as the marked variability of form in the oysters and various degrees of coiling in *Gryphæa* and *Exogyra*

Recently Schindewolf in Germany and Spath in England have done good service by emphasizing the existence of palæontological evidence for characters appearing cœnogenetically and extending in subsequent generations through later stages into the adult In 1925 Schindewolf proposed the term proterogenesis for this principle of ontogenetic anticipation In 1933 he wrote a fuller account of the principle and furnished a number of examples of his own as well as from other writers

The simplest clearest and at the same time the most fully authenticated example which Schindewolf describes is yielded by fossils from the Ordovician rocks of the Scandinavian Baltic belonging to the nautiloid family of the Lituitidæ The central genus *Lituites* is characterized by the fact that while the major portion of the shell is straight the early formed portion is coiled On the basis of the principle of recapitulation it has usually been assumed that *Lituites* was the retrogressive descendant of a completely coiled ancestor Schindewolf however describes a series of forms which commences in the Vaginaten Kalk with the genus *Rhynchorthoceras* in which the shell is wholly straight or only slightly curved This is followed in the Platyurus Kalk by a variety of forms including *Lituites* itself which exhibit various degrees of coiling The series ends in the Chiron Kalk in *Cyclolituites* in which the shell is almost completely coiled

There is no need to describe specific examples of the appearance of new characters towards the end of life (deuterogenesis) in detail since every case of recapitulation looked at prospectively provides all that is required

There is a possible third mode of appearance of new characters namely mutation in the de Vriesian sense Certain fossil evidence suggests the simultaneous appearance of a variety of forms In this case however the forms may be capable of arrangement in a continuous evolutionary sense with the passage of time successive members of the series may be eliminated and thus a false impression of progressive evolution is produced Though for the sake of clearness in thinking the various developmental processes have been considered separately Evidence is forthcoming that two or more of these processes may proceed simultaneously in one and the same organism

Metallic Compounds of Protein

By Prof Fritz Lieben, Vienna

THE experiments of which an account is given below were all made in co operation with Dr Hans Jesserer in the Institute for Medical Chemistry University of Vienna The work has been based upon the study of the biuret reaction of proteins which has been known since 1833 thus all the experiments have been carried out in an *alkaline medium* and it is to the latter alone that our results apply

If a 20 per cent solution of copper sulphate is added to a casein solution in 3 per cent sodium hydroxide and the precipitate of copper hydroxide thus formed is filtered off a solution of the well known violet colour results the intensity of colour being proportional to the concentration of protein and thus obeying the Beer Lambert law It has further been found that the intensity of colour of the protein solution used is completely independent of the nature of the protein provided that the concentration of the protein solution is always the same hence the intensity does not depend on the kind of amino acids of which the proteins are built up The amount of copper contained in the samples calculated for an equal quantity of protein is the same throughout

The intensity of colour is also unaffected by the disintegration of the protein to peptone during the digestion of fibrin by pepsin during this process the intensity of the colour produced in the biuret reaction remains completely unchanged after five or six days

It is of further interest that the violet tint of the biuret reaction is not a single colour but consists of *two components* one red and one blue The extinction coefficients observed with the aid of the Pulfrich Stufenphotometer and plotted as a graph against the number of drops of copper sulphate solution added do not result in parallel straight lines for the red and the blue colour but in straight lines meeting at an angle The red component like the full colour is of equal intensity for different proteins in solutions of equal concentration The mutual independence of the colour components is also shown by the fact that when a violet colour test is diluted with the protein solution used the colour is shifted towards red the copper atoms obviously taking the place in the protein chains necessary for the formation of the red component the violet coloration on the contrary remains completely unchanged when the solutions are diluted with 3 per cent sodium hydroxide In no case is the variation of the colour above mentioned due to different valence of the red and blue copper When acidified both colours completely disappear but can be produced again by renewed alkalization if ammonia is used for this purpose instead of sodium hydroxide the well known deep blue complex colour is produced which can be used for the colorimetric determination of the bound copper By gradual addition of copper sulphate the red component alone is obtained the blue not appearing until a given number of drops of the reagent is reached

The Italian chemist Hugo Schiff who was one of the first to study the biuret reaction (also for proteins) states that nickel as well as copper with protein in an alkaline medium shows a characteristic golden yellow tint It was therefore of interest to investigate first the *nickel* and afterwards the *cobalt* compounds of proteins The colour of the latter samples is reddish brown Here the *quantitative relations* in comparison to those of the copper samples are noteworthy

According to our experiments 0 5 gm of casein combines with 56 7 mgm copper the full violet colour consisting of both the red and blue components correspondingly 26 1 mgm nickel and 17 4 mgm cobalt respectively are bound under analogous experimental conditions Taking the atomic weights of these three metals into consideration it may be seen that two atoms of copper correspond to one atom of nickel and three atoms of copper to one atom of cobalt These simple proportions are easily demonstrated by adding two of the above mentioned metals *one after the other* to the *same* protein test solution In this case the order in which the addition is made is of importance when nickel or cobalt is added to a copper sample one atom of the added nickel displaces two atoms of copper and one atom of cobalt three of them so that it becomes evident that nickel requires twice and cobalt three times the space taken by copper If however the test solution contains nickel or cobalt from the first and copper is then added no displacement at all takes place copper occupying the places still left free by nickel or cobalt that is one atom of copper is added to every atom of nickel and two atoms of copper to each atom of cobalt finally as many places are occupied in the protein chains as in the tests with copper alone

Conditions become more complicated when the investigation is extended to the *silver protein compounds* in alkaline medium, for here there is a tendency to keep larger quantities of the metal—evidently in a colloidal form—in solution Investigations appropriately applied, however, make it possible to reduce the quantity of silver present in the solution after filtration of the silver oxide to about 100 mgm per 0 5 gm casein, while the quantity of silver equivalent to 56 7 mgm copper amounts to 97 mgm So we have here one atom of silver for each atom of copper in the protein solution

With *gold* the conditions are strikingly similar to those with cobalt The quantity bound by 0 5 gm casein amounts to 58 5 mgm gold, this means, taking the atomic weights into consideration, that three atoms of copper correspond to one atom of gold If copper is afterwards added to a sample with gold, the gold (as was the case with nickel and cobalt) becomes concentrated into a smaller space, but is not displaced and two atoms of copper are added again to each atom of gold Yet other similarities between gold and cobalt are that the test solutions in both cases must stand for several days to give the above mentioned constant values, and furthermore that both these metal solutions are resistant to addition of acid thus differing from copper (see above) and nickel solutions, which are thereby caused to disintegrate at once

Different from the group copper, silver, gold, nickel and cobalt, all of which produce protein compounds in an alkaline medium, is another and larger group the members of which give no protein compounds *under our experimental conditions* To this group belong, among other metals, iron, manganese, zinc, mercury, etc We shall, however, not linger over this group

A few words may be added on the *point of linkage* of metals belonging to the first group Most probably this occurs at the nitrogen atoms of the peptide linkages This supposition is based, among other reasons, upon the results of methylation, for the number of methyl groups combined with nitrogen is *reduced* by the presence of the metal in copper nickel and cobalt protein solutions, in each case by about one third

New experiments by Dr Jesserer show that the precipitation of proteins with copper, etc, in *neutral* or *acid medium* takes place in the same way and that as much fresh copper is bound if the alkaline metal compound described above has already been produced, as in cases of native protein solutions The copper, etc, added in *acid* medium must therefore be located at a *different* place from the metal in alkaline conditions, and as, very probably, only the carboxyl groups can be regarded as the place of location for the copper in the former conditions, the only place left for the metal in the latter conditions is the *imino* and *amino* groups

A number of questions, significant both chemically and therapeutically, which have only been hinted at here, arise from the investigation of metallic protein compounds, which can easily be obtained in a dried state and are soluble in water The investigations, which I still hope to carry on, must be continued in diverse directions, among others, the catalytic powers of these substances must be examined

The Prosobranchs of Lake Tanganyika

By Prof. C. M. Yonge

WHEN Sir Richard Burton discovered Lake Tanganyika in 1858 his companion, Speke collected a number of shells from the shores These proved to be Prosobranchs of types hitherto unknown in fresh water Later investigations, notably those of the three Tanganyika expeditions, the first two under the leadership of J E S Moore[1] and the third under that of W A Cunnington[2], revealed in fuller detail the remarkable nature of the fauna with its great number of endemic species of fish, Crustacea, sponges and, above all, prosobranch Gastropoda Cunnington lists 84 species of Gastropoda of which 76 are endemic The majority, 72 species, are Prosobranchia and of these 68 are endemic Moreover 58 species have a heavy, frequently ornamented, shell, in appearance much more like marine than freshwater species Moore, elaborating a suggestion made originally by Gunther[3], regarded these, and the other endemic species, as a relict fauna, the descendants of a diverse collection of marine species which lived in this region when Tanganyika was, as he maintained, an arm of the Indian Ocean He described them as "halolimnic" species

In his book, "The Tanganyika Problem", Moore[1] claimed in support of his theory that the shells of these Prosobranchs were more closely allied to certain Jurassic fossils than to any modern species

Opposition was at once forthcoming from Smith[4] who showed that the resemblance to the Jurassic fossils was no more than superficial and from Pelseneer[5] who maintained that the majority of the halolimnic species could be included under the purely freshwater family Melaniidæ (subfamily Paramelaniinæ according to Thiele) Hudleston[6] a geologist specializing in Jurassic Mollusca was equally critical of Moore s conclusions

Cunnington who preferred Bourguignat s non committal term thalassoid for these species considered that they evolved during a period of isolation It is known that other deep isolated lakes notably Baikal possess many endemic species Fuchs[7] has recently suggested that prolonged aridity during the mid Pleistocene might by evaporation have caused a great increase in the salinity of the waters of Tanganyika and that this led to the appearance of the thalassoid species

The controversy which once raged over Moore s theories has long ago died down but it has unfortunately been succeeded by a complete neglect of the really significant side of his work his descriptions [8] and those of his pupil Miss Digby [9] of the anatomy of many of these thalassoid Prosobranchia From some original melaniid stock there have evolved a series of Prosobranchs adapted apparently for life in widely differing habitats within Tanganyika Some such as *Tiphobia horei Bathanalia howesi* and *Bythoceras iridescens* occur in deep water of more than a hundred fathoms and therefore presumably on a mud bottom others such as *Tanganyicia rufofilosa* and *Nassopsis nassa* on rocks in the region where the surf breaks *Spekia* and *Tanganyicia* are naticoid in appearance *Chytra* and *Limnotrochus* are trochoid *Paramelania* and *Nassopsis* less specialized in form and somewhat resembling *Nassa*

They must all of them be herbivorous This can now be deduced from the universal presence within them of a crystalline style lodged in a style sac which Moore described as an anterior chamber of the stomach Moore was struck by this common feature in their anatomy but regarded it as a primitive molluscan character and so as further evidence in support of his theory But it is now known that the crystalline style is a specialized structure occurring only in herbivorous Mollusca—namely in Lamellibranchia and in those herbivorous Gastropoda which feed by ciliary mechanisms or by the slow but almost continuous action of a radula [1] It occurs in all the diverse members of the Melaniidæ It is a noteworthy fact that although marine Gastropoda are most varied in feeding habit freshwater species are all herbivorous whether they possess styles as do the majority of freshwater Prosobranchia or not The most probable reason for the absence of carnivorous species is the specialized nature of the food in the majority of marine carnivores (this may certainly account for the absence of Opisthobranchs all of which herbivores as well as carnivores are highly specialized feeders) while scavenging species such as *Buccinum undatum* possibly failed to penetrate estuarine waters owing to the paucity there of dead animal material Moreover carnivorous Gastropoda in general are more specialized and so probably less adaptable

The freshwater Prosobranchs which have established themselves in freshwaters feed on algæ or decaying vegetation [1] Typically they occur among vegetation in shallow water as they do in the other African lakes such as Nyassa In Tanganyika it would appear that past conditions made possible considerable evolutionary change while the wide expanse and great depth of the lake nearly eight hundred fathoms provided a great variety of possible habitats But as revealed by the universal occurrence of a style the animals remained herbivorous It is therefore in the form of the radula that some indication may be obtained as to the mode of feeding The wide range in function of this organ—which in different species may serve for rasping seizing small particles or act purely as conveyor belt—has recently been emphasized by Peile [1] In *Nassopsis Spekia* and *Tanganyicia* it is composed of short stout teeth not unlike those of *Littorina* and probably rasps algæ off the rocks while in *Tiphobia* and *Bathanalia* it resembles more closely that of *Aporrhais* with long marginal teeth concerned probably with picking up detritus of vegetable origin on a mud bottom as I have shown for *Aporrhais* [4] Moore speaks of the resemblance of the radula of *Chytra* to that of *Capulus* and this is now known to act merely as a conveyor into the œsophagus of mucus laden masses collected by the enlarged ctenidium [1, 5] In certain species the great size of the gill indicates the possibility of ciliary feeding mechanisms which have certainly appeared independently of one another in a number of marine genera[15]

Thus from the consideration solely of anatomical detail it can be predicted that the Prosobranchia in Tanganyika are adapted for collecting vegetable matter in various forms living and dead and at various depths and on different bottoms A study of the living animals in relation to these habitats would certainly amplify this greatly Moore also indicates differences in the form of the osphradium which there is reason for regarding as an organ for estimating the amount of sediment that enters the mantle cavity[16] These differences in form may therefore be capable of correlation with the amount of sediment in the particular environment Finally, he showed that a number of species, *Tiphobia horei*, *Tanganyicia rufofilosa* and *Nassopsis nassa* are viviparous, the young being retained in a brood pouch The first of these lives in deep water, and viviparity may therefore be regarded as one of the adaptations which have made possible this unusual penetration into deep water by fresh water Prosobranchia but reasons for its occurrence in the other two, which are shore living species remain to be discovered

Viewed along these lines the Tanganyika problem assumes a different but no less fascinating form from that originally propounded by Moore Instead of regarding the endemic Prosobranchia as the descendants of a Jurassic marine fauna of diverse elements, we must consider them as springing in the main from a common origin and gradually becoming adapted for life in the variety of habitats which are present in the wide and deep waters of Lake Tanganyika As a result of adaptive processes, different species have assumed the shell form of many different types of marine species, while retaining in all cases the original specialization for a herbivorous diet as indicated by the presence of a crystalline style A full examination of these animals in their native surroundings, besides providing a fascinating study of adaptive radiation, might be expected to throw much light on the reasons for these convergences and so possibly, by inference, on the factors influencing the form of many marine species

[1] Moore The Tanganyika Problem London (1903)

[2] Cunnington *Proc Zool Soc Lond* 507 (1920)

[3] Günther *Quart J Micro Sci* **36** 271 (1894)

[4] Smith *Proc Malac Soc* **6** 7 (1904)

[5] Pelseneer *Rpt Brit Assoc* 602 (1906)

[6] Hudleston *Geol Mag* 1 337 (1904)

[7] Bourguignat *Ann Sci Nat Zool* (1) **10** 1 (1890)

[8] Fuchs *J Linn Soc Lond Zool* **40** 93 (1936)

[9] Moore *Quart J Micro Sci*, **41** 159 181 (1898) **42** 155 187 (1899) *Proc Zool Soc Lond* (2) 461 (1901)

[10] Digby *J Linn Soc Lond Zool* **28** 434 (1902)

[11] Yonge *Sci Rpts G Barrier Reef Exped Brit Mus (Nat Hist)* 1 259 (1932)

[12] Boycott *J Anim Ecol* **5** 116 (1936)

[13] Pelle *J Conchol* **20** 292 (1937)

[14] Yonge *J Mar Biol Assoc* **21** 687 (1937)

[15] Yonge *J Mar Biol Assoc* **22** 453 (1938)

[16] Hulbert and Yonge NATURE **139** 840 (1937)

Obituary Notices

Mr G N Huntly

GEORGE NEVILL HUNTLY, whose death at the age of seventy one years occurred on August 2, was educated at the Royal College of Science, where he took the associateship in chemistry and also obtained the London B Sc degree His earliest work was of a purely scientific character and dealt with the salts obtained by the action of nitric oxide on sulphites, a publication by Hantzsch anticipated his results, much to his disappointment

Huntly was for three and a half years demonstrator and assistant to Prof R V Tuson at the Royal Veterinary College Camden Town, and then demonstrator in chemistry in the State Medicine Laboratories at King's College London Afterwards he practised as a consultant, devoting himself especially to fuel work This led to a joint paper with J H Coste (*J Soc Chem Ind*, **32**, 62, 1913) on the estimation of water in commercial products Direct, gasometric and indirect methods, nine in all, were compared and special attention was paid to the indirect ones depending on loss of weight on drying In the case of coals it was found that the results were invariably higher when the coal was dried at a low pressure over sulphuric acid than when dried in the water oven, the importance of making such a direct comparison is evident Up to the date of his death, Huntly was serving on committees of the British Standards Institution (Fuel Testing) He also held several appointments as gas examiner under the Gas Undertakings Act.

With his extensive knowledge and experience, Huntly was a useful man in discussions, and he served on the Council of the Society of Public Analysts and Other Analytical Chemists, of which he was a vice president in 1919–20 He acted as an examiner to the Institute of Chemistry for two periods of several years, and served for two periods on the council of the Institute For very many years he contributed the weekly summary of the *Comptes rendus* of the Paris Academy of Sciences to NATURE To render into clear English even the titles of papers communicated to the Academy over the whole range of the physical and biological sciences is a very difficult task, yet Huntly accomplished it with remarkable success

Huntly married Hilda Wace in 1904, who survives him with a son and three daughters His friends deplore the loss of a man whose wide interests always made him a good companion

Miss Agnes T Neilson

THE untimely death of Miss A T Neilson on July 9 at the age of fifty eight years has deprived the Geological Department of the University of Glasgow of a brilliant and beloved teacher of twenty eight years' service Miss Neilson was educated at the Glasgow High School for Girls, Royal Technical College, West of Scotland Agricultural College, and the University of Glasgow She joined the staff of the Geological Department of the University in 1910, having previously worked in an unofficial capacity as curator in the Hunterian Museum She retained her interest in the last named institution until the end, and made many valuable additions to its mineral collections Miss Neilson specialized in the teaching of crystallography and mineralogy, and, in addition, was the chief organizer of the practical work of the Geological Department The latter was a difficult and trying task, especially during the period, round about 1930, in which the numbers of the Part 1 class rose to more than four hundred, but Miss Neilson discharged it in the most efficient and tactful manner and, in its performance, became guide, philosopher and friend to successive generations of students

Miss Neilson contributed a petrological chapter to the late Prof J W Gregory's "Geology and Rift Valleys of East Africa" (1921), and papers on the igneous rocks of Kenya and Somaliland to monographs of the Geological Department of the Hunterian Museum Her last piece of research work, in collaboration with the present writer, was on the remarkable igneous rocks of Mount Jombo, Kenya

Miss Neilson had an intellectual range far beyond the ordinary She was widely read, especially in philosophy and psychology, and could be regarded as an authority on psycho analysis She had a wonderful gift of condensing whole systems of philosophy into a few stanzas of concise and witty verse Her untoward loss is deeply felt by her colleagues in the Geological Department of the University of Glasgow, and by past and present students who enjoyed and appreciated her versatile ministrations G W T

We regret to announce the following deaths

Mr A Hutchinson, president in 1937 38 of the Iron and Steel Institute on August 20

Prof N Parravano, professor of inorganic chemistry in the University of Rome, secretary of the class of Physical, Mathematical and Natural Sciences of the Royal Academy of the Lincei, and one of the seventy academicians of the Pontifical Academy of Sciences, on August 10

News and Views

Centenary of Arthur Auwers, For.Mem.R.S.

On September 12 occurs the centenary of the birth of the distinguished German astronomer Georg Friedrich Julius Arthur Auwers, whose work led to the founding of the Bradley Medal of the Berlin Academy of Sciences and to whom British astronomers, to mark the fiftieth anniversary of his doctor's degree, presented a copy of Richardson's portrait of Bradley in the possession of the Royal Society This association of the name of Auwers with Bradley sprang from his life's work on the observation of stars and the formation of star catalogues Born at Göttingen, he passed through the University there and at twenty one years of age he became an assistant at Königsberg Observatory Three years later he was given a similar appointment at Gotha, and there made important observations on Procyon and Sirius Two years after the founding in 1865 of the *Astronomische Gesellschaft*, Argelander proposed the formation of a catalogue of all stars to the ninth magnitude from -2° to $+81^\circ$ Dec The catalogue was entrusted to Auwers, who had then become a member of the Berlin Academy of Sciences, of which he was afterwards secretary and president His great work was his "New Reduction of Bradley's Observations 1750–62", which occupied him from 1866 until 1876 He was besides concerned in the organization of the German Transit of Venus expeditions of 1874 and 1882 and drew up the reports of them He participated in Gill's determination of the solar parallax from the minor planets Victoria, Iris and Sappho, and in 1889 visited the Cape Observatory Auwers was the recipient of many honours, including the Gold Medal of the Royal Astronomical Society, and he was made a foreign member of the Royal Society He died on January 24, 1915, the first anniversary of the death of his constant friend Sir David Gill

Natives of Northern Rhodesia

In further reference to the native question in Northern Rhodesia discussed in another column of this issue of Nature (see p 449) attention may be directed to a statement of the problem, which appears in *Man* of August, by Mr W Godfrey Wilson, director of the recently founded Rhodes Livingstone Institute of Central African Studies The main function of the Institute is research into problems of culture contact Mr Wilson points out that, of the able bodied male population of the Territory, 44 per cent are *always at any one time in* European employment, while in the three 'denuded" provinces (out of the total of five provinces) this figure rises to 60 per cent, mostly employed outside the provincial boundaries The remoter districts "possess no agricultural product which can support the expense of 400 miles of road transport", and there is no alternative as a source of money to the sale of labour power There are thus, it is stated, three interrelated problems to be studied (1) What is happening in the new African society that consists of permanent and semi permanent residents in urban and industrial areas ? (2) What is happening among the group of men that alternate regularly between the urban and rural areas ? (3) What is happening to African society in the rural, and especially the "denuded areas" ? Mr. Wilson notes that the Government is seeking continuously to develop economic crops and products in the denuded areas which will provide an alternative to this high percentage of absentees from home, but hitherto without success. Pending the expert investigation of the Institute any suggestion as to a possible solution may seem premature; but it is evident that the situation is one of urgency.

Metallurgy and Prehistory

ONE of the more useful, if less obtrusive functions of the British Association has been the assistance given by modest subsidies in initiating lines of research, which could offer little to attract support from the sources commonly available. Not infrequently the result has been out of proportion to this modest beginning. What would appear likely to become an instance in point is the research committee on Sumerian copper from which a report was presented at the Cambridge meeting. This committee was first appointed some years ago for the purpose of investigating by comparative analysis the provenance of the copper in objects found by archæological excavation on Sumerian sites—a question of no little moment in determining the cultural contacts of the early peoples of Mesopotamia. Since then samples of early copper and bronze from a large number of sites have been examined, and a quantity of valuable data has been collected in the investigations which have been carried out under the direction of Dr. C. H. Desch, who has acted as secretary of the committee since its inception. Archæologists now recognize the advantage of the facilities for such an examination of their material by a committee which has at its disposal a technique developed by experience and a staff now familiar with the analysis of such metals and with the characteristics of ores from various regions mined in antiquity. In the period under review in the current report, for example, it is stated that analyses were made of prehistoric copper from Anatolia and India, of slags from Persia, of bronzes from central Asia and Brittany, of bronze and copper objects from Troy IX, and of electrum from Tell Ajjul in Palestine, while Sir Robert Mond's excavations in Guernsey have led to the microscopic investigation of early iron, and much information has, in consequence, been collected about the structure of bloomery iron. This work has been carried out at the National Physical Laboratory; but the readiness of archæologists to seek the assistance of the committee has led to the suggestion that it should be placed upon a more permanent basis and given a more general title.

Meare Lake Village, Somerset

WORK has been resumed at the Meare Lake Village, Somerset, for the season of 1938 under the direction of Dr. Arthur Bulleid and Mr. H. St. George Gray, and will continue until September 17. Operations this year are being concentrated on the middle area of the eastern half of the village, and at the moment, it is reported in *The Times* of September 2, the dwelling known as No. XXIV is under examination. In the southern section of this dwelling three floors can be seen. Two hearths have been uncovered, while near by there is a third, which belongs to the lowest floor. A number of lias stones have been found lying about this hearth. One of those is in an upright position. It is conjectured that it may have been the back of a seat set around the fire. On the east side of this hearth parallel timbers of oak lie on the surface of the peat. The small finds indicate that the inhabitants of the dwelling followed the occupation of weavers. Sawn and cut lengths of red deer antler and several pieces of iron are included among the finds, as well as the rim of a bowl in bronze. Personal ornaments are represented by a spiral finger ring of bronze and an amber bead inlaid with a spiral ornament in fused white material. Funds for the continuation of the excavations are urgently needed. It is much to be desired that the investigation of this important Iron Age site should be in no way hampered or delayed by lack of funds, for the results of investigations of the western half of the village have been prepared for publication and will be issued shortly. Their value will be impaired if investigation of the village as a whole falls short of completeness. Subscriptions may be sent to Mr. H. St. George Gray, The Castle, Taunton.

Hittites in Syria

SIR LEONARD WOOLLEY'S investigations at Atchana in the Amk Plain of Syria near Antioch have continued to extend the evidence of Hittite occupation. There is now a strong presumption that it may be assigned to so early a period as the first centuries of the second millennium B.C. An unanticipated discovery of a palace extension to the north has led to the uncovering not only of an earlier palace structure of a different orientation, dated tentatively at 1600 B.C., but also of two preceding city walls, and beneath these of the well preserved remains of an acropolis gateway of the eighteenth, or even the nineteenth, century B.C. According to a description of this work in Sir Leonard's report (*The Times*, Sept. 3) it is an imposing structure, roughly seventy five feet square, and consisting of twin towers joined by a bridge roofing the entrance passage. This passage has a system of three doorways. The gateway is built of mud brick reinforced by timbers with massive limestone faced piers for door jambs. It is the prototype of the gates of later Hittite cities, such as Carchemish and Boghaz Keui. Assuming that confirmatory evidence of origin is forthcoming, it is the oldest example of Hittite architecture yet known. The conclusion as to its age and the relation of the succession of remains on the north side are corroborated by evidence from the south side, which includes painted pottery and figurines going back to the first century of the second millennium. Even more interesting, if possible, is the occurrence here of Cypriote pottery, including a sherd dated at three centuries earlier than this type appears in Cyprus itself. This with other evidence, Sir Leonard suggests, appears to demand older mainland archetypes for the wares of Bronze Age Cyprus, and once more illustrates the inter relations of East and West in the early history of civilization.

A Cyclotron at the Science Museum

Prof E O Lawrence, of the University of California, has very kindly lent to the Science Museum the cyclotron, built by himself and Livingston in 1931, with which his first nuclear transmutation work was carried out in 1932 With an applied oscillating potential of only 4 000 volts peak this instrument was capable of accelerating protons to a speed equal to that produced by a fall through 1 200 000 volts The instrument was slightly modified afterwards by M G White for experiments on the scattering of protons in hydrogen and in this modified form it has now been placed on exhibition in the Science Museum in close proximity to Cockcroft and Walton s original apparatus, which accelerated protons through 600 700 kilovolts by means of a D C voltage of this amount derived from a transformer through a special voltage multiplying rectifier circuit Prof Lawrence has also lent to the Museum a small collection of photographs illustrating the development of the cyclotron One of these shows the two preliminary cyclotron models built by Lawrence and Edlefsen in 1930 which, though relatively crude gave encouragement for further development because they showed resonance effects, a further photograph shows the original cyclotron of Lawrence and Livingston which accelerated hydrogen molecular ions through 80 000 volts with an applied high frequency potential of less than 2 000 volts, and a series of views illustrates the latest cyclotron of Lawrence and Cooksey, which delivers currents of the order of 100 micro amperes of deuterons with energies in the neighbourhood of 8 million volts or a beam of alpha particles of about one micro ampere at 16 million volts

Waterspouts off the British Isles

Waterspouts are not such rare phenomena in the seas around the British Isles as is sometimes supposed Many of those that have been observed from coast stations of the Meteorological Office far out at sea at times when few people are in the neighbourhood have doubtless been recorded only at the Meteorological Office This applies especially to those seen in waters off the main shipping routes With the rapid increase of continental air services and the R A F expansion, opportunities of observation have multiplied, and statisticians of the future may have to be on their guard against accepting as real any sudden apparent increase of waterspout activity that may be shown during the re armament period Apart from this, there has been the slower growth of seaside population in the last thirty or forty years The four waterspouts seen off the sea front at Bexhill on September 1 would almost certainly have been unrecorded had they occurred before that period, although some farm labourer might have returned to his native village after his day s work in the fields overlooking the sea to recount over his pint of beer how he had seen the Devil in the form of a four trunked elephant leaning out of a thundercloud to drink out of the sea and how the Foul Fiend s breath had hung like a cloud over the surface of the sea as he drank Those readers who wish to know more about the phenomenon can consult a work by Alfred Wegener called Wind und Wasserhosen in Europa (Braunschweig, 1917) or an account of a discussion by the late M A Giblett of a paper by the same author in the official *Meteorological Magazine* for April 1929 The waterspout is a well known manifestation of the tornado, and is replaced by a dust devil if the tornado passes from the water to a dusty land surface

Institute of Brewing Researches

Sir Gilbert Morgan director of chemical research in the Department of Scientific and Industrial Research has been appointed chairman of the Research Fund Committee of the Institute of Brewing For many years the Institute has been carrying out researches covering a wide range chiefly in connexion with the raw materials of brewing, namely barley hops and yeast which have been carried out in collaboration with numerous experts and with the following institutions namely East Malling Research Station (East Malling) Imperial Council for Agricultural Research (India) Municipal College of Technology (Manchester) National Institute of Agricultural Botany (Cambridge) Rothamsted Experimental Station (Harpenden) South Eastern Agricultural College (Wye) and in the University of Birmingham The offices of the Institute are at Brewers Hall Addle Street London E C 2 It will be recalled that Sir Gilbert s impending retirement from his post under the Department of Scientific and Industrial Research was recently announced (see NATURE July 30 p 200)

Power Supply in Small-Scale Industries

The Vienna Sectional Meeting of the World Power Conference which was concluded on September 2, was most successful Of the thirteen British papers presented four are concerned with power supply to small scale industries An important paper on this subject was presented by J N Waite, electrical engineer of Hull and F H Clough of the British Thomson Houston Co Ltd They point out that the market depends on the particular district served If the local supply undertaking finds it economic to encourage such uses as cooking water heating and space heating then the demand for power will probably be large They estimate that the total market for the uses covered in their paper is of the order of 11 thousand million units per annum Distribution methods are becoming standardized and new uses for electrical energy are steadily arising Attention is directed to the change in the economic position that may follow active development of what are now normally off peak demands provided new peak demands are created The authors emphasize the value of flexible tariffs as these promote uses which create 'diversity in demand Judicious expenditure on canvassing is considered wise The paper concludes with observations on the influence of taxation upon tariffs A paper by Mr W Dieterichs, of the Gas Light and Coke Company, deals with Gas for Small Scale Industries ' He stated that the gas industry has developed from a manufacturer and seller of a commodity into a specialized heat service

The organization being developed by the British gas industry in order to provide such a service is described. It is emphasized that while large firms can burn coal efficiently themselves or use it in producers, and can employ technologists of their own, small firms must depend entirely on outside specialized services. Hence although large firms use more gas, the supplying of small firms is of particular value to the gas industry.

Energy Supply for Electric Railways

ANOTHER paper read at the Vienna Sectional Meeting of the World Power Conference, by Mr. F. Lydall, a member of the well known firm of Merz and McLellan, consulting engineers, discusses the requirements and the supply of energy for electric railways. It is divided into four sections. The first discusses the energy requirements for electric traction. Mr. Lydall shows that these are much smaller than usually estimated. As an approximation he gives 50 kilowatt hours per 1000 ton miles. In the winter months about ten per cent has to be added to this for train heating. The second part deals with the consumption of energy for railway traction in Great Britain, giving figures for each electrified line, with the source of supply and the half hourly maximum demand. In the third part fluctuations of traction load and the ratio of the average to the maximum demand are discussed. Mr. Lydall states that, in general, for a new scheme of electrification, it would not pay a railway to provide its own power. The Southern Railway derives its electricity from three sources, its own power station, a power company and the Central Electricity Board. On the subject of the supply of energy for electric railways, fifteen papers were received by the Conference—four from France, two each from Germany and Switzerland, and one each from the Argentine, Denmark, Japan, Norway, Sweden, Great Britain and the United States.

The Central. Armstrong Memorial Number

OLD Centralians, their children and their wives, their servants and even the stranger within their gates, will do well to read the Armstrong Memorial Number of *The Central* (35, No. 83, June 1938) to be reminded in simple, vigorous form of the life work of a rugged old man whom so many of us were proud to call friend. The photographs of him are excellent and the appreciations of one whose giant mental stature made any attempt at appraising his qualities during his lifetime a graceless task—was he not "H. E. A."?—are just. Dr. E. F. Armstrong is to be congratulated on his choice of material no less than upon his handling of his father's documents. The result is worthy of the considerable labour that must have gone to the making, and it has the authentic Armstrong ring. The number must have pleased the professor himself—had one been able to take it round to show him. The author's lively wit illumines the section of his autobiography included here. Chemistry was to "H. E. A." a philosophy of life, and he had a biting scorn for those who thought it merely a means of earning a livelihood. He could never recommend us to suffer fools gladly, and he had an eagle eye for folly in scientific research. His (to his friends) familiar advice. "Sack the lot!" was more indicative of his true insight into the problems of this generation than many supposed. One is glad to think that this almost classic phrase has found a place in his memorial number of *The Central*: the old man would have had it so!

Centenary of Portuguese Medical Schools

PHILATELISTS and medical historians among others will be interested to know of the recent issue of a stamp of 25 centavos, of which a correspondent has sent us a specimen, on the occasion of the celebration on March 6, 1937, of the foundation of the medical schools of Lisbon and Oporto. Before the establishment of these schools, as we learn from a contemporary account (*British and Foreign Medical Review*, p. 284, July 1838), the majority of medical men in Portugal were very ignorant, knowing little of either anatomy or surgery. Many surgeons indeed were in practice who had never studied at any school. These men had not been examined by professors or teachers, but merely by surgeons in any part of the country selected by the chief surgeon of the kingdom. In some cases, no authority of any kind had been given. The value of the medical instruction in the new schools was shown not only by the presence of the most eminent Portuguese physicians and surgeons on the staff but also by the fact that shortly after the foundation of these schools the departure of future doctors for qualification abroad came to an end. Moreover, the improvement in education and the high standard required of candidates before receiving their diploma resulted in a considerable rise in the social status of the medical profession in Portugal.

Bio-Morphosis

THE first number of a new journal, *Bio Morphosis—International Journal of Morphology and Biology of Man and the higher Vertebrates*, has recently appeared. Prof. Bluntschli, of Bern, is principal editor, and the publisher is Karger, of Basle and Leipzig. The editorial board includes representatives from Sweden, Poland, China, Hungary, Holland, the United States, etc., and such well known names as those of Profs. J. P. Hill, G. Levi and E. Fauré Fremiet. In his general introduction, the editor points out that morphological and physiological researches have for decades been isolated from one another. The journal therefore has the very laudable aim of reconciling and exchanging the ideas of these two ways of biological investigation. Contributions on subjects possessing both morphological and physiological interest are therefore invited. They may be in English or French or German, summaries in the languages not used being provided at the conclusion of the paper. In the first issue, F. Weidenreich discusses the evolution of man in the light of new discoveries about *Sinanthropus*, *Pithecanthropus*, etc., coming to the rather surprising conclusion that "the developmental factors of Lamarckian and Darwinian conception are of no importance, the essence of the evolution being an independent progressive differentia

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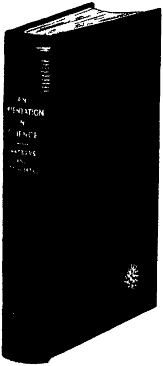

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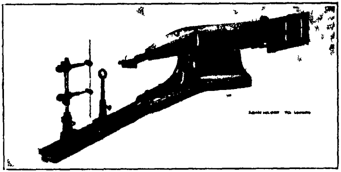

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tion of the type itself" A Weber has a short paper on the nerve fibres of the chick after spinal cord injuries to the embryo , and the geometrical characteristics of the head flexures, etc of the chick embryo are described by E Bujard A very interesting paper is that by A Portmann, who discusses the evolution of the mammalian placenta, concluding that although the histological classification of Grosser has much physiological importance, it cannot serve as the basis for an evolutionary scheme A new scheme is provided There is also an interesting schematization of the formation of the amnion in Eutheria by R A Goetz, who describes his work on the early development of the Tenrecoidea

Towns and Industry

ONE of the great merits of the broadsheets issued by P E P (Political and Economic Planning) is the way in which they direct attention to neglected problems or to changing conditions which are creating new problems A recent broadsheet on towns and industry is intended to stimulate discussion regarding the town as a background of industry, and as a social organism the development of which can be and is being shaped Its analysis of the different types of town from the village and country town, through the traffic town, the port, the mining camp town, such as Corby, Kinlochleven and Fort William, the military town, the cathedral city, the school and university town, the resort the residential town the dormitory town the planned town to the metropolitan centres, and particularly its bearing on transport questions indicates very clearly how imperative is decision whether to accept the types of town resulting from the blind play of economic and social decisions, all taken regardless of the type of town they will develop, or whether to examine the different possible types of town, to agree on the merits and demerits of each, and to make economic and social decisions within a framework which will ensure that the towns of the future combine the maximum advantages and the minimum drawbacks of their various types In the words of the broadsheet, our towns are, with few exceptions, deformed and diseased organisms It is clear that no less than in the sphere of physical fitness, the conquest and eradication of disease depend on dispassionate scientific investigation

Technical Information and Research

A PAPER by Dr E S Hedges and Dr C E Homer on "The Role of Technical Information in Industrial Research and Development", presented at the World Congress on Universal Documentation in Paris last year, has been included as No 6 in the Miscellaneous Publications of the International Tin Research and Development Council The paper reviews the functions of an information department in industrial research and development and describes the methods of disseminating technical information with particular reference to those used for the collection, storing and distribution of information by the International Tin Research and Development Council The policy of the Council of making available to those interested all information obtained is carried out to some extent by replies to inquiries but more generally by publishing all suitable information in the Technical Papers or Bulletins of the Council The first are issued in several series Series A is devoted to accounts of original work carried out by the Council's investigators and usually consists of reprints of papers presented to scientific societies , Series B consists of comprehensive accounts of special subjects , Series C is reserved for reports of new applications of tin , and Series D contains reports of original research by other organizations The Miscellaneous Publications deal with general nontechnical topics of interest to the tin industry while the Bulletins, which are written in a less severely technical style endeavour to provide a survey of the tin consuming industries

Study of Hormones

WE have received A Symposium on Hormones , being the Sigma Xi Lectures for 1936 37 in the Ohio State University (*Ohio J Sci* , 37 No 6 315–463 , 1937) These lectures are delivered biennially and the present volume is the third of the series Owing to the size of the field, only certain aspects of each subject have been selected by the different authors for elucidation and no discussion of the hormones of the parathyroids thymus or pineal gland has been possible The lectures include, however, two devoted to the growing field of the plant hormones, as well as discussions on the relationship of internal secretion to the nervous system by Leon Asher, and the less well known hormones of the gastro intestinal tract by A C Ivy C H Best gives an interesting account of the prolongation of the action of insulin by addition of protamine and zinc The sex hormones are dealt with by W O Nelson and H O Haterius, the thyroid hormone by D Marine the hormones of the adrenal gland by F A Hartman and those of the anterior lobe of the pituitary gland by O Riddle In each case the author has himself done much by experiment to advance our knowledge of the subject with which he deals

Raising the Compulsory School Attendance Age

LOCAL EDUCATION AUTHORITIES were advised by the Board of Education s circular 1457 as to preparations for meeting the situations arising when under the Education Act of 1936 applications are made for exemption from the obligation to continue attendance at school after the age of fourteen years The preparations recommended comprise a survey with the help of juvenile employment committees and inspectors of factories, of the conditions and circumstances in which children generally between fourteen and fifteen years of age are at present employed the prescription of forms for application for exemption, school reports and medical reports , the adoption of procedures already tested and found useful in regard to vocational advice , and co operation between authorities for contiguous areas The National Union of Teachers has issued a sixteen page pamphlet commenting on the circular and making a number of other suggestions and re affirming the Union s opinion that there should be no exemptions

Vaccination and Smallpox

IN the recent issue of *The Fight against Disease* (26, No 1, 1938), the quarterly journal of the Research Defence Society, Dr Monckton Copeman reviews the evidence of the value of vaccination as a preventive of smallpox A striking instance is that of Soviet Russia where vaccination was not made compulsory until 1918 In 1915, there were 126 518 cases of smallpox in 1925, 18,514, and in 1929 only 6 406 cases In the subsequent quinquennium, there was an increase in the incidence of the disease owing to laxity in carrying out vaccination, but more rigorous measures being adopted, the number of smallpox cases fell from 17 327 in 1934 to 3,156 in 1935, and to 385 in 1936, while in the first quarter of 1937 not a single case was notified

The Treatment of Malaria

THE Malaria Commission of the Health Organisation of the League of Nations has published its fourth report a valuable and important document, dealing with the treatment, and to a less extent with the prevention of malaria (League of Nations Bulletin of the Health Organisation, No 6 London Allen and Unwin, 1937 2*s* 6*d*) The Malaria Commission has been working for the last three years in making as exact a comparison as possible of the efficacy of quinine and the two synthetic drugs atebrin and plasmoquine for treatment of patients, for clinical prophylaxis, and for mass treatment and attempts at eradication of malaria In treatment of an attack, quinine in daily doses of 1 0–1 3 gm , and atebrin in daily doses of 0 3 gm , are almost equally efficient in causing disappearance of the trophozoites of the three forms of fever—quartan, benign tertian and malignant tertian —atebrin having a somewhat more rapid action than quinine Both these drugs also act upon the gametocytes of the quartan and benign tertian parasites, but have little or no action on those of the malignant tertian parasite Plasmoquine is active upon the trophozoites of the quartan parasite, is less active upon the benign tertian, and is without action upon the malignant tertian On the other hand, this drug is active upon the gametocytes of all three parasites, but particularly upon those of the malignant tertian parasite The association of quinine with plasmoquine represents one of the most efficacious methods of treating malaria It is interesting to note that quinine thus still maintains its place as one of the most efficient drugs in the treatment of malaria, and it has the advantage that with the usual doses it has little depressive or toxic effect, and is the safest drug to use without constant medical supervision

Earthquake in the Philippines

ON Monday, August 29, during the night, an earthquake occurred in the Philippine Islands (*The Times*, Aug 31) The epicentre was to the south east of Manila between the islands of Masbate and Samar, since both these islands were affected, property being destroyed and several people being injured No large earthquake has occurred in the Philippines since Batangas was destroyed just before 11 p m on the night of December 14, 1901, though small earthquakes are common in that part of the world The epicentre of the present shock is somewhat to the west of the most important seismic zone south of Manila This latter is the ocean trough known as the Philippine Deep lying to the east of Mindanao No fewer than 102 epicentres between 1920 and 1929 determined by Father W G Repetti, S J , of the Manila Observatory, were found to lie chiefly in two areas concentrated on lat 6° 30′ N , long 126° 40′ E , and lat 7° 45 N , long 127° 10 E

The Los Angeles Earthquake

A STRONG earthquake is reported as having taken place on Tuesday night, August 30, in the neighbourhood of Los Angeles, but little damage is mentioned A previous earthquake in Los Angeles occurred on January 28, 1931, at $12^h\ 50^m$ P S T , having its epicentre near the intersection of 48th Street and 2nd Avenue, Los Angeles (34 00′ N , 180° 19′ W), with intensity 4 on the Rossi Forel scale, and affecting an area of about one and a half kilometres radius The shock was studied by C F Richter of Pasadena, who stated that the epicentre was on the prolongation of the abrupt north face of the Baldwin Hills, previously considered an erosion feature, but now suspected to be a fault The present earthquake bears many resemblances to its predecessor, and we await further details with interest

North of England Zoological Society

THE North of England Zoological Society, which owns and controls the Chester Zoological Gardens, is making an appeal to raise funds to place the Society in a stronger financial position The objects of the Society are to establish a public zoological garden for the purpose of keeping wild animals and birds in spacious enclosures so that they can be admired and studied in safety The Society is bound by its memorandum of association to use all its income for the promotion of its objects, it is not allowed to have a share capital, hence the necessity for raising a fund for this purpose Further information can be obtained from the Secretary, North of England Zoological Society, Zoological Gardens, Upton-upon-Chester

Effect of Floods in East Norfolk

MR E V NEWNHAM, referring to his letter in NATURE of August 6, states that the date of the severe gale mentioned by him should have been June 29, that is to say, it came nearly at spring-tide Further, in line 3 of the penultimate paragraph of the letter, sledge covered' shallows should be read 'sedge covered' shallows Mr Newnham continues "I have not yet studied in detail the official statistics relating to the general character of the weather in the autumn and winter following a spring drought like that of 1938, but Dr C E P Brooks of the Meteorological Office is of the opinion that the statistics will show that more than the average degree of storminess over England is usual It is to be hoped that those gales that blow from the north-west will not come at spring tides"

Aeronautical Development in Australia

IN pursuance of its policy of encouraging aeronautical development in the Commonwealth, the Australian Government announced some time ago that it would assist in the initiation and maintenance of a chair of aeronautics at one of the universities The choice lay between Sydney and Melbourne, with much to be said in favour of each On the balance, it has been decided that Sydney is the more appropriate place, and steps will be taken at once to establish a school The Government will provide £32,000 for capital expenditure and £3,000 per annum for maintenance The Commonwealth Government has also decided to lend its support to the further development of meteorological science, being led to this largely by the requirements of aircraft services, both military and civil An associate professorship will be created in the University of Melbourne, the Government contributing £4,000 for expenditure on equipment and £1,500 per annum for maintenance

Engineering Public Relations

THE recently formed Engineering Public Relations Committee, supported by fourteen of the leading professional engineers' institutions, has arranged for the delivery of a series of twelve lectures at the Mary Ward Settlement, Tavistock Place, W C 1, on Tuesdays at 8 p m , commencing on September 27. The first lecture is to be given by Lieut -Colonel F H. Budden, public relations officer of the Committee, on "The Engineer and the Community" , subsequent lectures will be given by other eminent engineers on their special subjects, emphasizing how engineers have contributed to the welfare of the community in the past, how they are planning for present development, and what will be the effect of such development on society in the future Lectures 2–5 are specifically directed to the civil engineering of London, its roads, water-supply, buildings, and sanitation The remaining lectures deal with the implications of this machine age , the mass-production of goods, generation of power, production of wealth, transport by road, rail, and air, and the effect of these and mechanical forms of entertainment on economic life. A syllabus of the lectures and tickets for the series (3*s* 6*d*) can be obtained from the Mary Ward Settlement

Announcements

PROF. C O. E. BERGSTRAND, professor of astronomy in the University of Uppsala, has been elected *correspondant* for the Section of Astronomy of the Paris Academy of Sciences, in succession to Prof. L. Picart, professor of astronomy in the University of Bordeaux, who has been made a non-resident member of the Academy

DR H J. S SAND, head of the Department of Inorganic and Physical Chemistry at the Sir John Cass Technical Institute, London, E C 3, is retiring at Christmas. Dr. E de Barry Barnett, at present head of the Department of Organic and Applied Chemistry, has been appointed head of the combined chemistry departments as from January 1, 1939

ON the occasion of the centenary celebration of Dalhousie University, Halifax, Nova Scotia, the honorary degree of LL D will be bestowed on Lord Macmillan, Sir Walter Langdon-Brown and Prof Ernest Barker

THE Bavarian Academy of Sciences has presented the silver medal *Bene Merenti* to the pharmacologist Dr Ernst Frickhinger of Nordlingen

A DUTCH Congress of public health will be held at Maestricht on September 15–17 Further information can be obtained from Prof C T Van Oyen, Billstraat 166, Utrecht

THE twelfth Congress of Anæsthesia will be held in New York on October 16–20 Further information can be obtained from Dr F H McMechan, 318 Hotel Westlake, Rocking River, Ohio

THE 1938 39 session of the Royal Sanitary Institute courses of lectures will begin on Monday, September 19 The courses will be for sanitary inspectors, inspectors of meat and other foods, smoke inspectors, and will also deal with hygiene and sanitation in general and sanitary science applied to buildings and public works Further information can be obtained from the Secretary, 90 Buckingham Palace Road, S W 1

DR I. SNAPPER, professor of medicine in the University of Amsterdam and director of the clinic of internal medicine at the Wilhelmina Hospital, has been appointed professor of medicine at the Peiping Union Medical College

ACCORDING to the central office of statistics of Poland, there has been a recent decline in the birth-rate of that country During the first six months of 1937 the births numbered 433,306 compared with 454,437 in the corresponding period of 1936 During the same period of 1937 the number of deaths rose to 254,549 from 236,578 in the first half of 1936, so that the increases of population fell from 217,859 to 178,757 or from 12 9 to 10 5 per 1,000 inhabitants

A LEVERHULME research grant has been awarded to Dr G E Friend for an inquiry into gain and loss of weight of 5,000 boys in day and boarding schools as a possible manifestation of fatigue

THE Commission for the Special Areas has made a grant of £50,000 for the centenary appeal fund of the Cardiff Royal Infirmary for the purpose of reconstruction, on the condition that the infirmary shall join a regional scheme for the co-ordination of hospital facilities and services in the special area

ERRATUM In NATURE of August 13, p. 289, letter entitled "Radio Fadeouts, Auroras and Magnetic Storms", first paragraph, last line, for "January 20–22 and January 24–26, 1937" read "January 20–22 and January 24–26, 1938"

Letters to the Editor

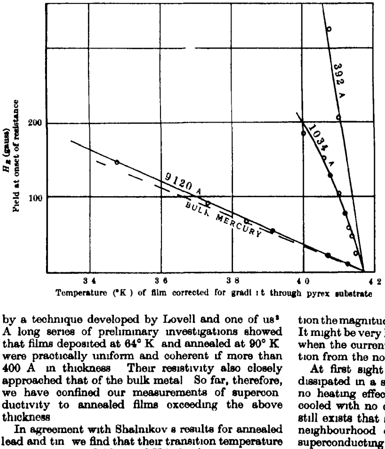
The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 483

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Superconductivity of Thin Films of Mercury

SHALNIKOV[1] in a recent letter has reported some results on the superconductivity of lead and tin films prepared by evaporative deposition We have recently obtained some measurements on the superconductivity of mercury films which were prepared by a technique developed by Lovell and one of us[2] A long series of preliminary investigations showed that films deposited at 64° K and annealed at 90° K were practically uniform and coherent if more than 400 A in thickness Their resistivity also closely approached that of the bulk metal So far, therefore, we have confined our measurements of superconductivity to annealed films exceeding the above thickness



In agreement with Shalnikov s results for annealed lead and tin we find that their transition temperature in zero magnetic field (4 14° K) closely approximates to that of the bulk metal (4 17° K) We attribute no significance to this small consistent difference of 0 03° K since the films are deposited on one side of a pyrex wall which is cooled on the other side by liquid helium, and temperatures are estimated from the vapour pressure of the helium bath A temperature difference of this order can easily arise from absorption of heat radiation on the outer face of the pyrex

We find, also in agreement with Shalnikov, that the films show very high magnetic threshold fields If the field is applied parallel to the plane of the film, complete restoration of resistance takes place over a considerable range of magnetic field, but the first onset of resistance is quite sharp

The accompanying figure illustrates the dependence of this onset' field upon temperature for three different films with thicknesses as shown The field changes by a factor of more than fifteen as we pass from the thinnest to the thickest film For comparison the critical field for bulk mercury is appended, it coincides satisfactorily with the critical field for the film 9 12 × 10^{-5} cm thick But it must be pointed out that even for this thick film considerably greater fields are needed to restore the resistance completely, whereas for the bulk metal the transition is sharp

Shalnikov gives details of the destruction of superconductivity by large currents We have not investigated the effect of high current density on the films because of the difficulty of correcting for the temperature gradient through the glass surface arising from the power dissipated in the film This may give rise to large temperature differences for example, assuming a current of 60 ma traverses a film 0 5 cm broad deposited on a pyrex surface 0 1 cm thick we find that a temperature difference could exist of nearly 0 9° C per ohm of a square patch (Thermal conductivity of pyrex extrapolated from Stephens' results[3]) Shalnikov does not mention the magnitude of the correction made for this effect It might be very large for the thinnest films, at any rate when the current is being reduced to give the transition from the normal to the superconducting state

At first sight it appears that since no power is dissipated in a superconducting film, there should be no heating effect at any currents when the film is cooled with no current flowing But the possibility still exists that some section of the film say, in the neighbourhood of the current leads may be non superconducting Heat will be developed here and will spread by conduction so that successive sections of the film show normal resistance, and the process will be cumulative Thus we feel that the interpretation of Shalnikov s results for the critical current should be accepted with some reserve

E T S **APPLEYARD**
H H Wills Physics Laboratory,
Bristol

A D **MISENER**
Royal Society Mond Laboratory,
Cambridge

July 25

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[1] Shalnikov NATURE 142 74 (1938)

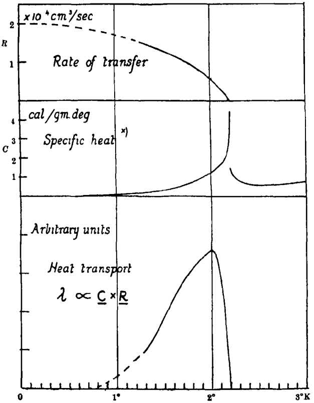
[2] Lovell *Proc Roy Soc* A 157, 311 (1936), Appleyard, *Proc Phys Soc* 49 118 (1937) Extra Part

[3] Stephens *Phil. Mag* 14 912 (1932)

Transfer Effect in Liquid Helium II

WE have recently reported on observations of a 'transfer' of liquid helium II on glass[1] Since then a great number of various experiments on this effect have been carried out, and, as the observed phenomena seem not only of interest in respect to theory but also in their influence on experimental conditions[2], a short summary of the more important results follows

The rate of transfer depends only on temperature and is practically *independent* of the difference in height between two levels (except if the higher level is very near—1 5 cm or less—the top of the barrier) This shows that although such a difference in height gives rise to a transfer, the gravity is not the driving force We conclude, therefore, that the rate of transfer is a characteristic quantity which only depends on the thermal state of liquid helium II



×) Keesom and Keesom, *Physica* **2** 557 (1935)

Although a higher rate of transfer per unit surface was observed on drawn copper wires, the rate on polished copper was found to be exactly the same as on glass We attribute the high rate on drawn wires to the influence of surface inhomogeneities, and conclude that the rate of transfer is not influenced by the underlying material

The transfer between two levels is limited by the narrowest part of the connecting surface *above* the higher level. A constriction below the higher level does not restrict the flow, as at places below the higher level drops of free liquid can be formed

The thickness of the helium film in which the transfer takes place was determined directly by the amount of liquid deposited on a known surface It was found to be about 5×10^{-6} cm thick and seemed not to change in order of magnitude between 2·1° and 1 5° K Above the λ point it was not more than 10^{-7} cm thick

Experiments on the heat transport through the film showed that less than three per cent of the trans ported heat was due to 'conduction' in the film, and that the whole heat transport could be accounted for by the transfer effect, that is, by actual flow of helium along the surface in the direction towards higher temperature This means that the high amount which evaporates from vessels containing liquid helium II is not due to heat conducted through the film into the vessel as was suggested by Kikoin and Lasarew[3], but is due to helium being transferred along the walls of the connecting tube out of the vessel This explanation agrees well with an assumption of Rollin and Simon[4]

A discussion of these phenomena in respect to the various theories of the properties of helium II has to be left to a detailed report It is evident that our observation of an actual transport of mass in the film lends weight to the suggestion[5] that the high heat conductivity of the free liquid is also due to a similar process Such a heat transport would depend on the transported mass and on the specific heat Assuming that the amount transported in the free liquid is proportional to the rate of transfer observed in our experiments, we arrive for the heat transport as a function of temperature at a curve with a maximum at 2° K (see accompanying figure) It must be added that such a picture has, of course, to be considered as a first approximation only

J G DAUNT
K MENDELSSOHN

Clarendon Laboratory,
Oxford
July 29

[1] Daunt and Mendelssohn NATURE **141** 911 (1938)

[2] Burton NATURE **142** 72 (1938) Giauque Stout and Barieau *Phys Rev* **54** 147 (1938)

[3] Kikoin and Lasarew NATURE **141** 912 (1938)

[4] Rollin and Simon to be published shortly

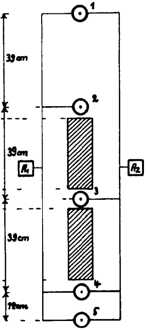
[5] Kapitza NATURE **141** 74 (1938) Keesom Keesom and Saris *Physica* **5** 281 (1938)

Search for Exchange Phenomena in Cosmic Rays

ACCORDING to the exchange theory[1,2], a collision between a sufficiently swift free proton (or neutron) and a nuclear neutron (or proton) may result in a reciprocal transformation of the colliding particles into each other A radiation consisting of protons of very high energy should therefore behave as if its particles alternately lost and recovered their ionizing faculty The mean distance separating such successive events, calculated on non relativistic theory, should be equal to about 2 cm in lead and should be some five times longer if relativity is taken into account

Jacobsen and, independently, Clay[3] have tried to discover an exchange effect of this type in the penetrating component of cosmic rays Double and triple coincidences were compared between counters (1, 2) and (1, 2, 3), all counters being disposed, with their axes parallel and horizontal, in a vertical plane and the pairs (1, 2) and (2, 3) being separated by 10 cm of lead If a proton goes into a neutron in the upper part and this neutron goes into a proton in the lower part, then there should be more coincidences (1, 2) than (1, 2, 3) After subtraction of accidental coincidences, however, the two series gave identical results

Although it is practically certain that the protons can constitute only a small fraction of the penetrating cosmic particles, we thought that the repetition of this experiment, in an improved form, may present some interest On one hand, it may lead to the appreciation of an upper limit of the relative number of protons in cosmic rays On the other hand, the properties of the heavy electron being very little known, one cannot exclude *a priori* the existence of an exchange effect exhibited by the new particles of the type described above



We have used five counters as shown in the accompanying figure, having an effective area of about 100 cm^2 The uppermost pair (1, 2) was separated by 35 cm air, the pairs (2 3) and (3 4) by 30 cm lead and 5 cm air and the pair (4 5) by 7 cm air The experiment consisted in comparing quadruple coincidences of the set (1 2, 4 5) with those of the set (1, 3, 4, 5) The first case corresponds to the case (1, 2) of Jacobsen s experiment and the second case to the arrangement (1, 2, 3) We have preferred to count in both cases coincidences of equal multiplicity, instead of comparing double to triple coincidences The pair (4, 5) has been added, in order to select only those particles travelling in a nearly vertical direction, because some previous experiments have shown that, owing to the scattering and showers taking place in lead, there may be particles coming obliquely through the counters 2 and 4, but not through the counter 3

In order to reduce statistical errors, the sets (1, 2, 4, 5) and (1, 3, 4, 5) were connected *simultaneously* to two separate amplifiers A_1 and A_2 and counting was made in alternating series in which the roles of A_1 and A_2 were interchanged The figures given below represent, for each set, the average value of the numbers of coincidences obtained with the two amplifiers (which were very nearly equal)

Set (1, 2, 4, 5) .	3 44 ± 0 2 hour
Set (1, 3, 4, 5)	3 53 ± 0 2 hour

We can conclude from this experiment that if the particles constituting the bulk of the penetrating component give rise to any exchange effect, the mean free path in lead for this effect is much longer than 30 cm On the other hand, taking into account the statistical error of the ratio of the two figures, which is certainly less, owing to the simultaneous counting, than the error of each series that is, than 5 7 per cent, and assuming the mean free length for the exchange proton neutron to be as large as 10 cm , we calculate that the relative number of protons present in cosmic penetrating radiation must be smaller than 0 2

Z WASIUTYŃSKA
L WERTENSTEIN

Mirosław Kernbaum Radiological Laboratory,
Warsaw Society of Sciences and Letters,
Warsaw
July 20

Bethe and Bacher *Rev Mod Phys* **8** 122 (1936)

[2] Bhabha NATURE **139** 1021 (1937)

The Adsorption of Deuterium on some Promoted Molybdenum Oxides

SOME very interesting results have been obtained during the course of an investigation into the adsorption of deuterium and hydrogen on surfaces of zinc nickel and cobalt molybdenum oxides

With all three adsorbents pronounced Van der Waals adsorption occurred at 77° K , deuterium being adsorbed to a greater extent than hydrogen These results are in accordance with the work of Taylor and Smith[1], who deduced a 2 9 per cent increase in the adsorption of deuterium over that of hydrogen on zinc oxide at 80° K Taylor explained this increase in adsorption by the greater ease of condensation of the deuterium

The low temperature heats of adsorption for deuterium on the three mixed oxides were found in every case to be some 600 cal lower than those for hydrogen These values were determined from the low temperature isotherms

Differences were also found between the adsorption of the two isotopes in the region of activated adsorption (184–444° C) At 218° C the rate of adsorption of deuterium was lower than that of hydrogen for all three adsorbents Before studying the adsorption of deuterium, it was proved essential first to flush out the adsorbent with deuterium at a high temperature (c 400° C) If this treatment was omitted, that is, if adsorption experiments with deuterium were carried out immediately after experiments with hydrogen, it was found that the measured adsorption of deuterium was the same as that of hydrogen The object of this preliminary treatment was the displacement of residual hydrogen from the surface, this hydrogen not being removable by evacuation It has been demonstrated that if this procedure is not undertaken, erroneous results are obtained due to the HD reaction occurring at the surface These results therefore strengthen Maxted and Moon's criticism[2] of Taylor and Pace s results[3]

The results obtained for zinc and cobalt molybdenum oxides were very similar, and each exhibited the 'inversion' found by Klar[4], and also by Beebe and co workers[5] Below about 300° C , deuterium was adsorbed to a smaller extent than hydrogen, whilst above this temperature the adsorption of deuterium was greater than that of hydrogen

With the highly active nickel molybdenum oxide, however, the activated adsorption of deuterium never exceeded that of hydrogen. The rates of adsorption were slightly lower in every case, but, above 218° C after a period of two or three hours, the rates became identical. Apparently the factors influencing the adsorption differences of the hydrogen isotopes are · (1) surface area of the adsorbent for Van der Waals' adsorption, and (2) the chemical constitution of the adsorbent in the case of activated adsorption

The high-temperature heats of adsorption for hydrogen on zinc-molybdenum oxide, cobalt-molybdenum oxide and nickel-molybdenum oxide were 21,400, 31,400 and 21,600 cal. respectively, compared with the corresponding values of 30,100, 34,200 and 31,125 cal for deuterium. These values were calculated from the adsorption isotherms at 400° C and 444° C. Differences in activation energy have also been found

These results are to be published in greater detail in the near future.

J H HUDSON
G. OGDEN

I.C I (Fertilizer and
Synthetic Products), Ltd ,
Billingham-on-Tees
Aug 17.

[1] Taylor and Smith, *J Amer Chem Soc*, **60**, 367 (1938)

[2] Maxted and Moon, *J Chem Soc*, 1542 (October 1936)

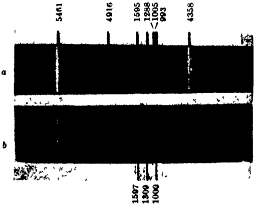
[3] Taylor and Pace, *J Chem Phys*, **2**, 578 (1934)

[4] Klar, *Naturwiss*, **22**, 822 (1934), *Z phys Chem*, **27**, B, 319 (1935), **174**, A, 1-14 (1935)

[5] Beebe *et al*, *J Amer Chem Soc*, **57**, 2527-32 (1935), **58**, 1703-6 (1936)

Raman Spectra of Compounds with Three Benzene Rings

IN this investigation we have succeeded for the first time in obtaining the Raman spectra of *o*-diphenyl benzene and *m*-diphenyl benzene. We have studied these compounds with the view of obtaining some evidence about the nature and symmetry of their benzene rings and also to record their Raman lines and to assign their frequencies correctly These two substances are solid at the ordinary temperature and they present the difficulty of showing such powerful fluorescence under the total radiation of the mercury arc that the Raman lines are almost all completely masked, leaving scarcely any trace of such lines on the plate. Using these substances in the molten state and taking other great precautions, we have been able to suppress, as the accompanying photographs show, a good deal of the continuous fluorescent background, which was found to be even more marked in the case of *m*-diphenyl benzene.



a, *o*-DIPHENYL BENZENE, *b*, *m*-DIPHENYL BENZENE

O-diphenyl benzene has yielded 33 new lines not recorded before, at frequencies 3196, 3059, 1608, 1595, 1577, 1503, 1471, 1430, 1288, 1247, 1180, 1158, 1059, 1032, 1005, 993, 874, 839, 774, 744, 708, 708, 615(br.), 558, 521, 501(?), 406, 359, 319, 253, 238(br.), 144(br), 112(br) and 73(br) cm $^{-1}$.

In addition to these frequencies, *o*-diphenyl benzene shows on our plates seven anti-Stokes lines not recorded before, at frequencies 993, 708, 615, 406, 359, 238 and 144 cm $^{-1}$

M-diphenyl benzene, in spite of very marked fluorescence observed on the plates, has also yielded 27 new lines not recorded before. The frequency shifts observed in this case are 3062, 1607, 1597, 1566, 1494, 1453, 1403, 1345, 1309, 1279, 1241(br), 1153, 1098, 1039, 1000, 964, 901, 838, 801, 766, 707, 611, 406, 275(diff), 238(diff), 151(diff and br) and 80(diff and br) cm $^{-1}$

Further investigation is proceeding on these very interesting results, and we hope to give all the details and discussions in a paper which we are offering for publication very soon.

S K MUKERJI

Agra College
July 8

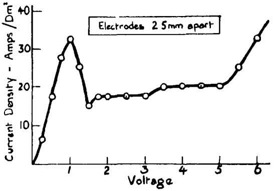
Electrolytic 'Polishing' of Zinc

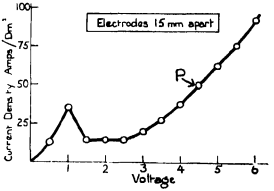
P A JACQUET has described a process whereby 'polished' copper surfaces, resembling in smoothness and brightness those yielded by ordinary mechanical polishing, could be obtained by anodic treatment in a suitable electrolyte, under prescribed conditions of current and E M F [1] He has since extended his method to lead and tin[2] and to aluminium[3], and the same principle has been applied to the polishing of nickel[4], but no work appears to have been published on the electrolytic 'polishing' of zinc

Recently, in the course of an investigation on the oxidation of zinc sheet, we have sought a method of preparation which would avoid production of a flowed or disturbed surface layer such as results from mechanical polishing, and at the same time be free from possible objections of chemical etching, notably the risk of traces of reagent remaining in crevices produced by the etching process itself

Employing a similar electrical circuit to that used in the earlier work, we have obtained quite smooth and bright surfaces from the following procedure. The specimen receives a preliminary abrasion with emery paper followed by de-greasing in benzene or other suitable solvent It is then made the anode (a strip of copper serving as cathode) in an electrolyte consisting of a 25 per cent solution of potassium hydroxide; this is used at room temperature, and is agitated by the passage of a stream of air or nitrogen as an alternative to the rotating anode recommended by Jacquet. Electrical relationships (E.M.F /current-density) are shown in the accompanying graphs for electrode distances of 2·5 mm. and 15 mm. respectively The shape of the curve is similar to the typical curve established by Jacquet for other metals and electrolytes 'Polishing' occurs characteristically, without evolution of gas, in the range represented by the nearly horizontal portion of the curve, that is, at a current density of approximately 16 amp./dm.^{2}, the effective E.M.F. being spread over a wider range at the shorter distance.

At lower and higher E M F values, etching or roughening of the specimen takes place, with gas evolution, but at still higher values (beyond the point *P*) the phenomenon of 'polishing' (now accompanied by gas evolution) reappears. For specimens previously abraded with fine emery paper (finishing with Hubert 0000) as in our experiments, 15 minutes at 6 volts suffices for the electrolytic treatment; coarser initial surfaces can, however, be satisfactorily dealt with in appropriately longer times.





We have followed Jacquet in the use of the term 'polishing'; neither of the alternatives that have been proposed ('brightening' and 'smoothing') is adequate, since each refers to one component only of the process actually involved.

W H J VERNON
E G STROUD

Chemical Research Laboratory,
Teddington, Middlesex.
Aug 10.

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[1] NATURE 135 1076 (1935).
[2] *Bull Soc chim* 3 705 (1936).
[3] *C R* 205 1232 (1937). See also *Trans Electrochem Soc* 69, 629 (1936); *J Electrodep Tech Soc First Internat Conf* 1937.
[4] Elektrokemiska Aktiebolaget German Pat 645 979 (June 9 1937).

Melting Point of High-Purity Silicon

Hoffmann and Schulze[1] have recently determined the melting point of high purity silicon (99.89 per cent) and of commercial silicon (98 per cent), and give the values 1,411° ± 2° C and 1,409° ± 2° C respectively.

When high-purity silicon was first prepared at the National Physical Laboratory by Tucker[2], I determined the melting point of a very pure sample, but the results were not published. In comparison with the above, the data I obtained are of considerable interest.

The silicon, in granular form, was packed tightly in a silica pot, the top of which was sealed, with a silica thermocouple sheath passing through to a depth of about a quarter of the height from the bottom of the pot. The temperatures of melting and of freezing were measured by means of a calibrated 5/20 rhodium platinum thermocouple.

The results obtained were as follows:

		Temperature in microvolts	
(*a*)	Cooling	8680	
(*b*)	Heating	8685	
(*c*)	Cooling	8681	
(*d*)	Heating	8683	
	Mean value	8682	1,415° C

The analysis of the silicon after the above experiment had been carried out is given below and was the same as that of the original batch of material.

Insoluble	0.01 per cent
Al	0.02
Fe	0.0
Ca	0.02
Silicon (by difference)	99.93

The melting point of silicon of purity 99.93 per cent is therefore given as 1,415° ± 2° C.

The silicon used by Hoffmann and Schulze was slightly less pure (99.89 per cent) and it would therefore be expected that the melting point of that sample, namely, 1,411° ± 2° C, should be a little lower than that described above.

M L V GAYLER

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[1] *Phys Z* 33 (22) 901 (193).
[2] *J Iron and Steel Inst* 115 412 (1927).

Photochemical Equivalent in Optical Sensitizing

IN a communication to NATURE[1] entitled "Mechanism of Optical Sensitizing of Silver Halides by Dyes", we described briefly some experimental results showing that sensitizing dyes adsorbed to silver halides produce by absorption of light in their own absorption bands decomposition of the silver halide into metallic silver and free halogen. In the presence of adequate halogen acceptors, the dye remains chemically unchanged.

The mechanism of the energy transfer in this process has not yet been explained adequately. G Scheibe[2], following the suggestions of Gaffron, Weiss and others, has applied the idea of quantum summation to dye sensitizing of photographic plates. According to this, large polymeric aggregates of dye molecules may absorb several quanta simultaneously and, in some unexplained fashion, integrate smaller quanta to form larger ones. In some such manner it is suggested that a quantum large enough to decompose silver halide is obtained from smaller quanta absorbed by the dye.

There are a number of reasons from photographic observations and theory which argue against this, but it is evident that a primary experimental datum is the photochemical equivalent. In continuing under improved conditions the experiments referred to in our letter, we have been able to show with both erythrosine, an acid dye, and with polymethine (cyanine) basic dyes, that the values for the photochemical equivalent cluster closely around unity That is to say, for each quantum of light absorbed per dye molecule, one atom of silver is produced, in any event in the initial high efficiency region of the adsorption[1] This result shows that Scheibe's hypothesis is unnecessary, as an explanation of the energetics, and, for the region studied is incorrect

S E **Sheppard**
R H **Lambert**
R D **Walker**

Research Laboratories
Eastman Kodak Company,
Rochester, N Y
Aug 8

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[1] Nature 140 1096 (Dec 25 1937)

[2] Scheibe G Naturwiss 25 795 (1937)

Diffusion in Non-Ideal Media

In 1934[1], it was suggested that the high temperature coefficients frequently found for diffusion processes in biological systems were a simple and necessary concomitant of the high potential energy barriers which prevent free diffusion in such systems It has now been found that the underlying theory can be put into a useful quantitative form

In an ideal diffusion medium, diffusion is a continuous process, and its rate is defined by the classical equation

$$Dm^{\frac{1}{2}} = \text{constant} \tag{1}$$

where D is the diffusion constant and m is the mass of the diffusing molecules In real liquids and solids, diffusion is retarded by potential energy barriers hence of the total number of molecules in a system, only those are free to diffuse which have kinetic energy sufficient to permit passage through the potential energy barriers Hence diffusion alternates with periods of vibration about a mean position

If the simplest possible assumptions are made about such a system, that is, that the potential barriers surrounding the molecules concerned are uniform and do not vary with time, and that all molecules having sufficient energy to diffuse through the potential energy barriers have in fact an equal chance of doing so, then it is easy to prove the following relationships, (2) for molecules diffusing in a concentration gradient, (3) for ions diffusing in a potential gradient

$$Dm^{\frac{1}{2}}Q_{10}^{n} = A \tag{2}$$

$$lQ_{10}^{n} = B, \tag{3}$$

where $n = (T + 10)/10$, T is the absolute temperature, l is the mobility of the ions, and Q_{10} is the ratio of the rates of the diffusion process concerned at the temperatures T and $(T + 10)$ A and B are constants independent of the diffusing species, but varying with temperature and with the nature of the diffusion medium These equations are reasonably satisfactory over a wide range of conditions

Another method of verifying equation (3) is to use it for the calculation of liquid junction potentials If the equation is correct, B/Q_{10}^{n} can be substituted for l If this is carried out in Henderson's procedure, it is found that liquid junction potentials can be calculated if the activities and the Q_{10}'s of the mobilities of the ions are known The difference between the calculated and the observed potentials is of the order of 0 2 millivolts, this is considerably better agreement than is obtained by calculating directly from the mobilities There is no theoretical reason why the calculation based on Q_{10} should be more accurate than that based on mobility, the advantage probably arises from the fact that in the measurement of Q_{10} systematic errors tend to cancel out

Equations (2) and (3) can be applied to biological systems for the elucidation of membrane structure If a membrane behaves as a homogeneous structure towards penetrating molecules, equations similar to (2) and (3) hold It is found that red blood cell membranes are far from homogeneous, whereas *Arbacia* egg membranes are probably homogeneous

Experiments are now being made to obtain similar information for nerve and muscle cells

J F **Danielli**

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July 26

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[1] Danielli and Davson *J Cell Comp Physiol* 5 502 (1934)

Isolation of Progesterone and Allopregnanolone from the Adrenal

The presence in the adrenal gland of material possessing progestational activity was reported by Engelhart[1], who obtained lipoid extracts which produced oestrous and progestational effects in the uterus of the immature rabbit Callow and Parkes[2] confirmed these findings and showed that a fractionation of the active materials was possible by the method of Allen and Meyer[3] They suggested, in view of the structure of the substances already isolated from the adrenal cortex, that the material responsible for the progestational activity might be progesterone or a closely allied compound

Using pentane soluble material kindly supplied by N V Organon Oss prepared by extracting ox adrenals by the modified method of Swingle and Pfiffner[4], followed by distribution of the crude extract between pentane and 30 per cent alcohol, we have each succeeded independently in isolating progesterone (m p 121°) and allopregnanol(3) one(20) (m p 198 200° cor) The latter which is without obvious biological activity, occurred in the greater amounts Bioassays carried on throughout the work by one of us (D B), with the kind co operation of Dr A S Parkes suggest that much, if not all, the activity can be accounted for by the progesterone content

Experimental details of the methods used by each of us for the isolation of these compounds will be published independently in full detail shortly

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T **Reichstein**

Chemisches Institut,
Eidg Tech Hochschule
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Aug 3

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[1] Engelhart E *Klin Wochr* 9 2114 (1930)

[2] Callow R K Parkes A S *J Physiol* 87 28P (1936)

[3] Allen W M Meyer R K *Amer J Physiol* 106 55 (1933)

[4] Pfiffner J J Vars H M Taylor A R *J Biol Chem* 106 625 (1934)

Changes in the Lymph Glands of Tumour-Bearing Mice

DURING experiments in this Institute as previously described[1,2,3], a spindle-celled sarcoma (*Mal. sarcoma* 1) was obtained in a mouse after 133 days' treatment with a carcinogenic compound Mice bearing grafted generations of this tumour showed blood changes to accompany the growth of the grafts, and on five occasions cell-free filtrates giving rise to sarcomas resembling the parent tumour were obtained and grafted for many generations In the 122nd generation of the original sarcoma, a cell-free filtrate of this tumour, together with blood from the mouse bearing the grafted generation, was introduced into an irradiated mouse, which produced a sarcoma (*Mal Fil* 6) at the site of inoculation This tumour and its descendants have provided the material for the experiments to be described

Mice bearing these tumours show the following changes:

(1) In many, the lymphoid tissue becomes involved in a widespread neoplastic change affecting the glands of axillæ, groin, lumbar and mesenteric regions The degree of involvement shows no relation to the proximity of the grafted tumour. Microscopic examination of the glands shows four conditions, namely:

(*a*) The gland may differ little if at all from normal.

(*b*) Changes similar to those seen in mice after X-radiation, or during induction of a sarcoma by a chemical agent[4,5].

(*c*) The lymphoid tissue is more or less wholly replaced by spindle-cells similar to those of the tumour grafts In these cases, such glands may or may not show enlargement Minute and remote glands giving no macroscopic evidence of change may be composed of tumour cells Comparison of sections suggest that this change begins at the periphery, for the medulla may be entirely surrounded by a band of large, pale cells which extend down the trabeculæ in close masses The appearances do not suggest the spread of these cells from a metastatic focus They seem rather compatible with some further development of process (*b*) The simultaneous changes in glands on both sides of the body are difficult to explain by any process of metastasis.

(*d*) The normal lymphoid cells appear to undergo hyperplasia with enlargement of the glands, suggesting a lymphosarcomatous change difficult to explain

(2) Subcutaneous injections of blood from these mice produce sarcomas—one of which is now in its sixth grafted generation

(3) Portions of glands, or whole glands from mice bearing grafted generations of *Mal. Fil.* 6 and other tumours similarly obtained, when grafted into mice, induce tumours at site of inoculation—which sarcomas have been propagated by grafting. In selecting glands for transplantation those appearing to be enlarged were avoided, and, where microscopic examination was made of other halves of glands grafted, many of these appeared normal. Hence the capacity for neoplastic growth on transplantation does not seem to depend on previous sarcomatous changes as described under 1(c). It might be suggested that the process of transplantation *per se* encourages growth[6]. The rapidity of changes involved is remarkable—a lymph gland transferred from mouse *A* to mouse *B* five days after grafting the sarcoma in *A* has been found fifteen days later to have produced a tumour histologically similar to the parent graft in *A*. Normal mice grafted with normal glands have not developed tumours.

Similar results have also been obtained with the mouse sarcoma *S* 37.

The factors concerned in these changes in lymph glands are under investigation here, and quantitative estimations of iron in such glands are being carried out by Mr Warren The metabolism of lymph glands is being examined by Mrs Boyland

These inquiries have been assisted by grants from the International Cancer Research Foundation, the British Empire Cancer Campaign, and the Finney-Howell Research Foundation.

DOROTHY PARSONS

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The Royal Cancer Hospital (Free),
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July 28

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[1] Cook, J W, *J Chem Soc*, 3277 (1931)

[2] Cook, J W, and Burrows, H, *Amer J Cancer*, **27**, 267 (1936)

[3] Parsons, L D, *J Path and Bact*, **40**, 46 (1935)

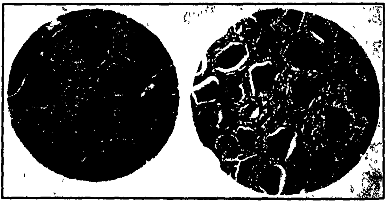
[4] Mayneord, W V, and Parsons, L D, *ibid*, **45**, 35 (1937)

[5] Clarkson, J R, Mayneord, W V, and Parsons, L D, *ibid*, **46**, 221 (1938)

[6] Fischer, A, *Amer J Cancer*, **31**, 1 (1937)

Assay of Thyrotropic Hormone

THE thyroid gland of the grass snake (*Tropidonotus natrix*) is readily affected by subcutaneous injections of small amounts of thyrotropic hormone, showing hyperplasia and a strong colloid loss As it presents a very constant histological picture under conditions where the thyroids of animals such as rats and guinea pigs often show considerable histological variation, this is suggested as a possible means of assay of thyrotropic hormone. Although effective at temperatures so low as 13° C., thyrotropic hormone reacts more strongly at 24° C. Grass snakes are inexpensive and easily handled in a laboratory.



THYROID OF CONTROL NON-HIBERNATING SNAKE (*a*), AND OF A SIMILAR SNAKE INJECTED WITH THYROTROPIC HORMONE (*b*).

The accompanying photomicrographs show the thyroid of a control non hibernating snake kept at 24° C (*a*) and the gland of a snake kept under similar conditions which had been twice injected with half a unit of thyrotropic hormone at 24 hour intervals, and killed twenty four hours after the final injection (*b*)

E M Mason

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July 25

Cholinesterase at the End-Plates of Voluntary Muscle after Nerve Degeneration

The concentration of cholinesterase is increased in voluntary muscle of guinea pigs after nerve degeneration[1] It has been suggested[2] that this increase results from the considerably decreased volume (V) of muscle fibres The number of fibres and end plates remains constant at least during the period examined (five weeks) Whilst the volume of muscle fibres decreases the unchanged volume of end plates becomes relatively more important Due to the high concentration of the enzyme at the end plates a change in the relation V end plates/V muscle fibres in favour of V end plates must produce an increase of the enzyme concentration of the whole muscle as taken for the determinations

We have measured the relation between the volume of normal and denervated muscle fibres and determined at the same time the concentration of the enzyme Two weeks after cutting the sciatic nerve of guinea pigs the increase of the concentration of cholinesterase is approximately inversely proportional to the decrease of volume of the denervated muscle fibre This indicates that the concentration of enzyme at the end plates at this time is nearly unchanged Four to five weeks after denervation the diminution of volume of the denervated muscle fibre is more important than the increase of the enzyme concentration The concentration at the end plates at this date seems to be a little smaller than in normal end plates But even then there is still a very high concentration

In the peripheral part of the cut sciatic the concentration of cholinesterase after two weeks is decreased (about 30 per cent) whereas in the neuroma formed at the central end of the cut sciatic the concentration increases to a value which is twice as high as in the normal nerve[3] The endings of the nerve fibres in muscle at this date have disappeared These experiments provide evidence that the enzyme is localized at a high concentration in the end plates of muscle and not in the endings of the nerve fibres

This work has been made possible by a grant of the Ella Sachs Plotz Foundation

R Couteaux
D Nachmansohn

Laboratoire de Biologie expérimentale et
Laboratoire de Physiologie générale de la
Sorbonne, Paris
Aug 4

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[1] Marnay, A and Nachmansohn D *C R Soc Biol* **126** 785 (1937)

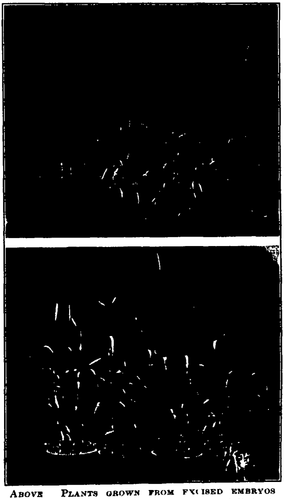
[2] Nachmansohn, D *C R Soc Biol* **128** 599 (1938)

[3] Nachmansohn D not yet published

Vernalization of Excised Embryos

In a previous letter[1] attention was directed to the fact that the process of vernalization could be carried out successfully on excised embryos of winter rye var Petkus (fuller information has been published elsewhere[2]) The embryos in the case referred to were removed from grains previously soaked for 5 hr in a sterilizing solution and were kept on an agar medium containing nutrient salts and glucose

More recent work has shown that even during the first few hours after soaking far reaching changes occur in the grain leading to exchanges between aleurone layer endosperm and embryo resulting in large variations in growth of roots and coleoptile The experiment here reported investigates the possible role of such exchanges by utilizing embryos excised from the dry grain Such exchanges were found to be inoperative in vernalization On the other hand the presence of carbohydrate supply (3 per cent sucrose) has been found to be essential



Above Plants grown from excised embryos kept at 1° C for six weeks on nutrient agar without carbohydrate

Below Plants grown from similar embryos treated in the same way but on nutrient agar containing 3 per cent sucrose

In the accompanying photographs plants are shown grown from excised embryos removed after different periods of soaking, one set placed on agar and nutrient salts only, the other set receiving 3 per cent sucrose in addition All were kept at 1° C for six weeks, at the end of which period sugar was added to the control set now kept at room temperature until large enough to transplant to soil It will be seen that, in the absence of sugar during the low temperature exposure (upper photograph) almost complete failure of vernalization has resulted Clearly therefore the vernalization effect is concerned with some change in the absorbed carbohydrate occurring at low temperature only (lower photograph)

Further work will be undertaken with different concentrations of various sugars and also on the effect of omitting inorganic nitrogen from the culture medium

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R S DE ROPP

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[1] Gregory F G and Purvis O N NATURE 138 249 (1936)

[2] Gregory F G and Purvis O N *Ann Bot* N S 2 237 251 (1938)

Discovery of *Cœloplana sp* at Krusadi Island Marine Biological Station, Madras

AFTER the silver jubilee session of the Indian Science Congress in Calcutta, to which I was a delegate, was concluded, I went down to the south of India to the Marine Biological Station Krusadi Island, at the kind invitation of the director of fisheries for Madras, Dr Sundara Raj to study the fauna of that coral island

While there I was fortunate to collect a single specimen of *Cœloplana*, which I detected crawling in a dish containing seaweeds, chiefly *Halimeda opuntiades* The specimen was about 5 mm in length translucent and faintly suffused with green to tone in with the weed on which it was living I made several observations on and sketches of the living animal, but was unable to preserve it as it fragmented when I attempted to kill it with corrosive sublimate Unfortunately, I had to leave for Colombo the next day and was unable to obtain and study any further material

The animal resembles *C bocki* Komai, described from Japan, but certain differences compel me to think that it represents a new species The work of describing the animal has been entrusted to Dr D W Devanesan, assistant director of fisheries for Madras, and his research assistant, Mr S Varadarajan I have since heard that these two workers have secured a good deal more material and we may hope for a full description before long In the mean time, it seems desirable to place on record this interesting find, the first from Indian waters, and in a locality far removed from any other in which the genus has been found The species is evidently not uncommon and the clue to its habitat may be useful to others who may have the opportunity of biological work in the tropics

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Aug 5

Function of the 'Gills' in Mosquito Larvæ

IT has been assumed until quite recently that the 'gills, or anal papillæ, of mosquito larvæ serve for respiration and I accepted this view in a previous publication[1], though with some misgivings in view of Dr Wigglesworth's demonstration[2], that the respiratory function is at most secondary

Wigglesworth (1938)[3] has summed up work of his own and of others and has shown beyond doubt not only that the main function of the gills is the absorption of chloride but also that the size of these structures in a given species of mosquito is largely governed by the concentration of chloride in the water, the gills being considerably larger in water of low chloride content than when the concentration of chloride is comparatively high

Though, however, Wigglesworth mentions that this phenomenon provides an explanation for the large sausage shaped type of gill characteristic of larvæ breeding in small containers (tree holes, plant axils, etc) and, by inference for the small rounded gills of those which breed in saline waters, he has omitted to note that it also explains the anomalous case of those larvæ which breed in small containers but which are predaceous These latter have very short rounded papillæ (ref 1, p 21) instead of the large sausage shaped type which is found in nearly all other species occurring in small containers In the light of the discovery that the chief function of the anal papillæ is to absorb chloride, the explanation of this apparent anomaly becomes obvious predaceous larvæ obtain their chloride from the bodies of their victims and thus do not require large gills wherewith to absorb it independently

G H E HOPKINS

Agricultural Laboratories,
Kampala, Uganda

[1] Hopkins Mosquitoes of the Ethiopian Region Part 1 (1936) p 12

[2] Wigglesworth The Function of the Anal Gills of the Mosquito Larva *J Exp Biol* 10 16 26 (1933)

[3] Wigglesworth, The Regulation of Osmotic Pressure and Chloride Concentration in the Hæmolymph of Mosquito Larvæ *J Exp Biol* 15 235 247 (1938)

A Curious Atmospheric Phenomenon

ON July 23, at 5 p m , while visiting Ranelagh, a friend and I were sitting in the small temple which is at the highest point in the grounds It was a bright day with little wind, but there were haze and some cloud I do not know the bearings from this temple, but considering a line at right angles to the door of the temple as zero, the phenomenon to be described occurred at an angle of azimuth of 45° or 50° to our left, which may have been E S E

The occurrence was first noticed at 5 p m and went on until 5 15 and later, and was again seen at 6 15 from another station at the general ground level

What we saw was a tall and very narrow, vertical, grey column subtending a vertical angle of 20° or 25° In the foreground about a quarter of a mile away were tall trees and the column appeared behind these at perhaps a third of a mile away from us There was a slight wave motion up the column, the amplitude of the waves being say two or three diameters of the column, which was perhaps fifty or more diameters high The diameter was constant all the way up The column persisted for a time always in the same place except when there were two (? three) columns separated by an angle of azimuth of say 2° or 3°

When the column disappeared, as it did frequently, it did so along its whole height at the same time, and formed again suddenly along its whole height Occasionally a top short length would break off, float away and disappear

I directed the attention of two women (strangers who happened to visit the temple) to the occurrence and they too saw it easily, so in all four saw it

The only cause I can think of is that there was a whirlwind, or a series of whirlwinds which concentrated the haze Smoke seems unlikely The straightness, verticality, uniformity of diameter, constant position and repeated occurrence were most marked

It would be interesting to know if such a phenomenon has been seen before and what explanation, if any, has been suggested

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July 28

Points from Foregoing Letters

A GRAPH showing the variation with temperature of the intensity of the magnetic field needed for the onset of resistance in very thin superconducting films of mercury (400 1000 and 10,000 A approximately) is submitted by Dr F T S Appleyard and A D Misener The intensity of the field changes by a factor of more than fifteen on passing from the thinnest to the thickest film

Drs J G Daunt and K Mendelssohn find that the film of liquid helium II which forms on solid surfaces is about 5×10^{-4} cm thick, and that the heat transport through the film is a transfer of mass They conclude that the rate of transfer depends only on the thermal state of liquid helium II

Using five counters separated by various thicknesses of air and lead, Miss Z Wasiutyńska and Prof L Wertenstein have sought for evidence of neutron proton exchange phenomena in cosmic rays They conclude that if the particles constituting the bulk of the penetrating component give rise to any exchange effect, the mean free path in lead for this effect is much longer than 30 cm , and they calculate that the relative number of protons present in cosmic penetrating radiation must be very small

The difference between the absorption of hydrogen and of deuterium on promoted molybdenum oxides is found by J H Hudson and G Ogden to vary with temperature and type of promoter (zinc, nickel or cobalt) At 77° K the deuterium is absorbed to a greater extent than hydrogen by all three absorbents , at 218° C the absorption of the deuterium is lower than in the case of zinc and cobalt molybdenum whilst above 300° the absorption again becomes greater

Photographs of Raman spectra of *ortho* and *meta* diphenyl benzene in the molten state are submitted by Prof S K Mukerji Thirty three new lines were recorded for the *ortho* compound and 27 new lines for the *meta* compound, and these may throw some light on the nature of the symmetry of the benzene rings in their structure

Dr W H J Vernon and E G Stroud describe a method for obtaining 'polished surfaces of zinc (comparable in smoothness and brightness with those produced by mechanical polishing) by means of anodic treatment in an aqueous solution of potassium hydroxide under prescribed conditions of current density and E M F

The melting point of a high-purity silicon sample (99 93 per cent) was found by Dr M L V Gayler to be 1 415 C this being 4° higher than that recently found by Hoffmann and Schulze for a sample of slightly lower purity

Measurements of the photochemical equivalent in the optical sensitizing of silver halides by dyes have been made by Dr S E Sheppard Dr R H Lambert and R D Walker The absorption of one quantum of light per dye molecule gives one atom of silver A quantum equivalent of unity is held to contradict the hypothesis of quantum summation for the process

Formulæ for molecular diffusion in a concentration gradient and for ions diffusing in a potential gradient are submitted by Dr J F Danielli These equations, he states are reasonably satisfactory over a wide range of conditions and may be used to indicate whether biological membranes such as egg membranes and those of the red blood cells are homogeneous or not

D Beall and Prof T Reichstein have each isolated progesterone and allopregnanolone from ox adrenal concentrates

Changes in the lymphatic tissue in rats which have developed a tumour, originally induced by a cancer producing substance are described by Dr Dorothy Parsons The tumour can be produced in other rats by transplantation of a lymph gland or by injection of blood and cell free filtrates from tumour bearing animals

Photomicrographs of thyroid gland sections of the grass snake, showing changes brought about by injection of small amounts of thyrotropic hormone are submitted by Miss E M Mason who suggests that the effect observed may be suitable for the biological assay of the hormone

Following upon the cutting and destruction of the sciatic nerve, the concentration of the enzyme cholinesterase at the end plates of the voluntary muscle of guinea pigs is found by R Couteaux and D Nachmansohn to decrease in inverse proportion to the volume of the muscle This indicates that the enzyme is localized at a high concentration in the end plates of the muscle and not in the endings of the nerve fibres

Photographs of rye plants obtained from embryos excised from seeds and grown after keeping at 1° C for six weeks on agar plus nutrient salts, with and without the addition of 3 per cent sugar solution, are submitted by Prof F G Gregory and R S de Ropp They show that in the absence of sugar during the low temperature exposure, almost complete failure of vernalization results

Research Items

Viking Figure Head from the Scheldt

THE wooden figure head from a Viking ship purchased by the British Museum (Bloomsbury) with the aid of grants from the National Art Collections Fund, and regarded as the most important relic of the Vikings outside Scandinavia has recently been described and figured by Mr T D Kendrick (*Brit Mus Quart*, 12 3, 1938) It is the figure head or stern post of a Viking ship, made of oak and measuring four feet nine inches in length It was found about two years ago with ship s timbers during dredging operations in the River Scheldt at Appels, near Termonde, Belgium The carving consists of a beaked head on a long neck, with a perforated tenon at the end It is the only example of the zoomorphic terminals frequently mentioned in the Sagas and represented in the sculptures on Scandinavian tomb stones It is dated tentatively at not later than A D 800 Its attribution, it is anticipated, will be a matter of much discussion It is obviously north German work, and may be Danish, but that it is Norse is unlikely It bears only a distant relationship to the carving which adorned the Norwegian ships, while on structural and morphological grounds it can be shown that it could not have adorned the prow or stern of a vessel of the Oseberg or Gokstad kind While there is nothing precisely like it in Danish archæology it has to be remembered that little or nothing is known of Danish boats, while there is strong probability that a Viking ship sunk off Termonde would be Danish Not only did the Danes for long assail the Frisian coast but they also had a base at the mouth of the Scheldt If this attribution should be correct the Termonde carving is the only considerable fragment that has survived of the ships in which the Danes attacked the Low Countries and the coasts of England

Navaho Ceremonial

IN a study of the agricultural and hunting methods of the Navaho of Arizona and New Mexico, Mr W W Hill points out the unusual amount of ritual that has been integrated in the affairs of everyday life among this people (*Yale Univ Pub Anthrop*, No 18, 1938) To understand their reasons for this, regard must be paid to the salient physical conditions of the Navaho country The difficulties of the physical background, due to its aridity and the distribution and quantity of rainfall, have been overcome by the Navaho in two ways first by the practical adjustment of agricultural methods, and second by incorporation into the agricultural round of a series of ceremonies, which attempt to realize for the individual a control over phenomena that actually he cannot control So in hunting, which was the second most important economic pursuit of the Navaho next to agriculture, they practised a ritual and a non ritual form They believed that game, when killed, did not die but returned to its own country, while they themselves were under the observation of the Talking Gods Hence they were careful to observe all ritual and taboos The observance of ritual made it possible for them to accomplish more than on ordinary occasions For example, in the Wolf Way of hunting they actually came to possess many of the attributes of the wolf, including his prowess in the hunt A peculiar feature of the ritual hunt was the complete reversal of the psychology of the participants Their demeanour, habitually gay, became dour, and no joking or levity was permitted In agriculture the ceremonies were definitely magical and religious in content but in contrast to the bulk of Navaho ritual, they were primarily esoteric in character As attributes of agricultural procedure, they took a role of vital importance in every stage of cultivation and they were most often found interwoven with the actual procedure at points where it had failed to meet the necessities of an inhospitable environment and served to compensate for the lack of technical development

Orthopædic Aspects of Sciatica

DR ARTHUR WESSON (*Reports on Chronic Rheumatic Diseases*, No 4, 1938 H K Lewis) deprecates the view that sciatica indicates inflammation of the sciatic nerve, and maintains that the so called sciatic pain is a referred pain from pathological conditions in the muscles, ligaments and lumbo sacral and sacro iliac joints He describes three main groups of sciatica The first two groups have in common a positive Lasègue s sign and spinal deformity, while in Group III these signs are absent The characteristic features of Group I, which is due mainly to acute and chronic trauma are pain, deformity and lumbo sacral tenderness, and the treatment consists in restoration of alignment, restoration of normal muscle balance and maintenance of full mobility The characteristic features of Group II, which is due to a chronic muscle imbalance, arising from postural and occupational causes, are pain of a more gradual onset, deep tenderness in the area between the iliac crest and great trochanter due to changes in the regional muscles, marked weakness in the abductor muscles of the hip and a functional scoliosis The treatment of this group consists in the production of muscular relaxation and restoration of normal muscle balance

Statistics of the Halibut Fishery

DR P JESPERSON has recently given a comprehensive statistical survey of the halibut fishery in the waters round the Faroes, Iceland and Greenland (*Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser*, Serie Fiskeri, 10, No 5) The 27 tables and 20 figures show the changes in the yield of the Faroese and Icelandic fishery since the year 1906 and of the Greenland fishery since 1928 The proportions of the total yield of the fishery taken by different countries are given and it can be seen that in all three areas the English catch greatly exceeds that of other countries Scotland takes second place in Faroese waters 1907 and 1908 and the immediate post War years of 1922 and 1923 were 'peak periods' in the fisheries of both the Iceland and Faroese areas, and each of these peaks has been followed by a marked and steady decline in the total yield of the fishery The total yield after the peak of 1922 and 1923 reached a minimum in 1929 and 1930 in the Icelandic and Faroese waters, and was thereafter followed by a fairly steady increase in the Faroese fishery and a slight one in the Icelandic fishery. Data concerning the Greenland fishery were obtainable only from the year 1928. The year 1929 showed the greatest total yield, since when there has been a decline so that in 1935 the total catch amounted to only half that of 1929. The statement that "these fluctuations in the catches are certainly due more to accidental circumstances connected with the fishery than to any change in the size of the fish stock" may be some reassurance, but the figures of the statistical tables and the graphs which Dr. Jespersen has prepared from them certainly do not present the picture of a stock of fish which is being rationally exploited.

The Cultivated Mushroom

No plant taxes the skill of the gardener so much as the common mushroom; its cropping is often erratic, even with expert commercial treatment. Miss D. M. Cayley has experimented with various composts for the growth of several kinds of wild and cultivated mushrooms (*J. Roy. Hort. Soc.*, 63, Pt. 7, 325–333; July 1938). A loose mixture of chopped straw, chopped hay, crushed oats and sand, watered with a solution of sulphate of ammonia, was found suitable for spawn production. Cultivated mushrooms would produce fruiting bodies upon a wide variety of fermented and unfermented composts. Most of the wild species, however, would not fruit upon artificial composts, but a kind of mushroom which grows around old hay stacks provides an exception. It can be grown upon a simple, cheap compost of naturally rotted material, and offers considerable possibilities for commercial development. Miss Cayley also describes (*Gard. Chron.*, July 16) the history of mushroom cultivation. Marchant le Père was apparently the first to discover, in 1678, the mycelium of the organism, and in 1707 Tournefort first described its horticultural propagation. Other records bring the history to modern times.

Early Echinoderms

Two new echinoids (*Aulechinus* and *Ectinechinus*) from the Upper Ordovician of Girvan are described by E. W. MacBride and W. K. Spencer (*Phil. Trans. Roy. Soc.*, B, 229, 91; 1938). Some of their features recall those seen in the early stages of development of living echinoids, such as the undivided or incompletely divided ambulacral pores, the arrangement of the plates on the peristome, and the incomplete radial symmetry of the apical disk due to the presence of only one inter-radial plate, the madreporite. The test was thin and flexible with two columns of ambulacral and seven to nine of interambulacral plates in each area. The pores in the ambulacral plates are near the per-radial line. A striking feature is that the radial water vessel was enclosed in the test, thus resembling the Asterozoa. The lantern is of a simple type, consisting of jaws and teeth only, and there are no auricles. In the periproct there is an anal pyramid with valvular plates—a character previously unknown in the Echinoidea. Both genera are regular forms, but one (*Ectinechinus*) is stated to be elongate, but with the plane of symmetry different from that in the heart urchins. Even more remarkable than the echinoids is *Eothuria* which, although resembling in many respects the two Echinoids, is regarded as a holothurian, since it is without ocular plates, and possesses five pairs of oral plates instead of jaws. Unlike other holothurians *Eothuria* has a complete test formed of thin plates, a condition comparable with the post-larval stage of *Cucumaria*. The pores in the ambulacral plates differ from those of the echinoids in having many openings.

Lead-Uranium-Thorium Ratio in Cleveite

RECENT analyses of different layers of crystals of uraninite show that the composition may not be uniform throughout a single crystal. Ruth Bakken and Ellen Gleditsch have now examined a single cleveite crystal from Auselmyren in Norway (*Amer. J. Sci.*, 95–106; 1938). Analyses were made of yellow and reddish alteration products (I), adherent gangue material (II), outer layer of the black lustrous cleveite (III), middle layer (IV), and core (V). It is interesting to find that PbO, which is about 13 per cent in V–III, rises to more than 20 per cent in I. Iron oxide similarly rises from about 1 per cent to nearly 4. ThO_2 varies but little in V–III, but is more than doubled in I. Uranium, on the other hand, shows a marked decrease in I. From III to V the colour deepens and the ratio UO_3/UO_2 increases from 1.35 to 1.48. The lead ratios and corresponding (approximate and uncorrected) ages are:

	III	IV	V	Average
$\frac{Pb}{U + 0.36\ Th}$	0.1668	0.1703	0.1721	0.1702
Millions of years	1283	1294	1308	1293

In a similar investigation of a Canadian uraninite from Wilberforce, Alter and Youll (*J. Amer. Chem. Soc.*, 390; 1937) found the lead ratios for the outer and middle layers and core to be 0.1668, 0.1678 and 0.1864 respectively.

Thixotropy

SOME new experiments on thixotropy have recently been described by C. W. Correns and H. G. F. Winkler (*Naturwiss.*, 26, 517; 1938). Powders of a known nuclear size (microscopic and sub-microscopic) were placed in tubes with different quantities of liquids. The degree of thixotropy is given by the ratio of the volume of liquid to the volume of solid for which the system after one minute's rest just shows no liquid flow when the tube is inverted, though the system is liquid when shaken. It was found that of the particles examined, those which were flat or rod-shaped showed thixotropy in water. The following substances of this type were used: kaolin, halloysite, metahalloysite, muscovite, glauconite, graphite, molybdenum glance and tremolite. Quartz, felspar and fluorspar, on the other hand, are approximately isometric, and do not show the phenomenon in water. The degree of thixotropy is greater the finer the particles. The presence of electrolytes is not necessary for the occurrence of the phenomenon. Their effect varies and does not follow the coagulation series. Thixotropy occurs not only with aqueous sols, but also in organic media. In fact, some substances, such as quartz, felspar and fluorspar, which do not show the phenomenon in water, do so in benzene provided the particles are of the right size. It may be concluded that every substance, if the particles are sufficiently fine, will show thixotropy in a suitable liquid.

Mechanism of Mutarotation

R Kuhn and L Birkofer have recently discussed the catalytic reduction of glucosides derived from secondary bases and the bearing of their experimental results on the theory of mutarotation (*Ber deutsch chem Gesells* July) Jacobson and Stelzner regarded the mutarotation of sugars as a process of oxo cyclo desmotropy, or ring chain tautomerism, which involves the change from one ring structure to another through an intermediate open form, in which a doubly linked oxygen atom appears Since the resulting carbonyl group is readily reduced by the addition of two hydrogen atoms, it would appear that the mutarotation of a sugar derivative is intimately associated with easy reducibility Thus the alkyl glucosides and the fully acetylated hexoses, which do not exhibit mutarotation, cannot be reduced in the same way as the free hexoses The authors have already described (*Ber* of March) two compounds namely, the *d* glucosides of piperidine and dibenzyl amine, which unexpectedly exhibit mutarotation As derivatives of secondary amines they are incapable of yielding Schiff's bases, and it would be reasonable therefore, to suppose that they would not be easily reduced In fact under the usual conditions reduction at 100° C leads only to the formation of free base and *d* sorbitol, but by keeping the temperature below 75° C and using nickel as catalyst it has been found possible to isolate N 1′ sorbityl piperidine, so that mutarotation and alcoholic reduction are again shown to be interdependent Further explanation of the mechanism of mutarotation is furnished by a study of the glucoside derived from dibenzylamine, which has an extremely low mutarotation velocity The latter was enormously increased by the addition of water and to an even greater extent by hydrochloric acid Thus the authors conclude that in such cases either bases or salts must be formed before mutarotation can occur, so that it is not the glucoside itself but rather its cations which undergo this transformation This seems to bring their views into harmony with those expressed by Lowry

Thermal Data for Organic Compounds

THE heats of combustion of some compounds which are important in carbohydrate metabolism have been determined by means of the bomb calorimeter by H M Huffman and S W Fox (*J Amer Chem Soc*, 60 1400, 1938) From the results at 25°, the values of the heats of formation (ΔH) and the free energies of formation (ΔF) in k cal are calculated to be as follows

	$-\Delta H$	$-\Delta F$
Fumaric acid	194 88	157 23
Maleic acid	189 45	151 32
Succinic acid	225 66	179 86
α d Glucose	305 73	218 72
α-d Glucose hydrate	376 52	275 76
β-d Glucose	304 23	218 32

Sulphur Dioxide

SOME thermal properties of sulphur dioxide have been accurately measured by W F Giauque and C C Stephenson (*J Amer Chem Soc*, 60, 1389, 1938) The melting and boiling points were found to be 197 64° K and 263 08° K, respectively (0° C = 273 10° K) The heats of fusion and evaporation per mol are 1769 1 gm cal and 5960 gm cal, respectively The vapour pressures were determined and represented by an equation From calorimetric measurements, the entropy of the gas at the boiling point was found to be 59 23 units per mol, which agrees with the value found from spectroscopic data, showing that the entropy approaches zero at the absolute zero The bond angle (between S and O) in the sulphur dioxide molecule is calculated as 129 ± 4°, with the S—O distance as 1 46 ± 0 02 A

Galerkin's Method in Differential Equations

THIS method was given by V G Galerkin in his treatise Rods and Plates' (Vestnik Ingeneroff) so long ago as 1915 but owing to language difficulties is little known in Great Britain The account by Prof W J Duncan (*Aeronautical Res Com Rep and Mem*, No 1798, 1937) will therefore serve a useful purpose The method starts by choosing a certain number of functions which satisfy the given boundary conditions, and taking a linear combination of these, with coefficients chosen so that the mean square error shall be as small as possible In practice, the minimum condition gives a set of simultaneous linear algebraic equations The method is particularly suitable for mechanical problems concerning elasticity or oscillations, such as occur in engineering and aerodynamics The equations obtained have a direct dynamical significance, namely, that of the vanishing of the virtual work in an appropriate displacement, and the method itself can be regarded as equivalent to the employment of Lagrange s dynamical equations with a special co ordinate system It is interesting to notice that, to make the best choice of certain multipliers it is necessary to know the physical meaning of the differential equation to be solved It is probable that the Galerkin method can be applied to every mechanical problem concerning elastic or other continuously deformable bodies, as well as to ordinary problems in the numerical solution of differential equations

Constants of Star-Streams

SOME years ago, Prof W M Smart published a paper concerning the constants of the star streams derived from the photographic proper motions of stars in which an analysis was made of the photographic proper motions of 3,029 stars (*Mon Not Roy Soc*, 87, 122, 1926) The plates, on which the determination of proper motions was based, were mainly parallax plates, taken with the Sheepshanks equatorial of Cambridge Observatory The material for a paper by Prof W M Smart and T R Tannahill (*Mon Not Roy Astro Soc*, 98, 7, May 1938) is derived from the measurement of similar Cambridge plates of 21 regions, and the photographic proper motions of the 1775 stars have been analysed according to the two stream theory by Eddington s method Stenquist found that there was a rapid increase of the probable errors for stars beyond a certain distance from the centre of each region, and in accordance with his procedure the present authors have rejected stars with images in the corner of plates Although the intervals are rather longer, on the average, than those used in the first paper, it is considered that the above refinement has so reduced the probable error that they are practically the same in both cases It was concluded in the first paper that the average probable error of the centennial proper motion was ±0 4″ in each co-ordinate. The analysis shows that 909 stars belong to Drift i and 794 to Drift ii, and the position of the vertex in galactic co ordinates is 337°, −1 4°. The solar motion with respect to the effective total of stars is directed towards the position, R.A 261° 1, Dec + 42°·5.

Chemistry of Cements

AN international symposium on the chemistry of cements, organized by the Royal Swedish Institute for Engineering Research and the Swedish Cement Association, was held in Stockholm on July 6–8 and attended by representatives from Great Britain, Canada, the United States and many of the European countries A short tour was arranged to precede the meeting, to enable visitors from abroad to see the cement and concrete industry in southern and central Sweden

The meeting, which was limited to a discussion of scientific problems and from which questions of testing and utilization were excluded, was the first international discussion of its type since the meeting held in London by the Faraday Society in 1918 A comparison of the papers presented at these two meetings shows how great have been the advances made in fundamental knowledge during the last twenty years?

After an opening address by Prof A F Enstrom, president of the Royal Swedish Institute for Engineering Research, two introductory lectures were given, one by Prof The Svedberg on 'The Study of Giant Molecules by Means of Ultra centrifugal Sedimentation, Diffusion and Electrophoresis , and the other by Prof A Hedvall on "Reactions between Substances in Solid State with Special Regard to Systems Containing Silica" At an early stage in the subsequent proceedings of the congress an act of homage to the memory of Le Chatelier was paid in the form of the following telegram sent to the Sorbonne, Paris

"A l'occasion du 'Symposium on the Chemistry of Cements' tenu à Stockholm le 6–8 Juillet sur invitation de L'Académie Royale des Sciences Polytechniques et de la Société Suédoise du Ciment, les participants au Congrès, venus d'Allemagne, d'Angleterre, de Belgique, du Canada, du Danemark, des Etats Unis, de Finlande, de Norvège, de Pologne, de Suède et de Suisse sont heureux d'accomplir un devoir de profonde reconnaissance en rendant hommage à la mémoire du grand savant français Henry le Chatelier, qui par son génie a tant contribué à la prospérité de la Science chimique et de la Technique en frayant spécialement la voie à la Chimie des Ciments par ses travaux proéminents et fondamentaux "

The papers presented to the congress, which together with the discussion will later be published in one volume by the Royal Swedish Institute for Engineering Research, were as follows 'Constitution of Portland Cement Clinker" by Dr R H Bogue (Bureau of Standards, U S A), "X rays and Cement Chemistry" by Dr W Bussem (Kaiser-Wilhelm Institüt für Silikatforschung, Germany), "Calcium Aluminate and Silicate Hydrates" by Mr G E. Bessey (Building Research Station, Great Britain), 'The Calcium Aluminate Complex Salts" by Mr F E. Jones (Building Research Station, Great Britain), "Portland Cement and Hydrothermal Reactions" by Prof T Thorvaldson (University of Saskatchewan, Canada), "Reactions of Portland Cement with Water" by Prof P Schläpfer (Technische Hochschule, Zürich, Switzerland), "The Chemistry of Retarders and Accelerators" by Dr L Forsén (Skanska Cementaktiebolaget, Limhamn, Sweden), 'Constitution of Aluminous Cement Clinker" by Dr N Sundius (Geological Survey of Sweden), Reactions of Aluminous Cement with Water" by Dr G Assarsson (Geological Survey of Sweden), 'Chemistry of Pozzolanas ' by Dr F M Lea (Building Research Station, Great Britain) and "Physical Structure of Hydrated Cements ' by Mr S Giertz Hedström (Royal Swedish Institute for Engineering Research, Stockholm) The discussions, including written contributions submitted by authors unable to be present, were maintained at the high level set by the papers

Particular interest attached to the glass phase present in Portland cement clinker Under very rapid cooling conditions, homogeneous structureless glasses can be obtained, but, with rather less rapid quenching, products are obtained which, although apparently glassy, give a strong X ray diffraction pattern This seems to be identical for glasses containing lime, silica and alumina, or lime, silica and ferric oxide, and also almost identical with that of the compound $3CaO\ Al_2O_3$, which has been found to have a structure of the perovskite type The suggestion was made by Bogue and Brownmiller that this pattern may be attributed to the formation of oxygen polyhedra, giving rise to the periodicity necessary for a strong X ray pattern, but that the accessory atoms are still randomly distributed, and only when cooling is slower do these atoms take up definite lattice positions and give rise to crystalline compounds It has been suggested that the patterns may be due to sub microscopic crystallization of alumina and iron compounds of very similar structure of the perovskite type While the compound $3CaO\ Al_2O_3$ is well known, however, the corresponding compound $3CaO\ Fe_2O_3$ has not been found in either binary or ternary systems containing lime and ferric oxide

No hydrated calcium alumino silicates of the more basic type had previously been prepared in the laboratory, but Bussem reported that evidence of the formation of compounds $3CaO\ Al_2O_3$, $2SiO_2$ aq and $2CaO\ Al_2O_3\ SiO_2$ aq in the quaternary system $CaO-Al_2O_3-SiO_2-H_2O$ have now been obtained It was evident that knowledge of the ternary systems involved in this quaternary system is now sufficiently far advanced to render a systematic investigation of it possible The complexity of the crystalline calcium silicate hydrates is indicated by the finding that, in addition to the naturally occurring mineral hillebrandite, $2CaO\ SiO_2H_2O$ three other crystalline hydrated dicalcium silicates, differing in their X ray pattern and optical properties, can be prepared by the action of high pressure steam on the anhydrous compound It is also noteworthy that, though no more basic compound than that with a 2 1 $CaO\ SiO_2$ ratio has been obtained from aqueous reactions, a hydrated crystalline tricalcium silicate can be obtained from the corresponding anhydrous compound by similar means

The general subject of the retardation of chemical reactions has been discussed recently by Prof K. V Bailey in his book "The Retardation of Chemical Reactions" The new work on the action of retarders and accelerators on Portland cement, reported by Dr L Forsén, has shown that their effects are dependent on the rate at which they cause precipitation of alumina from solution, and that the action of a wide variety of substances can be explained in this manner

The mineralogy of aluminous cement is complex, and the nature of the iron compounds present is still controversial A large part of the ferrous iron is found in that portion of the clinker which solidifies last, forming a dark and usually opaque glass X-ray evidence suggests that free ferrous oxide is present as wustite in sub-microscopic form, thus accounting for the high refractive index of the glass The unstable form of the compound $5CaO\ 3Al_2O_3$ (probably more correctly formulated as $12CaO\ 7Al_2O_3$) is somewhat remarkable in that it is the only member of the lime alumina series showing pleochroism It seems probable that, in aluminous cement at least, this is not a pure compound and that ferrous and other oxides are also present

Many difficult problems still remain in the study of pozzolanas and of the physical structure of hydrated cements, but in connexion with the last of these there now appears to be a definite trend towards the view propounded by Le Chatelier that the hardening of Portland cement is primarily to be attributed to crystal formation

During the period of the meeting and the tour which preceded it, visitors were entertained with much generosity by their Swedish hosts, and they owe to them a debt of gratitude both for this and for their work in the organization of a very successful meeting

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Hydro-Kinetic Power Transmitter[*]

By Prof F C. Lea

THE problem of devising a hydro-kinetic power transmitter capable of performing effectively the functions both of a clutch and of a change speed gear has not infrequently been declared to be incapable of solution Tests of a transmitter evolved by Commendatore Piero Salerni indicate that the problem has now been satisfactorily solved Within the range of variation of torque ratio requisite in an automobile or a heavy lorry the transmitter in question performs the two functions effectively and has an advantage over the orthodox clutch and gear mechanism in efficiency, performance, simplicity, soundness of construction, and also cost Furthermore, due to its inherent smoothness it relieves the whole of the transmission system, from engine to road wheels, of shock loads and thus reduces general maintenance

A variable ratio hydro-kinetic transmitter consists essentially of three vaned elements, namely, a centrifugal pump or driving element, a turbine or driven element, and a reaction element In the new transmitter the design of each of these elements involves important original conceptions, and of these conceptions that which relates to the centrifugal pump is of a fundamental nature and has important implications

In a hydro-kinetic power transmitter which has to function under conditions varying as widely and unpredictably as in an automobile or a locomotive, the major causes of loss of energy have heretofore been (1) unsteadiness of motion of the liquid medium within the ducts constituting the hydraulic circuit of the transmitter, (2) shock at the inlet of the driven element Of these two causes of inefficiency, the first, although *per se* the lesser, is fundamental, since the second, though considerably graver, is in consequence of the first

Since the liquid medium has to pass from a vaned driving element to a vaned driven element rotating relatively to one another at greatly differing and constantly varying speed, it is evident that, if losses of prohibitive magnitude are to be avoided, the rotational velocity with which the liquid emerges from the driving element must be so controlled that the direction in which the liquid impinges upon the receiving ends of the vanes of the driven element is maintained under all conditions, at an angle at which the liquid can be received without appreciable shock Hitherto such control has not been achieved Control of velocity variations implies, as a pre-requisite, steadiness of motion of the liquid, and it was held that in a centrifugal pump—and therefore in a hydro-kinetic power transmitter—the motion of the liquid could not be other than unsteady Hence the accepted theory that under variable conditions a hydro-kinetic power transmitter can function with acceptable efficiency only within a comparatively narrow range of variation, and that efficient performance by a single transmitter of the widely differing functions of a clutch and of a variable ratio gear is an impossibility

The fundamental characteristic of the new transmitter is that its driving element is a centrifugal pump of such a construction that the motion of the liquid within its ducts remains steady for the velocities that obtain in the ducts, with the result that a steady stream can be maintained within the hydraulic circuit of the transmitter under all conditions, and velocity variations can be, and are, adequately controlled By virtue of this characteristic, both the fundamental and the consequential causes of loss of energy are virtually eliminated

A series of laboratory tests have been carried out directed towards establishing the soundness of the hydraulic principle which governs the design and functioning of the machine, and I have had opportunities of observing and testing the performance of it in an automobile The automobile tested was a standard 21 6 h p 1936 model fitted with the standard size tyres and the standard back axle ratio of 4 1 to 1, the unladen weight of the vehicle being 29 cwt The tests included trials under all driving conditions, that is, in traffic, in hilly country and on the open road

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[*] Substance of a paper read before Section G (Engineering) of the British Association on August 22

The hill climbing capacity of the vehicle, and the rate of its acceleration at get away and under all other conditions, have proved to be appreciably greater than is advertised by the makers as achievable by the same model when driven with the standard clutch and gears , and, though acceleration was lively, it was always smooth and progressive, the torque ratio decreasing gradually as road speed increased Inasmuch as with the transmitter there is neither de clutching nor gear changing, optimum performance is achieved without involving gear changing skill on the driver s part Passage from drive at the ratio of 1 to 1 to drive at higher ratios and *vice versa* is controlled solely by the accelerator so that even at very low speed the car is driven at the ratio of 1 to 1 when acceleration is not needed while torque increase takes place whenever needed the moment the accelerator pedal is pressed hard

The hill climbing performance of the vehicle was particularly impressive A special hill climbing trial was made on the 1 in 4 portion of the Brooklands test hill The car was loaded with progressively greater weight until the final test when a net load of 22 cwt was put on the car The car was then driven on to the 1 in 4 portion of the hill was stopped and then restarted without difficulty on the same gradient and was driven comfortably to the top of the hill This particular feature should prove of great advantage in heavy lorries caterpillar tractors and the like

I have carried out also a prolonged road test to ascertain the fuel consumption of a car fitted with the transmitter as compared with the fuel consumption of the same model when fitted with the standard clutch and gear box mechanism This test has proved that with the transmitter a saving in fuel is effected

As a result of tests in the laboratory and on the road and of an examination of the working parts after they had been in use in an automobile over 65 000 miles I have come to the conclusion that

(1) The transmitter resolves in a satisfactory manner the problem of transmission of power at a torque ratio varying automatically and gradually within the whole range covered by the orthodox friction clutch and change speed gear mechanism

(2) Its application in an automobile in substitution for the orthodox clutch and gear mechanism results in an improvement of the performance of the vehicle in get away general acceleration, hill climbing drive in traffic and drive on the open road

(3) The mechanical construction of the transmitter is in every way simple and sound , as compared with the orthodox clutch and gear mechanism it is simpler and less costly and its overall efficiency (as measured by petrol consumption on a long run) is appreciably greater

(4) Its scope transcends the field of the automobile and should include vehicles of every kind driven by internal combustion engines both of the petrol and of the heavy oil type

Progress in Seismology

THE forty third report of the Committee of Seismological Investigations of the British Association has just appeared and shows great activity on the part of the members and others in numerous directions The six Milne Shaw seismographs belonging to the British Association have remained on loan to the seismological stations at Oxford (2), Edinburgh, Perth (Western Australia) and Cape Town (2) During the year a Jagger shock recorder has been made for the Committee at Bristol under the supervision of Dr C F Powell, and this instrument is to be set up at Dunira, near Comrie (the village in Perthshire which is famous for the prolonged series of minor earthquakes in the last century), thanks to the co operation of Messrs Macbeth and White At Kew Observatory, the three Galitzin and two Wood Anderson seismographs have been rehoused in a new underground building, and it is very satisfactory to learn that in their new position they are not affected by the wind as they were previously, due to the rocking of the building A full description of the new housing is being published in a memoir written by Dr A W Lee

It is very satisfactory to learn that the work on British earthquakes which was carried on so long and so assiduously by Dr C Davison is now being continued by Dr Dollar with the support of the Committee Dr Dollar is organizing the collection of data very thoroughly, and already has collected information from numerous collaborators concerning six earthquakes, four subsidences and mine shakes, two explosions and six earth tremors felt by people in Great Britain since July 1, 1937 The earthquakes had the following dates and epicentres 1937, July 9 at Walsall in Staffordshire 1937 July 20 in Perthshire 1937 September 8 at Horsham in Sussex , 1937 December 4 at Comrie in Perthshire 1938, March 21 in S E Edinburgh and 1938 June 11 with epicentre at Ghent in Belgium The latter was by far the most important though the only damage done in Great Britain appears to have been a single fall of a few tiles at Herne Bay, in Kent The low rumbling earth sound was imperceptible west of London In the West Indies earthquakes for the time being appear to be less frequent The Weichert seismograph and eight Jagger shock recorders are still in operation in the care of Mr Kelsick who is making regular reports From August until November 1937 about forty earthquakes were reported by observers in Dominica and valuable reports on the geological structure of the island and on the distribution of earthquake centres were written by Mr A G Macgregor and Dr C F Powell

The work of the International Seismological Summary is being actively pursued at Oxford by Mr J S Hughes and Miss E F Bellamy The I S S has now been prepared in manuscript as far as July 1933 and January, February and March are in the press From January 1933 onwards an attempt is being made to distinguish between anaseisms and kataseisms Theoretical work on southern earthquakes and the core waves periodicities and deep focus shocks has been done by the indefatigable Dr H Jeffreys, and on the travel times of *P* and *S* waves by Dr A W Lee Dr E C Bullard is likely to undertake work on the thickness of the strata overlying the continental shelf round the British Isles

Science News a Century Ago

A Record Balloon Ascent

ON the evening of September 11, 1838, Charles Green (1785–1870) the aeronaut, made The Second Experimental Ascent with the great Nassau balloon, accompanied by a Mr Rush In his account of the journey which he described fully in *The Times* of September 15, he said that the balloon and its appendages weighed 4056 lb of which the balloon, netting and car accounted for 702 lb the ballast for 1,500 lb, he and Rush 145 lb each, the grapnel 32 lb and the elastic rope to the latter 20 lb The remainder was due to the weights suspended from the car and released on starting The balloon was set free from the Vauxhall Gardens at 6 30 and landed near Lewes an hour and a quarter later The barometer used was made by Mr Jones, of Charing Cross ' The greatest altitude we reached was 27,146 ft, indicating an elevation from the earth of 5 miles and 746 ft the barometer having fallen from 30 50 to 11 and the thermometer from 61 to 5 or 27 degrees below the freezing point

Ure's "Dictionary of Arts and Manufactures"

IN 1838 Dr Andrew Ure (1778–1857), a Scottish chemist, published the first part of his Dictionary of Arts, Manufacture and Mines' In a notice of this, *The Times* of September 12, 1838, said This was a book much wanted The first number or part appears to be very well done, and contains a mass of information, important to the generality of readers, divested of the difficulties of technicality and the pedantry which generally confuses and deters the mere common sense and common capacity student The first part has some articles of very general interest—viz, Acetic Acid, Alcohol, Assay, Beer, etc ' Quoting from the article on ' Baths," in which reference was made to the water supply of London, the reviewer added the extract I am led to these remarks by observing the filthy state of the water usually supplied at very extravagant rates by the water companies It often partakes more of the *appearance of pea soup than of the pure element* and he who reflects upon the miscellaneous contents of Thames water, will not have his appetite sharpened by a draught of the Grand Junction beverage nor feel reanimated and refreshed by bathing in a compound so heterogeneous and unsavoury '

Loudon's "Arboretum et Fruticetum Britannicum"

ON September 15, 1838, the *Athenæum* reviewed the Arboretum et Fruticetum Britannicum, or the Trees and Shrubs of Britain, Pictorically and Botanically delineated, etc, with their Propagation, Culture, Management, etc "The English gardener,' the journal said, is the best in Europe, the English forester the worst nowhere has art more generally neglected the advantages of a favourable climate than in English woods

"Mr Loudon s object has been to enable the landed proprietor to avail himself of the discoveries of modern science, and to show him the real value of the many new species and varieties of trees and shrubs now in this country He has performed his task with great industry and perseverance, the results of which are eight octavo volumes, containing 2,694 pages of closely printed letterpress, 297 figures of plants and 2,546 woodcuts The appearance of the plants themselves, the value of their timber, the kind of soil they require, the manner of multiplying them, their periods of flowering and bearing fruit, the climate most favourable to their growth, their botanical distinctions are all discussed in ample detail So useful a book upon trees and shrubs is not to be found in any language

John Claudius Loudon was born in Lanarkshire in 1783 and died in Bayswater in 1843 He was brought up as a landscape gardener, and between 1813 and 1828 made many visits to the Continent In the writing of his later works he was assisted by his wife Jane Loudon (1800 58)

Societies and Academies

Paris

Academy of Sciences (*C R*, 207, 101–195, July 11 1938)

H VINCENT Influence of protected' inoculations on the accession to virulence and on the morphology of the typhoid bacillus An impregnated plug in a glass cylinder open at the ends is inserted into the peritoneum of the experimental animal Such a culture increases rapidly in virulence and many of the organisms produced are smaller than normal and enclosed by a clear capsule

L DANIEL Variations in colour of the rush and borage grown in a calcareous soil

G BENNETON Representation of numbers by a sum of *s* distinct squares

K POPOFF An extension of the notion of a derivative

M SCHIFFER Minimal domains in the theory of pseudoconformal transformations

R GARNIER Extension of the Euler Savary formula to the most general movement of a solid

A TOUSSAINT and M GDALIAHU Experimental realization of solid boundaries without a limiting layer

P CHADENSON A wave theory in celestial mechanics

A VÉRONNET Theory of natural and artificial radioactivity based on the constitution of the atomic nucleus

P VERNOTTE Distribution of a heat flux arising at the interface of two limited media in imperfect contact Paradox on the propagation of heat

M PAUTHENIER High tension [electric] generators employing a current of gas

J VIRGITTI Determination of the form to be given to high tension collectors

V MAJERU Propagation of electric waves in ionized gases between two coaxial cylinders

T BOGGIO New integral of the equations of movement of an electrified particle in an electric field and in a superimposed magnetic field

E BRYLIŃSKI Symmetries of the magnetic field

F J TABOURY Role of the degree of ionization of electrolytes in the structure of the transition zone, Beilby layer electrolyte Comparison with analysis by the Raman effect

A MICHEL and MLLE M GALLISSOT Thermo magnetic anomaly presented at ordinary temperature by microcrystalline ferromagnetics

A ROUSSET and R GARNIER Molecular diffusion of light by liquids variation of the diffused intensity with the wave-length

J JANIN Emission spectrum of ozone in the ultra violet region

A Kastler Principle of a new method of separation of isotopes Metastable atomic levels of isotopes of an element may have very different life periods A scheme for the separation of isotopes is based on this fact The method should be applicable to all elements having metastable levels

I Zlotowski Disintegration of boron with emission of deuterons Bombardment of boron in a Wilson chamber in a field of 16 000 gauss gave a few tracks which are assigned to deuterons The reactions are

$$ {}^{10}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{12}_{6}\mathrm{C} + {}^{2}_{1}\mathrm{H} $$
$$ {}^{10}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{13}_{6}\mathrm{C} + {}^{1}_{1}\mathrm{H} $$

the former predominating

M Paić A glass electrode for differential titration It consists of a U tube with constriction at the bottom across which is a membrane of Corning glass 015

Mlle M Gex Variations of different physico chemical properties of naphthalene as a function of the *p*H

G Arditti Autoxidation of normal hexadecane

W Heller and **E Vassy** Optical study of iso thermal and non isothermal transformations sol → gel

R Faivre and **A Michel** Variations of the crystalline parameter of cadmium oxide by the insertion of cadmium atoms in its lattice

Mlle L Chaumeton Copper salts of imidodi sulphonic acid

V Auger α and β Monohydrates of molybdic anhydride

A Borocco Contribution to the study of the action of ultra violet rays on mercury fulminate A change of colour occurs, which is accompanied by partial decomposition Other physical properties are not appreciably affected

J Laval Scattering of X rays by a crystal

M Gautier and **M Roubault** Crystalline rocks of the Nemours region (Algeria)

F Trombe Wells and subterranean rivers of the Haut Comminges (Haute Garonne)

Mlle L Levina Modifications of the diffusion of glucose in presence of salts the case of vegetable tissues

P Crété Embrogeny of the Lobeliaceæ Development of the embryo of *Lobelia syphilitica* L

P Castel and **M Bosc** Localization of copper in the foliar tissue of the vine after treatment with copper sulphate The cuticle appears to have great powers of retention for copper

J Dalmon Different modes of sexuality among lamellibranch molluscs of the family Pectinidæ, change of sex and transitory hermaphroditism in *Chlamys varia* L

I Grundland and **H Bulliard** Demonstration of the existence of fluctuations in the physical and chemical aspect of lipo protein complexes (chemical Brownian movement)

J Loiseleur Variations of the viscosity of antivenom serum in presence of its antigen

M Polonovski and **M Jayle** Study of the peroxidative action of hæmoglobin

Mme Y Jérome Lévy Influence of various carbons on alcoholic fermentation

R Herpin and **R Duliscouet** The role of a microbial membrane in the effectiveness of paints used to protect the bottoms of boats against fouling by organisms The film is gelatinous and contains infusorians, flagellates and bacteria, it is physically unsuitable for the fixation of larvæ, and further, it contains *Bacillus subtilis* which by removal of oxygen creates unfavourable conditions for aerobic organisms

Brussels

Royal Academy (*Bull Classe Sci* 24 No 3 1938)

O Rozet Abelian involutions of order nine belonging to an algebraic surface

R Ledrus Application of the cathode ray oscillograph to the direct registration of the characteristics of probes in periodically variable plasmas

M G E Cosyns Study of the azimuthal distribution of cosmic radiation Measurements on the Pic du Midi have shown that for 0° longitude and a height of 3 000 m the critical magnetic latitude is 48° at most

M Florkin Concentration of the external medium and hydration in a soft water lamellibranch (*Anodonta cygnaea* L)

G A Homès Surface phenomena in the cold working and recrystallization of metals

G A Homès and **P Duwez** Distinction between the crystalline mechanism of static rupture and that of dynamic rupture While static rupture is produced by a progressive deformation of all the crystals fatigue rupture is produced by the progressive deformation of only a part of the crystals

Melbourne

Royal Society of Victoria July 14

E S Hills Age and physiographic relationships of the Cainozoic volcanic rocks of Victoria These rocks fall into two distinct groups an older volcanic series of Oligocene to Lower Miocene age and a newer volcanic series of Middle Pliocene to Recent age Certain of the newer volcanic rocks in western Victoria underlie consolidated dune rocks which are regarded as ranging throughout the Pleistocene and are correlated with the Helicidæ sandstones of the Bass Straits islands Newer volcanic rocks are recorded from several localities in the eastern highlands

F Lindsay Two Gregarines from *Ctenolepisma longicaudata* with notes on forms in other silverfish *Lepismatophila ctenolepismæ* sp nov and *Gregarina ctenolepismæ* sp nov have been described and the former was found only in *Ctenolepisma lineata* var *pilifera* Luc

Tokyo

Imperial Academy (*Proc* 14 No 7 July 1938)

Akitsuga Kawaguchi On the contractions of extensors

Shizuo Kakutani Two fixed point theorems concerning bicompact convex sets

Katsutada Sezawa and **Kiyoshi Kawai** Anomalous dispersion of Rayleigh waves

San ichiro Mizushima, **Yonezo Morino** and **Syuna Sugiura** Raman effect in tetradeutero 1 2 dibromoethane

Haruyosi Huzimoto Radiolarian remains discovered in a crystalline schist of the Sambagawa system

Shôshirô Hanzawa An aberrant type of the Fusulinidæ from the Kitakami mountainland, north eastern Japan Fossil foraminifera from the Permian formation Three new species of *Nipponitella* n gen are figured and described

Takeo Kamada Intracellular calcium and ciliary reversal in *Paramecium*

Forthcoming Events

Fifth International Congress for Applied Mechanics, September 12–16, at the Massachusetts Institute of Technology, under the presidency of Prof K T Compton

Faraday Society September 15–17 —General Discussion on Luminescence, in the Biochemical Laboratory, University of Oxford

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

A Senior Professional Officer (Physiology) and a **Senior Professional Officer (Biochemistry)** in the Department of Agriculture and Forestry in the Union of South Africa—The Secretary High Commissioner for South Africa South Africa House Trafalgar Square London (Application form 7 83 September 12)

Keeper with knowledge of archæology in the National Museum of Antiquities of Scotland—The Secretary Board of Trustees Portrait Gallery Buildings Edinburgh 2 (September 17)

Lecturer in the Department of Pharmacy and Biology at the Central Technical College Suffolk Street Birmingham 1—The Principal (September 20)

Principal of the Bengal Engineering College Sibpur near Calcutta—The High Commissioner for India General Department India House Aldwych London W C 2 (September 23)

Assistant III (adult male) on the staff for scientific research of the War Department—The Superintendent Air Defence Experimental Establishment Biggin Hill Kent (postcard September 23)

An Assistant Lecturer in Biology and a **Lecturer in Physics** in the University of Western Australia—The Agent General for Western Australia Savoy House 115 Strand London W C 2 (October 1)

A Lecturer in Physics and a **Professor of Philosophy** in the University of Queensland—The Agent General for Queensland London, or Universities Bureau London for conditions of appointment (Registrar of the University of Queensland October 1 and 15 respectively)

Three European Engineer Sub Lieutenants in the Royal Indian Navy—The Secretary Military Department India Office London S W 1 (October 15)

Senior Research Assistant in Highway Engineering in the University of the Witwatersrand *Johannesburg*—The Secretary High Commissioner for South Africa South Africa House Trafalgar Square London W C 2 (October 17)

Professor of Anatomy in the University of Birmingham—The Secretary (October 31)

Lecturer in Forestry in the University of Aberdeen—The Secretary (October 31)

Chemical Assistant in the laboratory of the Colne Valley Water Company Aldenham Road Watford Herts—Chief Chemist (endorsed Chemical Assistant")

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1799 (2913) Approximations to Functions and to the Solutions of Differential Equations By Dr R A Frazer W P Jones and Sylvia W Skan Pp 33 4*s* 6*d* net No 1822 (3175) Relaxation Methods applied to a Spar of Varying Section deflected by Transverse Loading combined with End Thrust or Tension By R J Atkinson K N E Bradfield and R V Southwell Pp 33 4*s* 6*d* net No 1826 (3283) Flight Tests on the Profile Drag of 14% and 25% Thick Wings By J E Serby M B Morgan and Dr E R Cooper Pp 16+4 plates 3*s* 6*d* net (London H M Stationery Office) [198

Department of Scientific and Industrial Research Forest Products Research Records No 25 Machinery and Equipment used for Bending Wood By W C Stevens Pp ii+13+2 plates (London H.M Stationery Office) 6*d* net [198

North of Scotland College of Agriculture Calendar Session 1938 1939 Pp viii+112 (Aberdeen North of Scotland College of Agriculture) [228

Department of Scientific and Industrial Research Report of the Forest Products Research Board with the Report of the Director of Forest Products Research for the Year 1937 Pp vi+87+10 plates (London H M. Stationery Office) 2*s* net [228

Scottish Society for Research in Plant Breeding Report by the Director of Research to the Annual General Meeting 21st July 1938 Pp 32 (Edinburgh Scottish Society for Research in Plant-Breeding) [238

Two Lectures on Practical Aspects of Absorption Spectrophotometry By Dr R Alan Morton Pp 59 2*s* 6*d* net The Profession of Chemistry By Richard B Pilcher Fourth edition Pp xii+108 2*s* 6*d* net Register of Fellows, Associates and Students 1938 Pp 477 5*s* net (London Institute of Chemistry) [268

Other Countries

Sudan Government Agricultural Research Service Report of the Government Chemist for the Year 1937 (Chemical Section Publication No 80) Pp 19 (Khartoum Agricultural Research Service) [178

Botanical Museum Leaflets Vol 6 No 6 A Remarkable Fossil Selaginella with Preserved Female Gametophytes By William C Darrah Pp 113 136 (Cambridge Mass Harvard University) [198

U S Department of the Interior Geological Survey Bulletin 874–C Geology and Fuel Resources of the Southern Part of the Oklahoma Coal Field Part 3 The Quinton Scipio District, Pittsburg, Haskell and Latimer Counties By C H Dane H E Rothrock and James Steele Williams Pp v+151 258+plates 12–26 65 cents Bulletin 886 D Preliminary Report on the Alunite Deposits of the Marysvale Region Utah By Eugene Callaghan (Contributions to Economic Geology 1937) Pp iv+91 134+plate 18 15 cents Bulletin 888 Spirit Leveling in Vermont, 1896 1935 By J G Staack Pp ii+155+1 plate 20 cents Bulletin 895–C Geophysical Abstracts 90 July September 1937 Compiled by W Ayvazoglon Pp ii+93 136 10 cents Bulletin 899 A Geologic Structure and Occurrence of Gas in Part of Southwestern New York Part 1 Structure and Gas Possibilities of the Oriskany Sandstone in Steuben Yates and parts of the Adjacent Counties By W H Bradley and J F Pepper Pp iv+68+4 plates 35 cents Water Supply Paper 796 F Geology and Ground Water Resources of the Valley of Gila River and San Simon Creek Graham County Arizona By Maxwell M Knechtel with a Section on The Chemical Character of the Ground Water by E W Lohr (Contributions to the Hydrology of the United States 1937) Pp iv+181 222+plates 45 53 35 cents (Washington D C Government Printing Office) [198

Survey of India Geodetic Report 1937 Pp x+89+23 plates (Dehra Dūn Survey of India) 3 *rupees* 5*s* 3*d* [228

Royal Observatory Hong Kong Meteorological Results 1937 Prepared under the direction of C W Jeffries Pp iv+148+36+8+8 plates (Hong Kong Government Printers) 3 dollars [228

Annual Report of the Director of the Royal Observatory for the Year 1937 Pp 8 (Hong Kong Government Printers) [228

Department of Agriculture Straits Settlements and Federated Malay States Economic Series No 9 Malayan Agricultural Statistics 1937 By D H Grist Pp xi+89+2 plates (Kuala Lumpur Department of Agriculture) 1 dollar [228

Mémoires de la Société de Physique et d Histoire Naturelle de Genève Vol 41, Fasc 4 Études sur la partie occidentale du Lac de Genève 3 Constitution physique et chimique des sédiments du Lac de Genève Par E Joukowsky et J Ph Buffle Pp 415 466+plates 14–20 (Genève Georg et Cie) 7 francs [228

Queen Victoria Memorial Library Salisbury Occasional Paper No 1 A Rock Shelter on Nyazongo Mountain Penhalonga District Southern Rhodesia By C Martin Technical Reports by Rev Father P Stapleton and L H Wells Pp 18 (Salisbury S Rhodesia Queen Victoria Memorial Library) 5*s* [228

Southern Rhodesia Report of the Trustees and Director of the National Museum of Southern Rhodesia for the Year ended 31st December 1936 Pp 8+3 plates Report of the Trustees and Director of the National Museum of Southern Rhodesia Bulawayo for the Year ended 31st December 1937 Pp 10 (Salisbury Government Stationery Office) [228

U S Department of the Interior Office of Education Bulletin 1937 No 35 The School Building Situation and Needs By Alice Barrows Pp vi+62 10 cents Bulletin 1938 No 1 Educational Directory 1938 Pp iii+48+28+82+70 n p (Washington D C Government Printing Office) [238

Report and Accounts of the National Botanic Gardens of South Africa Kirstenbosch Newlands Cape (and the Karoo Garden Whitehill near Matjesfontein) for the Year ending 31st December 1937 Pp 25 (Kirstenbosch National Botanic Gardens of South Africa) [268

Societas Scientiarum Fennica Commentationes Physico Mathematicae X 4 Über die Ionisierungsspannungen der Elemente in verschiedenen Ionisierungszuständen Von Eugenie Lisitzin Pp. 121 (Helsingfors Akademische Buchhandlung) [268

Parliament of the Commonwealth of Australia Report by H E Wimperis on the Inauguration of Aeronautical Research in Australia dated 21st December 1937 Pp 17 (Canberra Government Printer) 1*s* [298

Department of Science and Agriculture, Jamaica Bulletin No 11 A Study of the Yields of Sugar Cane in Jamaica 1935 1936 Report by H H Croucher Pp 39 Bulletin No 13 Report on an Agricultural Survey in the Cayman Islands By W H Edwards Pp 41+6 plates Bulletin No 14 Proceedings of the Summer Course of Lectures and Demonstrations 1937 Pp iii+83 Bulletin No 15 Cercospora Leaf Spot of Bananas By F S Ward Pp 7+6 plates (Jamaica Government Printing Office) [298

Bulletins of Indian Industrial Research No 12 The Manufacture of Soap in India By A K Menon Pp ix+63+5 plates (Delhi Manager of Publications) 1 rupee 1*s* 6*d* [298

Catalogues, etc

Dunns Seed Wheats 1938 Pp 32 (Salisbury Dunns Farm Seeds Ltd)

A Catalogue of Scientific Works, including books in Natural History Zoology Geology, Ornithology Agriculture Botany and Gardening also Books and Periodicals on Mathematics and Physics from the Library of the late Dr J R Airey (No 489) Pp 40 (Cambridge Bowes and Bowes)

Heparin B D H Pp 9 (London The British Drug Houses, Ltd)

Optical Utilities Pp 16 (London W Watson and Sons, Ltd)

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The Science Museum, South Kensington

THE rapid extension of scientific knowledge and of its application to industry during the past fifty years and most particularly in the post War period has exercised a tremendous influence on our social and economic life We are not yet able to utilize and control this to full advantage and therefore its source and development require to be revealed in as comprehensive and comprehensible a manner as possible to those who seek to understand The Science Museum at South Kensington aims to provide a proper representation commensurate with its importance of the scientific and technical aspects of human endeavour and achievement in the national life by means of exhibits which provide a continuous story from the birth of a new idea expressed in a new material instrument or machine up to its most modern development It differs from other national museums in that it deals with an aspect of life which is essentially dynamic and rapidly progressive and its task necessarily becomes an increasingly complex one

The continuous growth of scientific knowledge and the progressive reduction in the time lag between its discovery its application in industry and its transformation into goods and services available to the public present a formidable problem to those responsible for recording the process of historical evolution This is particularly the case since many modern industrial developments have arisen not so much from an independent expansion of one branch as from the interaction of several branches of scientific knowledge so that sectionalization in presentation is rendered increasingly difficult

The object of the Museum is in the first place educational It is inevitable that the community will become increasingly aware of the reaction of science on its everyday life and a well equipped museum is the best means of ensuring an intelligent appreciation of scientific and technical developments and of the benefits which they bestow It is very important that the Science Museum should keep abreast of these developments so that the average visitor may see clearly the relation to what has gone before of the devices which he is called upon to use in his normal activities In performing this function the Museum does a very great service to the industry of the country

In order to deal with this complex situation the Science Museum has adopted the practice of combining with its permanent historical and sectionalized exhibition exhibitions of a temporary character dealing with special industrial developments of considerable present importance from which individual exhibits may be withdrawn afterwards for incorporation in the permanent collection The interest which these temporary exhibitions arouse may be judged from the fact that the most recent one on Electrical Illumination was attended by more than a quarter of a million people while during 1937 the total number of visitors to the Museum as a whole was more than one and a quarter millions The vast majority of these are not idle sightseers but persons genuinely interested and keen to learn something from what they see and it would be impossible to over estimate the educational and inspirational benefit which accrues particularly to young people from this visual exposition of scientific and technical development

It has become increasingly evident however that the space available is quite inadequate to enable the Museum to develop in a manner befitting its importance At the present time the existing collection is badly overcrowded and it is not possible to house or display it with the dignity which has been given to our arts and humanities to find accommodation for objects in store or acquirable which should rightly be exhibited or to advance towards the creation of several new sections for which there is a pressing need

In 1911 12 a Committee under the chairmanship of Sir Hugh Bell recommended the construction of new eastern and central portions and visualized their completion by 1922 the eastern portion was finally completed in 1928 but no start has yet been made on the centre portion Even however if the latter were available in the form suggested by the Committee the total space then available would permit of only a partial satisfaction of the present needs and would therefore leave no provision for such natural growth as is to be expected during the next fifty years The total exhibition space which the Advisory Council of the Museum has estimated to be necessary amounts to some fifty per cent increase over that envisaged by the Bell Committee It is realized that this estimate is conservative but it has been kept down to this figure deliberately in order that the collections in the Museum should not exceed what can be usefully displayed in the convenient compass of one building The Council advocates that the main exhibition galleries should be confined to not more than three floors a system which has been wisely adopted in both the older and the newer museums of Great Britain and other countries

These considerations constitute the basis of recommendations which have been put before the Board of Education recently by the Advisory Council and with the full support of the Federation of British Industries for a considerable extension of the present space allocation in South Kensington The present time is opportune since the site adjacent to the existing buildings on which any extension must necessarily occur if decentralization is to be avoided may soon become available by the project now under consideration for the readjustment and expansion of the Government and collegiate institutions situated on the area between Kensington Gore and Cromwell Road The calculation of the site area necessary to provide the estimated floor space required and allowing for the inclusion of some central courts to admit light into the galleries covers the area enclosed by the Natural History Museum boundary Exhibition and Imperial Institute Roads and Queen s Gate exclusive of the two blocks occupied by private residences and the Meteorological and Post Offices The acquisition of this site is in the opinion of the Advisory Council essential if practical effect is to be given to that long view of the future function and progress of the Museum which its national importance and value to the industry demand

It is to be hoped therefore that the Board of Education will give the most serious consideration and its ultimate endorsement to these recommendations the value of the Museum as a means of educating the general public and of demonstrating the continuous development of our national resources is becoming increasingly appreciated by industry and there need be no doubt as to the enthusiasm with which industry would support and give assistance towards their full subsequent realization

The example has been set in Germany by the Deutsches Museum in Munich and in the United States by the Rosenwald Museum in Chicago in Great Britain we need not and should not suffer as we now do in comparison with them

Kinetic Theory of Gases

Kinetic Theory of Gases
with an Introduction to Statistical Mechanics By Prof Earle H Kennard (International Series in Physics) Pp xiii + 483 (New York and London McGraw Hill Book Co Inc 1938) 30s

NEW books on the kinetic theory of gases are rather rare phenomena The best early comprehensive works on the subject were written in German by O E Meyer (Kinetische Theorie der Gase first ed 1877) and L Boltzmann (Vorlesungen über Gastheorie vol 1 1895 vol 2 1898) the former book was meant for physicists and the latter for mathematicians The second edition of Meyer s treatise translated into English by R E Baynes was published in 1899 and even now is worth reading It has not been reprinted probably because of the appearance in 1904 of the first edition of Sir James Jeans s Dynamical Theory of Gases

The expressed aim in Jeans s first edition was to develop the Theory of Gases upon as exact a mathematical basis as possible The fact that further editions of this book were called for in 1916 1921 and 1925 shows that the book proved widely useful and acceptable In the second and later editions the original aim was combined with an attempt to make as much of the book as possible intelligible to the non mathematical reader for which reason the plan of dividing the book to a large extent into mathematical and physical chapters which was already partly adopted in the first edition was more extensively followed The later editions grew in size but not because the developments of the classical Maxwell Boltzmann theory made between 1910 and 1917 were incorporated only their results were quoted Little was added moreover concerning the new experimental researches on gases the new matter mainly referred to the quantum theory which gave an entirely new outlook on the difficulties concerned with the equipartition of energy discussed at length in the first edition Much of the chapters on quantum theory in the later editions had but slight bearing on gas theory

In 1927 L B Loeb published the first edition of his Kinetic Theory of Gases which made a considerable break with the Jeans tradition He omitted altogether most of the difficult mathematics for which he substituted an account of many topics nearly or wholly omitted by Jeans such as the experimental and theoretical work on the Brownian motion by Perrin and Einstein the studies of rarefied gases by Knudsen and a discussion of magnetism in gases

Now again from across the Atlantic comes another Kinetic Theory of Gases in English by E H Kennard This resembles the book by Loeb much more than that by Jeans The treatment is actually more mathematical than that of Loeb but the difference between the two is small compared with the great gulf that would separate either book from one giving a systematic mathematical presentation of the pure kinetic theory of gases Few physicists however will wish to penetrate far into the mathematical labyrinth of the theory of gases

Justification for a new book on the subject on the same general lines as were followed by Loeb may be found in Prof Kennard s inclusion of work both experimental and theoretical that has appeared since 1927 Among the additional topics or topics treated in a materially different way in Kennard s book are statistical mechanics leading up to statistical wave mechanics the wave mechanics of gases and molecular beams and scattering The author also goes further into the approximate theory of the mean free path phenomena and follows Jeans—somewhat distantly in referring to terrestrial and planetary atmospheres

If one book could be made out of the two by Loeb and Kennard the reader s convenience might be still better met than by the possession of the two separate works But it will certainly be worth the while of many possessors of Loeb s treatise also to read the new book by Prof Kennard The book is well documented and will materially help readers wishing to follow recent work although the kinetic theory is now as Prof Kennard says in a state of staid maturity it retains importance in modern physics which has many interesting interactions with it an example is the theoretical calculation of the accommodation coefficient duly referred to in the book under review A novel and commendable feature is the inclusion of a number of exercises for practice

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Petrography of the Igneous Rocks

A Descriptive Petrography of the Igneous Rocks By Prof Albert Johannsen Vol 3 The Intermediate Rocks Pp xiv+360 Vol 4 Part 1 The Feldspathoid Rocks Part 2 The Peridotites and Perknites Pp xvii+523+1 plate (Chicago University of Chicago Press London Cambridge University Press 1937) 21s net each

VOLUMES 3 and 4 of this work complete what must be the most compendious handbook of petrography ever issued In the first volume Johannsen gave an admirably illustrated account of rock textures and structures, together with an account of the many systems of classification in use He himself has devised a quantitative mineral classification and this is used in the descriptive part of the work In this system rocks are first divided into classes according to the relative amounts of light and dark coloured minerals present and then into families and sub families on the percentage ratios of certain other mineral components actually present

To some extent the divisions thus made cut across those generally used Thus the second volume includes all the rocks with more than 5 per cent of modal quartz and quartz bearing varieties of basic rocks are found in the same volume as the acid granites and rhyolites. Those with less than 5 per cent are described in the third volume under the title of "The Intermediate Rocks". They comprise syenites, monzonites, diorites, norites and gabbros together with their hypabyssal and volcanic equivalents. In the older classifications many of these are termed basic, and indeed such rocks, norites, gabbros, dolerites and basalts, occupy half the volume. Volume 4 is divided into two parts. The first part, "The Feldspathoid Rocks", includes the so-called alkali-syenites, essexites and gabbros with the corresponding lavas and intrusives. In the second part, "The Peridotites and Perknites", the ultrabasic rocks, are described.

One of the author's aims is to bring precision to the nomenclature and classification of igneous rocks. Accordingly, in his treatment of the families, the units for descriptive treatment, he first reviews the history and definition of the rock name. He is able to show that with the passage of time many rocks have been given names to which they are not entitled, and that many new names have been given to rocks that would conveniently fall into types already defined. Where ambiguity occurs he suggests a re-definition of the type, or in some cases that the name should be abandoned and another adopted. He is fertile in the invention of new names. He then proceeds with the macro- and micro-scopic characters of the rocks in the family, and in all the principal groups gives a full account of the mineralogy. Tables of chemical analyses, of norms and of modes are abundant. In the author's classification the mode is all-important, and where the original description of a rock lacks this, Johannsen has frequently supplied it from typical material. The treatment is very full and comprehensive.

Some idea of the scope of the work is given by the indexes, of which three are given at the end of the last volume. More than 800 authors are cited, some of them being referred to many times. Localities number more than 2,000, and there are more than 1,200 rock names. Though many of these have been devised by Johannsen to suit his classification, there can be few, if any, old names omitted. These are all adequately referenced, and it is pleasing to note that the author has personally verified all references to which he has access. The few that he has been unable to check are indicated.

The value of the work is independent of the classification or the nomenclature. An enormous amount of data, gathered from world-wide and often relatively inaccessible sources, is made available in one work. To petrographers it will be a mine of information and a great time-saver. It is the fruition of the life-work of a great petrographer and scholar.

The general get-up of the volumes is excellent. They are well printed on good paper, with pleasing type. Proof reading has been well done, the few corrigenda for the early volumes being mainly in the spelling of place-names. The binding is such that a volume of 500 pages will remain open at any page. The book will be a welcome addition to any geological library.

Astrophysical Methods and Problems

Astrophysik

Herausgegeben von B. Stromgren. (Handbuch der Experimentalphysik, herausgegeben von W. Wien und F. Harms, Band 26.) Pp. xv + 998. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 76 gold marks.

AS the authors point out, the vital point in a presentation of astrophysics in one volume, such as offered here, is the limitation of the material dealt with. In accordance with the character of the "Handbuch der Experimentalphysik", of which it forms volume 26, in planning this volume the methodology of the observing astrophysicists has been brought to the fore. Therefore, the main emphasis is given to a very complete representation of the methods and instruments of astrospectroscopy and astrophotometry. To perform this task it was necessary, of course, also to look into the problems of theoretical astrophysics, in order to elucidate the purpose and value of the multitude of spectroscopic and photometric observations which are now available.

In emphasizing this, Prof. Strömgren points out very clearly his and his collaborators' aims. The book is intended for both the physicist and the astronomer. It furnishes the former with the latest information regarding the methods of astrophysics. The general principles of astronomical spectroscopy and photometry are the same as those used in the laboratory. But, to solve the special astrophysical problems, a number of quite independent methods of interest to the physicist have been developed, and the methods of laboratory physics have been refined.

For the astronomer the book is intended to serve as a textbook and a handbook of practical astrophysics ’ This is a great promise for a one volume work on a subject of such wide scope not hitherto treated in one volume as a homogeneous whole But the promise is kept and it is difficult to avoid superlatives in referring to the work

The introductory chapter by J Stobbe of the Kiel Observatory gives in 178 pages an outline of those astronomical subjects which do not find a place elsewhere in the book Here we have paragraphs on co ordinates and time on the positions and motions and radiation of the stars giving the essential principles Stobbe goes on to give an exposition of the theoretical foundations of photometry and spectroscopy adding a description of the optics and mechanics involved in the construction of astronomical instruments and observatories An instructive chapter on the physiological and psychological components of the observer s activity concludes this clearly written and well condensed summary the value of which is enhanced by ample references

The following 139 pages cover spectral analysis so far as it is concerned with qualitative con siderations In this chapter W Schaub first outlines briefly the problems involved in the classification of the stellar spectra and refers to spectroscopic parallaxes radial velocities rotation of the stars etc But the position of greatest importance is occupied by an excellent description of the instruments in use namely the different types of spectrographs measuring microscopes and spectrocomparators and a full account of the methods for measuring and reducing the spectro grams Here we find also especially useful the detailed survey of the ways of testing the optical and mechanical parts of the spectrographs and of all the various corrections to be allowed for in practical radial velocity work

The photometric part of the work is naturally the most extensive of all its treatment being divided up between B Stromgren (Copenhagen and Chicago) H Kienle (Gottingen) and J Hellerich (Hamburg) Stromgren s two chapters —one on the tasks and problems of astrophoto metry, the other on objective photometrical methods —362 pages in all form more than one third of the whole contents of the book Not only in quantity but also in quality these chapters form the key of the whole and unite in an article of unique construction a wealth of material hitherto scattered in countless sources

The wide variety of problems and the limita tions of astrophotometric measures are elucidated in great detail Comprehensive sub chapters deal with the present photometric systems and catalogues, with the results of the work on colour indexes and on other colour equivalents A full and stimulating discussion is devoted to the problems of spectrophotometry towards which so much of the present day interest in astrophysics is directed Here Stromgren shows how the con tinuous spectrum has recently been opened up to far reaching quantitative investigations and how the resulting different types of temperatures etc are related to each other Then he proceeds to the measurement and reduction of line contours and finally treats with a number of special problems such as the spectrophotometry of surfaces of the sun of galactic nebulæ etc Atmospheric extinc tion belongs also to Stromgren s subject and is disposed of in a short but interesting manner whilst a full account is given of the instruments used for the measurement of the total radiation of sun planets stars such as pyrheliometers bolometers thermo photo electric and selenium cells

Photographic photometry is dealt with in a masterly way by H Kienle The well known ability of this author for clear concentrated and vivid writing helps greatly to make this chapter not only a most important but also a very pleasant one The widely scattered data on the properties and the treatment of photographic plates are to be found here critically summarized and the reader finds references to appropriate literature The same may be said of the discussion of all the many different types of photometers designed for measuring photographic effects Thus Kienle s 145 pages give invaluable information to the astrophysicist in a field of ever growing interest

It is logical and useful that two shorter chapters of 114 pages have been separated from Stromgren s and Kienle s work namely the treatment of the methods and the results of visual photometry and of colour measurement with colorimeters effective wave lengths etc Both articles have rightly been entrusted to J Hellerich of the Hamburg Bergedorf Observatory whose own successful work lies in this line thus enabling him to give an authoritative and well written survey

The same remark applies indeed to the whole book A very restricted number of well chosen representatives in their own special fields have succeeded in avoiding the weaknesses of some similar undertakings in other branches of science where too great a number of collaborators pre vented the necessary co ordination thus leading to unnecessary repetitions or omissions and to discord in style and presentation But in the new Astrophysik Rosenberg’s thoughtful plan ning and Strömgren s firm direction have created a book which will impress the reader as being a first class standard work

A B

A Manual of Psychological Experiments

By Edwin Garrigues Boring, Herbert Sidney Langfeld, Harry Porter Weld, and collaborators Pp ix+198+3 plates (New York John Wiley and Sons, Inc London Chapman and Hall Ltd , 1937) 8*s* 6*d* net

THIS is an elementary manual of psychological experiments suitable for first year students and containing about sixty experiments mostly new Besides the editors, seventeen other psychologists have collaborated to produce the book The work is designed apparently to accompany the widely used general text book in psychology by the same authors, but it can also be used together with any good text book

Many of the fifty nine experiments are planned on traditional lines , twenty three are concerned with psychophysics and sensation, seven are on perception, eight on learning and the rest on emotion, action thought and personality The methodology of each experiment is given briefly and clearly together with a number of questions and a few essential references

An advantage of the course of experiments is the simple and inexpensive apparatus that is required A disadvantage is the absence of the more recent experiments used in researches in *Gestalt* psychology There is only one experiment on memory and none on attention, will imagination, perseveration, oscillation or fatigue It is a relief to see that the plethysmograph is not introduced as a measure of affectivity Most of the experiments are planned to take about one hour , a few take about two hours and can be performed with large or small groups

A short chapter is included on the computation of a few statistics, but no instruction is given in the psychophysical methods

The manual is to be recommended for use by students in England, and could also be used to much advantage in tutorial and extension classes in psychology J I COHEN

A Textbook of General Botany

for Colleges and Universities By Richard M Holman and Prof Wilfred W Robbins Fourth edition Pp xvii+664 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1938) 20*s* net

THE subject matter in the fourth edition of this familiar text book has not been materially changed, though in the light of most recent research it has been brought up to date It is a pity that the subject-matter has not been modified for it is based essentially on the morphological concept Physiology receives scant treatment the chapter on evolution and heredity is wellnigh out of date and genetics is practically ignored Research on the more practical side of botany, and especially strictly economic botany, is going on apace, especially in the country of origin of this book, yet it scarcely receives a mention

These blemishes are unfortunate, for works by the late Prof Holman and Prof Robbins are well known and widely used The book, as it is, brings that narrow conception of botanical science to the reader which was peculiar to the academic student of twenty years ago Substantial changes are slowly taking place, and it is to be regretted that such an otherwise authoritative and well written text gives so little attention to them

The Farming Year

By Prof J A Scott Watson Pp 144+64 plates (London, New York and Toronto Longmans, Green and Co , Ltd , 1938) 7*s* 6*d* net

THIS excellent little book has been written at the request of the National Federation of Young Farmers Clubs The farmer s son may be familiar with the type of farming practised in his district but in most cases he will not have had the opportunity of taking at first hand a general view of our very varied husbandry The next best thing is to have the situation briefly and accurately set out by a competent observer Prof Scott Watson has written his account in very simple style, and continually directs the attention of his readers to the causes that have operated to mould agriculture into its present form The main styles of farming each form the subject of a chapter, and the scope is wide enough to include vegetables and flowers farming under glass and fruit An outstanding feature of the book is the quality of the numerous illustrations, which with their well phrased captions are full of information

Readers other than young farmers will be found for this book For the townsman young or otherwise it will provide a very readable account of an industry that makes as big a demand as any on the technical skill and business ability of its members

A Swahili Dictionary of Plant Names

By P J Greenway Pp xvi+112 (Dar es Salaam Government Printer 1937) 3*s*

MR GREENWAY has performed a very valuable service to all interested in the life of the East African native by the preparation of this dictionary Hitherto the available information was scattered through larger dictionaries or recorded only in botanical papers or on herbarium sheets Now the accurate identification of the native names of medicinal, food and other plants will be greatly simplified

Under each native name the English equivalent, if any, is given, followed by a brief description and the scientific name and family Notes on the uses of the various species are also given, and there is a list of native morphological terms and a botanical glossary

As Mr Greenway remarks in his introduction, the vegetable kingdom plays a very important part in the economy of the African native A thorough knowledge of native usage in plant nomenclature is therefore a valuable asset in understanding the African mentality, and the publication of this well-prepared and handy dictionary will be welcomed by all those concerned with study and administration in East Africa

Radio Transmission and Solar Activity*

By Prof E V Appleton, F R S.

I PROPOSE to review very briefly the progress made in certain branches of radio research since the last General Assembly of the International Scientific Radio Union in 1934 In selecting such topics for consideration I have been constantly struck as many others doubtless have been by the way in which the range of the interests of the radio worker has been gradually expanding so that now it overlaps almost every field of physical knowledge In that everyday tool we employ the amplifying valve we find problems of thermionics electrostatics and electrodynamics The study of aerials and their radiative properties involves problems entirely analogous to those of physical optics The investigation of the travel of radio waves excites our interest in fundamental atomic processes by way of which the electron population in the ionosphere increases and decreases The profound control maintained by the sun on the ionosphere and especially the response of upper atmospheric conditions to events on the sun s surface identifies our interests closely with those of the solar physicist while by way of the troposphere which is the seat of atmospheric disturbances we find much of common concern with the meteorologist

Radio researches depend fundamentally on the behaviour of the electrical circuits we employ at both sending and receiving stations To make measurements on long waves and on low frequency oscillations is comparatively easy but with ultra high frequency oscillations where the wave length is comparable with the size of the apparatus such measurements have demanded the development of a new technique of great elegance in which our Italian colleagues have played an outstanding part The result is that with the availability of new valves and new circuits a rich field of research has been opened for our exploration

The study of the travel of ultra short waves to distances beyond the horizon has again directed attention to the classical problem of the transmission of waves around an imperfectly conducting earth The pioneer work of G N Watson on this subject has been used as the starting point of more recent investigations, but while the solution of the problem reached by him was formally complete its application to practical cases has encountered considerable practical difficulties Elucidations and extensions of Watson s analysis have been recently made by Eckersley Wwedensky and van der Pol and Bremmer which readily permit the comparison of theory with experiment in practical cases where the sender and receiver are elevated above the ground As the last two authors have shown the theory predicts no marked diminution in the intensity of television signals on wave lengths of the order of 7 metres when the receiver passes beyond the optical horizon of the sender The attenuation of such signals is in fact determined by the finite conductivity of the earth rather than by lack of bending over moderate distances Whether atmospheric refraction further assists the influence of the diffraction is still not quite certain and further systematic experimental investigations on the subject are desirable

The systematic investigation of the ionosphere by means of radio waves has been actively pursued during the last four years The critical frequency method of measuring such upper atmosphere ionization densities has now received widespread adoption and the register compiled by the Ionosphere Sub Commission shows that as many as twenty four stations are at present making measurements of this type in different parts of the world Observations have for example been made within ten degrees of the North Pole and within forty seven degrees of the South Pole In some cases both sender and receiver are manually operated in others part or all of the apparatus is automatic and requires merely maintenance attention But in all cases there is obtained the relation between equivalent height of reflection at vertical incidence and electric wave frequency from the features of which the maximum electron concentrations in the various ionospheric regions may be calculated

Observations made by the critical frequency method are now sufficiently extensive to permit us to make various deductions concerning the major ionospheric variations There is now ample evidence to show that during the daytime the behaviour of Regions E and F_1 is such as can be explained by a simple theory involving the simultaneous operation of photo ionization by solar radiation and recombination Region F_2 on the other hand behaves abnormally since experiments conducted in the northern hemisphere have shown that over a period of years the summer noon ionization is actually less than the corresponding winter value Valuable additional information on this point has more recently resulted from the comparison of results made at the two stations of Washington and Watheroo which are situated at approximately the same distances north and south of the equator At first it appeared that Region F_2 ionization varied similarly at both of these stations indicating an annual effect but a more extended series of observations showed that this was not the case The nature of the anomaly was clearly elucidated by Goodall who in a very important discussion of the available Washington and Watheroo data showed that there is a seasonal variation in both hemispheres together with non cyclic changes which appear to affect both hemispheres similarly and is related in some way to the general solar activity It will be thus seen that there are two problems associated with Region F_2 One is to explain the anomalous seasonal effect first recognized in the northern hemisphere and the other is to explain the non seasonal variation which has been found in the examination of the valuable observations in both hemispheres made by Berkner and his colleagues under the auspices of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington

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* From the presidential address to the International Scientific Radio Union delivered in Venice on September 4

Advantage has been taken by members of the International Scientific Radio Union to make ionospheric observations on the occasion of three out of the four solar eclipses which have taken place since 1934 The results have amply confirmed the earlier conclusions that the electrons in Regions *E* and F_1 are liberated by solar photons and are captured according to a recombination law On the occasion of the total eclipse in Japan in 1936 an opportunity also arose to investigate the origin of the so called abnormal or sporadic Region *E* echoes which appear to be due to locally ionized clouds or strata embedded within the normal Region *E* From the results obtained there is a suggestion of a partial solar photon origin but it would perhaps be wiser to regard this more as an incentive to further work on the subject than as a definite conclusion The extensive results for the same eclipse have unfortunately not solved the vexed question of the origin of Region F_2 for while some observers interpret the data as indicating ionization by photons others argue equally plausibly in favour of ionization by corpuscles There is evidently need for a further critical examination of the available data in the light of the known abnormal behaviour of Region F_2 as well as for the harvesting of further experimental observations The forthcoming solar eclipse of October 1 1940 in South Africa and South America should provide us with an excellent opportunity for the latter The preparatory calculations concerning both optical and corpuscular eclipses in the ionosphere for this occasion have already been made by H M Nautical Almanac Office Great Britain

I now turn to a fascinating story in the history of solar physics the first chapter of which was written many years ago On September 1 1859 a historic observation was made by R C Carrington a British astronomer While making in the forenoon of that day his customary examination of the forms and positions of spots on the sun he was startled to note two patches of intensely bright and white light associated with a particular group He hastily left his apparatus to call some one else to witness the phenomena with him but on returning within sixty seconds was to use his own words mortified to find that the outburst was already much changed and enfeebled On calling at Kew Observatory a day or two afterwards Carrington was interested to learn that at the very moment he had seen the solar flare the three magnetic elements at Kew were similarly disturbed About 17½ hours after these disturbances there occurred one of the most violent magnetic storms ever observed It should be here noted that the year 1859 was one of sunspot maximum

This interesting story has acquired fresh significance in recent years as a result of the fertile collaboration of many workers on the subject of solar and terrestrial relationships In 1930 Mögel in an undeservedly neglected paper analysed a series of short wave radio observations made during the years of sunspot maximum 1927 29 In this paper he describes the occurrence of what he calls short disturbances or interruptions of radio communication over circuits traversing the illuminated side of the earth Such short disturbances were found to affect communication for periods up to an hour and were accompanied by a characteristic disturbance of the earth s magnetic field Mogel suggested that the radio and magnetic effects were due to abnormal ionization in the lower layers of the atmosphere

It would of course scarcely be permissible to deduce from the single observation of Carrington and the work of Mögel that the three phenomena solar flare radio fade out and characteristic magnetic disturbance were associated That connexion has been satisfactorily established only as the result of the combined efforts of many observatories and radio stations Such collaboration was prompted first by the French National Committee of the International Union which through its chairman M Jouaust directed the attention of other national committees to the reappearance of Mögel s short-disturbances in 1935 From that year onwards an extensive research has been conducted by numerous organizations and individuals At the request of Dr J H Dellinger for example special solar observations were made at Mount Wilson Observatory at times when fade outs were expected to see if any visible solar effect could be associated with them while an examination of old spectroheliograms immediately revealed the fact that a number of fade outs already recorded had been accompanied by bright chromospheric eruptions But perhaps the first really striking example of these inter related phenomena occurred on April 8 1936 when a very intense solar flare photographed at Mount Wilson was found to occur simultaneously with a widespread radio fade out and the characteristic magnetic variation As the solar activity has increased in recent years many more examples of such correlations have been noticed

To the student of the ionosphere the temporary abnormal absorption of radio waves during a fade out is a phenomenon of great interest When the disturbance is not too severe and weak echoes can still be received it is generally found that the height of reflection is not materially altered The fade out must thus be due as Mogel suggested to increased ionization at levels below those normally responsible for the reflection of medium and short radio waves Such increased electron content in what was identified many years ago as Region *D* would be expected to have three effects It would temporarily increase the conductivity of the lower ionosphere for the overhead currents which cause the daily magnetic variations and so account for the observed magnetic disturbance It would increase the normal Region *D* attenuation of radio waves passing through it and so explain the occurrence of the short and medium wave fade out At the same time however it would increase the reflection coefficient of Region *D* for the very long waves which are deviated by its lower boundary Such enhanced reflection of very long waves on the occasion of a short wave fade out was first noted by R Bureau in his study of the propagational characteristics of atmospherics

There can be little doubt that the enhanced ionization in Region *D* during a solar flare is electronic in character and that the exaggerated attenuating properties of this region as a radio transmission medium is due to the high frequency with which the electrons collide with the neutral molecules Since the attenuating stratum is produced at a low level the atmospheric absorption coefficient of the solar photons responsible must be relatively high Possibly the electrons in question are liberated by photo detachment from the negative ions which we suspect are present in large numbers during the daytime in Region *D*

Archæological Sequence in North-West Honduras

DURING 1936 a joint archæological expedition of the Smithsonian Institution and Harvard University excavated a number of sites in the Departments of Cortes Yoro and Santa Barbara in north west Honduras The expedition which was in the nature of an archæological reconnaissance rather than a systematic exploration had as its objective in part the extension of the exploratory work carried out by Dr W D Strong in north eastern Honduras on behalf of the Smithsonian Institution in 1933 in part and more immediately to carry further the work of Byron D Gordon (1895–97) and of the late Mrs Dorothy H Popenoe (1928–29) Mrs Popenoe s pioneer work at Playa de los Muertos where Gordon also excavated in affording valuable and much needed evidence of the stratigraphical relations of early cultures in this region had opened up new vistas in the study of the archæology of Honduras This evidence it was the purpose of the expedition to test and extend

A detailed report of the results of the excavations of 1936 is in course of preparation, but as the mass of material precludes early publication, a preliminary report has been prepared by Dr Strong the senior member of the expedition and his colleagues in which an account is given of the major results emerging from the investigation *

The sites investigated lie in what may be termed the drainage area of the Ulua River (including the Chamelecon River which formerly drained into it) north eastward from Lake Yojoa The environmental conditions of this region belong to two types On one hand are the broad alluvial valleys of the lower Ulua and Comayagua Rivers with dense rain forests on the other hand are the elevated mountain valleys with clear flowing streams in which the rain forest is limited to the border of the stream or in the Lake Yojoa area of the lake while raised plateaux with oak and pine afford a background

The sites examined are distributed geographically in three groups the Chamelecon group, of which Naco is the most extensive the Ulua and Comayagua group of which Playa de los Muertos is the most important and for the early culture the type and the Lake Yojoa group This last includes only the northern shore of the lake where is situated the most southerly ancient Mayan settlement The reconnaissance thus covered the northern half of a natural transition area between the Pacific highland and the Atlantic lowland regions At this point occurs one of the easiest passages across the central American isthmus from Tehuantepec to Panama a factor of considerable archæological and historical importance

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* Preliminary Report on the Smithsonian Institution Harvard University Archæological Expedition to North Western Honduras 1936 By William Duncan Strong, Alfred Kidder II, and A J Drexel Paul, Jr *Smithsonian Miscell. Collect* 97 1 1938 Pp 129 + 14 plates

Characteristically the sites are found either in the alluvium of the broad lower river valleys or on the banks of the streams of the elevated valleys Hence while in the latter mounds affording evidence of habitation sites sometimes with burials added are accessible to excavation in the alluvial valleys owing to the depth of the river silt the investigation was most readily carried out by the examination of cultural deposits in the steep river banks exposed by the action of water

At the time of the Spanish conquest it would appear from early documentary and linguistic evidence this part of Central America was occupied by Jicaque and Lenca speaking peoples but various Nahuatl speaking (Aztecan) pueblos existed along what would seem to have been trade routes extending into this region from southern Mexico and the Pipil (Nahuatl) territory in Salvador One such line of settlement crosses the Chamelecon near Naco and extends east to a short distance south of Trujillo West of the Ulua there were groups of Mayan people their influence also extending well into Lenca territory The region in fact was a contact area in which advanced Nahuatl and Mayan peoples impinged from the west upon less advanced peoples to the east whose linguistic affinities were with the south and ultimately centred possibly through the Chibchan stock in northern South America The archæological data now made available bear out this evidence of contact

The artefacts obtained were predominantly ceramic—monochrome and polychrome painted ware There was also a large number of pottery figurines in human and animal form some of which are whistles or had been attached to whistles Artefacts of other material are comparatively speaking rare Obsidian flakes are ubiquitous but nowhere in large numbers Knife blades one projectile point and a few small celts were found Stone polishers pestles of large size hammer stones and broken metates with a few beads of jade jadeite and other material occurred on various sites Stone statues much mutilated are found in the Lake Yojoa area where the sites are particularly rich in painted pottery and have been a prolific hunting ground for collectors One specimen only of metal was found a small fish hook of copper from Las Flores Bolsa in the Ulua area Charcoal with hearths or fire pits is found on the floors of habitation sites while burnt clay shows the impression of wattle and daub The evidence of the numerous animal bones in the early culture of Playa de los Muertos points to a hunting people Human skeletal remains from the numerous burials were in too bad a condition to provide much if any material of evidential value

The excavations revealed a striking general resemblance in the stratification and contents of the deposits Two distinct cultural horizons are separated by a period of sterility The upper cultural level marked by the occurrence of potsherds begins on the stratified sites other than mounds at a depth below the surface of usually from forty to eighty centimetres but sometimes more It is characterized by two distinct classes of pottery painted and a coarse domestic ware On the painted pottery the decorative designs are either conventionalized animal or human forms or geometric They are of various colours red black white purple and sometimes blue on a background or slip of white black orange buff or yellow This ware is polished some to a high degree In some instances incised ornament also appears On most if not all of the sites however the second class or domestic ware predominates This is normally a monochrome varying from a deep or brick red to grey or black but a considerable number of sherds show crude linear designs in brown deep red or black

The upper cultural level is superimposed on a sterile level of a sand and/or clay extending from approximately two to as much as four metres down On certain sites a cultural horizon appears below the sterile deposits It belongs to an earlier culture and at Playa de los Muertos comprises from the four to the six metre level The distinguishing feature of this culture is a form of pottery falling into a number of types or classes according to surface finish and decoration The ware is found both with slip and without and is mostly highly polished One class however is a painted ware black and red or red and buff and rarely a white slip with red lines Not only is this painted pottery rare but also it is highly variable and has an experimental appearance Certain finds suggest that Usulatan ware such as is found in Salvador the earliest painted pottery found in Central America , forms a part of this early cultural complex At Los Narranjos on Lake Yojoa occurs what is apparently an early form of the Playa de los Muertos early culture It shows a very primitive type of pottery but its chronological relations are not yet definitely established

The main significance of these results lies not so much in the character of the finds on individual sites, as in the light thrown as a whole on the cultural sequences and affinities of north western Honduras and ultimately as a contribution towards the solution of the archæological problem of Central America more especially in the matter of cultural and ethnic origins

In determining the sequence and chronological relation of the cultures revealed by the results of this archæological reconnaissance, a point of departure is afforded by the excavations at Naco on the Chamelecon River, an important native settlement, also occupied for long by the Spaniards Here in association with evidence of Late Nahuatl influence and a painted pottery culture were found two pieces of European pottery of which, if one may have been a later intrusion the other was probably contemporary with the early Spanish occupation

From this point the cultures determined may be arranged in a chronological sequence as follows First in the upper cultural level comes the Ulua Polychrome, comprising the domestic monochrome and two (or three) classes of painted ware of which one, showing conventionalized human and animal forms, both from the character of the decorative motifs and the form of the vessels, is undoubtedly of Mayan derivation and with this is the class, or classes, termed Bold Geometric and Bold Animalistic, the latter from Lake Yojoa in which certain animal forms appear but nevertheless to be associated closely with Bold Geometric In both the Mayoid and the Geometric and Animalistic classes there is evidence of a lower and an upper type, indicated by a development from a more naturalistic to a more highly conventionalized style in which animal forms found in early Geometric disappear The Mayoid pottery occurs in such quantity as to justify the inference that it is the product not merely of Mayan influence but also of an actual association of Mayan settlers with the makers of the Geometric and Animalistic classes each group pursuing its own tradition The Geometric of the Ulua River is attributed to the Jicaque the Animalistic of Lake Yojoa to the related Lenca

As connecting links between the Ulua Polychrome and the earlier culture of the lower level of Playa de los Muertos are placed tentatively the Ulua Bichrome from Santa Rita and the early painted ware, Playa de los Muertos Bichrome, between which there would appear to be some evidence of relation The occurrence of Usulatan ware in this level at Santa Rita is a link with Salvador while the painted ware of Playa de los Muertos is referred to early levels at Uaxactun The early Playa de los Muertos culture from the lower level on this site, which precedes the sterile deposits may itself be preceded by the apparently primitive Monochrome from Lake Yojoa—a point still to be determined

As regards the absolute chronology of this series of cultures it is suggested not without reason, that the Ulua Polychrome represents a development which took place after the fall of Copan, where the dated monuments according to one computation come to an end at A D 800 The Mayan element in north western Honduras, on this argument, would represent settlements made on the dispersal which followed the fall of the Mayan Old Empire

Obituary Notices

Mr A J Greenaway

JOHN GREENAWAY, for so he was known to his numerous friends, died after a long illness at Mill Hill on August 25 He was born at Islington on July 12, 1852, the youngest of four children and only son of John Greenaway (1816–90) well known as a wood engraver and draughtsman from whom that great artist, Kate Greenaway (1846–1901)—the greatest and closest friend among many her brother ever possessed—derived her artistic inspiration

After his early education at a local private school, Greenaway was apprenticed to his father, but later by his own wish he was allowed to study chemistry and entered the Royal College of Chemistry in Oxford Street, and was appointed demonstrator under Sir Edward Frankland when the College was transferred to South Kensington. Among his pupils during that period (1872–81) were the late Profs W H and A G Perkin, with whom Greenaway maintained lifelong and intimate friendships In 1880, Greenaway became an abstractor for the Chemical Society, beginning an editorial connexion which lasted until his retirement in 1924 In 1885, he was appointed sub editor in charge of the Abstracts and after the death of his friend, Dr J C Cain, in 1921, he became editor

During the early part of his work for the Chemical Society, Greenaway lived with his sister, Kate, in the house at Frognal, Hampstead, which had been built for her After her death, he went to live at The Orchard, Chertsey, which was owned by Miss Ethel Boyce, a well known musician Through most of his life, Greenaway knew intimately great artists and musicians, particularly friends of his sister

Had it been possible for Greenaway to complete his chemistry training in Germany, as was then the custom, there is evidence that he might have become distinguished in his chosen profession. There is also evidence that had he not devoted his life to chemistry he might have become a distinguished artist. As it was, he was overburdened in his younger days with routine and irksome teaching from which he had to break away. In 1877, he published a paper, with the late R. J. Friswell, on thallous platinocyanide, and in 1881, while still teaching, he translated and edited, with the late Prof. W. R. Hodgkinson, Wislicenus's Short Text book of Organic Chemistry. At a time when he must have been fully occupied with editorial work he edited in 1891 the translation of the fifth edition of Mendeléeff's Principles of Chemistry; he also edited with the present writer a volume of the Faraday Lectures for the Chemical Society and he wrote a charming personal account of his friend, Prof. W. H. Perkin, who died in 1929. Greenaway became a fellow of the Chemical Society in 1874 and was elected a vice president in 1924. He was an original fellow of the Institute of Chemistry (1877).

For the Chemical Society, John Greenaway did outstanding and self sacrificing work and to him the Society must always be greatly indebted. He will long be remembered for his personal charm and modesty by many whom he taught to appreciate, as he did so intensely, beautiful things.

CHARLES S. GIBSON

WE regret to announce the following deaths:

Prof. S. Alexander, O.M., F.B.A., honorary professor of philosophy in the University of Manchester on September 13, aged seventy nine years.

Dr. Charles Carpenter, C.B.E., formerly president of the South Metropolitan Gas Company, on September 7, aged eighty years.

M. de La Baume Pluvinel, member of the Section of Astronomy of the Paris Academy of Sciences, known for his solar researches and for numerous instrumental developments, on July 18, aged seventy seven years.

Sir Basil Mott, C.B., F.R.S., president in 1924 of the Institution of Civil Engineers, on September 7 aged seventy eight years.

News and Views

Herman Boerhaave (1668-1738)

HERMAN BOERHAAVE, eminent alike as physician chemist and botanist, was born at Voorhuit, a village near Leyden, on December 31, 1668. He first intended to become a clergyman like his father, and after studying philosophy, theology and mathematics, qualified as a doctor of philosophy at Leyden in 1690 with a thesis on the distinction between the mind and the body. He then took up medicine, in which he qualified in 1693 with a dissertation on the importance of examining the excreta in disease. In 1702 he was appointed lecturer in the institute of medicine, his inaugural address being devoted to the importance of the study of Hippocrates. In 1709 he was made professor of botany and medicine, and five years later succeeded Bidloo in the chair of practical medicine, becoming in the same year rector of the University of Leyden. In 1718 he became professor of chemistry, on which subject he published several works, the most notable being 'Elementa chemiæ" (1724), regarded by Garrison as the best work on chemistry in the eighteenth century. His other principal works are 'Institutiones medicæ" (1708) and "Aphorismi de cognoscendis et curandis morbis" (1709). Moreover, in conjunction with Albinus, the greatest contemporary anatomist, he edited the collected works of Vesalius. In addition to Peter the Great, he counted among his pupils such eminent physicians as Haller, Pringle, Cullen, De Haen and van Swieten, the last of whom published a commentary on the Aphorisms. Boerhaave enjoyed a world-wide reputation, and many of his works were translated into different languages including Turkish and Chinese. His many honours included that of fellowship of the Royal Society and membership of the Academy of Sciences of France. His death took place on September 23, 1738.

Boerhaave Celebrations

THE Dutch Medical Association, the Leyden Faculty of Medicine and the Society of the History of Natural Sciences of Leyden are organizing a celebration beginning on September 23 to commemorate the two hundredth anniversary of the death of Herman Boerhaave. Visits will be paid to the old St. Cecilia Hospital, where Boerhaave gave clinical lectures, his country house 'Poelgeest" near Leyden and the village of Hardewyk on the Zuyder Zee, the seat of the ancient university where Boerhaave presented his inaugural thesis on July 15, 1693. A commemoration volume will be published.

The Royal Flemish Academy of Belgium

KING LEOPOLD OF BELGIUM has recently appointed the first thirty members of the Royal Flemish Academy of Belgium. The Academy comprises three classes: Sciences, Letters (including Political and Moral Sciences) and Fine Arts. A decree creating a Flemish Academy of Medicine may be expected to follow soon. This will form a complete equivalent of the old Académie Royale de Belgique, the official language of which is French. By thus putting both Academies on the same footing, instead of merely organizing a bilingual system within the Académie de Belgique, the Belgian authorities have achieved a further step towards cultural autonomy of the Flemish and French speaking parts of the kingdom —following upon the creation of the Flemish University at Ghent soon after the Great War. For the present, each of the three classes of the new Flemish institution will consist of ten members appointed by royal decree. Further members will be co-opted, the total number being confined to twenty per class.

THE original members are: *Sciences*: J. De Smedt, A. Dumon, W. Robyns, G. Verriest (all of the University of Louvain), J. Gillis, J. Meuwissen, A. Schoep, H. L. Vanderlinden, A. J. J. Vandevelde (all of the University of Ghent), H. Schouteden (director of the Congo Museum); *Letters, etc.*: P. Bellefroid (University of Nymegen), E. De Bruyne, H. J. De Vleeschauwer (both of the University of Ghent), E. Van Dievoet (University of Louvain), H. de Man and R. Victor (both of the University of Brussels), J. Denucé, C. Huysmans, F. Prims and F. Van Cauwelaert (all of Antwerp); *Fine Arts*: P. Gilson, L. Mortelmans, J. Van Nuffel, composers; C. Permeke, A. Servaes, W. Vaes, painters; H. Vandevelde, architect; E. Wynants, sculptor; S. Leurs, University of Ghent; R. Maere, University of Louvain. Provisionally, Messrs. Van Cauwelaert and Schoep will act respectively as president and secretary of the Academy, the full title of which is 'Koninklijke Vlaamsche Academie voor Wetenschappen, Letteren en Schoone Kunsten van België'.

Control of Nickel Distribution

IN a valuable paper on "The Control of War Metals as a Peace Measure", by F. E. Lathe and S. J. Cook, of the National Research Laboratories, Ottawa, the view is expressed that, although Canada produces more than 80 per cent of the world's output of nickel, control of distribution would not be a simple matter because only about 20 per cent of the annual production is used for war purposes, and the metal frequently passes through several hands before reaching the ultimate consumer. The calculations are based on 1934 figures, but the estimates are believed to be still substantially correct. The pamphlet has been forwarded to NATURE by way of comment on a suggestion made in the course of an article on "Science and a World Foundation" published in our issue of August 6, p. 227. Two further possibilities must be borne in mind. Reserves of the metal could be readily accumulated by the Government of a country which anticipated war; and, in the event of shortage, no effort would be spared to discover substitutes for essential metals. For an extended war, however, extremely large stocks would be required of such metals as iron and steel, copper, zinc and lead. The aim, therefore, should be to introduce restrictions of a temporary or unexpected character. But the only real hope of effective restriction lies in international action, and it would be most effective in the case of tin, antimony, nickel, copper and iron. This conclusion adds point to the proposal that scientific workers of all nations should, as a group, combine with other groups to give what help they can in promoting the evolution of a World State, capable when necessary of exercising suitable control over the distribution of such commodities.

Smoke-like Swarms of the Harlequin Fly

REFERRING to the letter from Mr. A. S. E. Ackermann entitled "A Curious Atmospheric Phenomenon", in NATURE of September 10, several correspondents suggest that the curious grey columns described by him were due to swarms of *Chironomus*, the Harlequin fly. Swarms of these insects dance about in the air at evening time and are commonly called 'gnats', to which they have considerable resemblance, though they differ from them in being entirely harmless. They often appear in columns on a calm evening and the columns may break up and re-form with a wavy motion. Capt. C. T. P. Cave writes: "I once saw a number of such columns on a very still evening in Lombardy. At first I took them to be very small narrow pillars of smoke from burning weeds, but a closer view showed them to be swarms of gnats. The whole description given by Mr. Ackermann tallies with my recollection of the phenomenon."

National Museum of Southern Rhodesia

DR. G. ARNOLD, director of the National Museum of Southern Rhodesia, Bulawayo, writes to point out that some confusion would appear to have arisen in reference to the proposal to establish a museum for Zimbabwe, reported incorrectly to be intended as a 'National' museum (see NATURE, July 9, p. 65). The proposed museum, Dr. Arnold states, is to be a small one-roomed building, in which will be exhibited some of the original antiquities which have been found in that neighbourhood, and also plaster casts of finds which are now the property of the British Museum and of other museums in Southern Rhodesia and Cape Town. The National Museum of Southern Rhodesia, already in existence at Bulawayo, was formerly the Rhodesian Museum, which was founded in 1901 by the Rhodesia Scientific Association and the Rhodesia Chamber of Mines jointly. From 1902 the Government of Southern Rhodesia contributed to maintenance an annual grant equal in amount to the subscriptions guaranteed by the founding bodies and an annual contribution from the Bulawayo Municipality; but in 1936 the Government, acting on a recommendation made by the Museums Commission, of which Sir Henry Miers was chairman, took over the Museum under an Act of Parliament of Southern Rhodesia, and constituted it the National Museum of Southern Rhodesia. The control is vested in a Board of Trustees appointed by the Governor. It includes departments of zoology, entomology, geology, and ethnology, prehistory and national history. Under the provisions of the Act, the Board is also empowered, subject to the approval of the Governor, to acquire by agreement any existing museum in the Colony, and also, if directed by the Governor, to establish and maintain any new museum in the Colony. The number of visitors in the first year under the Board of Trustees was 24,585, excluding natives, and in the year ending December 31, 1937, 23,501.

The Carnegie United Kingdom Trust

So all pervasive are the Trust's activities that its annual report (Twenty-fourth Annual Report, January–December 1937, approved by the Trustees at their General Meeting held on Friday, March 4, 1938. Pp. vi+92+2 plates. Dunfermline: Carnegie United Kingdom Trust) is almost equivalent to an index to all organized voluntary effort toward social amelioration. It is noteworthy that a very large proportion of the enterprises favoured by the Trust are concerned with rural life: land settlement, rural community councils, village halls, survey of Scottish villages, local history records, schools for rural music conductors, young farmers' clubs, women's institutes, youth hostels, Y.M.C.A. farm training scheme, village colleges, women's rural institutes' handicrafts scheme. Land settlement schemes, for which the Trust allocated £150,000 for the period 1936–40, progressed steadily last year. The Land Settlement Association now controls twenty-five estates in fifteen English counties, comprising 11,000 acres and providing, when fully developed, small holdings for 7,000 persons, all taken from distressed areas. The settlers who are definitely established are happy in their surroundings and are mixing more and more with the old inhabitants of neighbouring villages, and the general health, especially of the children, has shown notable improvement. The Association is, however, finding it difficult to induce local authorities to make use of the powers vested in them. For many years, the Trust has fostered the development of agencies for caring for the welfare of boys and girls over fourteen years of age. Among these are the National Association of Boys' Clubs and the National Council of Girls' Clubs, which are in receipt of subsidies from the Trust amounting to £25,000 for the current quinquennium. Valuable as the work of these clubs undoubtedly is, it is very small in volume when compared with the corresponding activities in Germany and Italy.

The Agricultural Research Council

Farmers and others interested in agriculture have sometimes expressed the view that insufficient information is available about the activities of the Agricultural Research Council. To meet what it recognizes as an important need, the Council has issued a booklet entitled "Constitution and Functions of the Agricultural Research Council", copies of which can now be obtained on written application to the Secretary at 6a, Dean's Yard, Westminster, S.W.1. The Council, which was established by Royal Charter in 1931, is responsible for tendering advice to the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland and the Development Commissioners as to the expenditure on agricultural research of State funds amounting to more than four hundred thousand pounds yearly. It is also charged with the scientific supervision of subsidized agricultural research, and, in addition, it has research officers engaged in the investigation of particular problems. A recent development has been the acquisition of an estate at Compton in Berkshire for use as a field station. Here problems such as those involved in certain diseases of animals will be investigated on a field scale, when the necessary laboratory experiments have been carried out at the research institutes, and a supply of animals, which have been raised in isolation and are free from disease, will be kept available for the workers at these institutes. In addition to advising on research in progress, the Council plans and co-ordinates such immediate extensions of the research programme as seem necessary to secure a more intensive attack on problems of special urgency, particularly in the field of animal and plant diseases.

Nomenclature in Electrical Engineering

The development of electrical science and its applications during the last century has led to the introduction of a host of names, units and definitions, many of them now household words. The history of these words, and of others which have been introduced, only to be discarded, is of considerable interest, and recalls the difficulties the pioneers experienced in explaining clearly new facts and phenomena. Though many terms go back to Greek science and to the sixteenth, seventeenth and eighteenth centuries, the majority belong to the last century and the days since Faraday. The subject is an intricate one and it has not, we believe, been dealt with before so fully as by Prof. G. W. O. Howe, in a paper entitled "The Concepts and Language of Electrical Engineering" read to the Association of Engineers at Calcutta, and printed in the *Engineer* of September 2. In coming the words anode, cathode, ions, electrodes and others, Faraday was assisted by Dr. Whewell of Cambridge, whose encyclopædic knowledge led someone to write, "You may roam where you will through the realm of infinity, and find nothing so great as the Master of Trinity." Whewell had proposed the terms inductricity and inducteous, which fortunately, like the mac, bob, tom and dick of Heaviside, were not adopted. Prof. Howe does justice to the various individuals who have devoted their attention to the matter of units, as well as to the committees and congresses which have assisted in standardizing them.

Indian Forest Research

The value of forestry research work in its direct bearing upon other Government departments and industry is admirably portrayed in a publication entitled "Forest Research and Indian Industry", issued by the Government of India Press, New Delhi. Experts are maintained at the Forestry Research Institute at Dehra Dun to undertake research work in sylviculture, botany, mycology, forest protection, entomology, biochemistry, forest utilization, wood technology, timber seasoning, preservation and testing of timbers, wood working and minor forest products including paper pulp. The work of these experts often interlocks, as becomes evident from a perusal of this very informative publication. Illustrative of some of the sylvicultural work undertaken at the Institute is a recent paper in sylviculture entitled "Seed Weights, Plant Percents, etc, for Forest Plants in India", by J N Sen Gupta (Ind Forest Records, New Series Sylvic, 2, No 5, Government of India Press, New Delhi, 1937). In this paper the author gives data for the date of collection, seed weight, germinative capacity and germination per cent of 505 tree species, including 52 exotics, from all parts of India. In the botany section, Mr C E Parkinson published two numbers dealing with Indian tree species in the *Indian Forest Records*, New Series, Botany (Govt of India Press New Delhi, 1937). The first (1, No 1) deals with the important Indian *Terminalia* of the section *Pentaptera* comprising trees of forest and economic importance. Four species with three varieties and nine forms are recognized. No 2 of vol 1 is devoted to part 4 of Illustrations of Indian Forest Plants the paper dealing with five species of the family *Dipterocarpaceæ*.

Broadcasting Station LS-1, Buenos Aires

THE broadcasting station LS-1 belonging to the municipality of Buenos Aires and situated about 20 miles from the city, has recently been re equipped and is now one of the most powerful in South America. The antenna is the tallest vertical broad cast radiator in South America, being 778 feet high. It uses the new shunt excitation method developed by the Bell Telephone Laboratories, a full description of which is given in their quarterly *Journal* of July. The ground system consists of 120 buried radials, each 670 feet long with an equal additional number of radials each 280 feet in length. Power is fed on to the antenna system through a 62 ohm nitrogen gas filled concentric copper tube transmission line, 640 feet long. The station is operated under the administration of the Colon Theatre of Buenos Aires, which is one of the world's finest opera houses, where many of the world's leading artists are heard each season. There are 16 hours of transmission daily, with a varied programme of widely international flavour and cultural and educational subjects. Its main feature is the complete transmission of the opera and other musical activities of the Colon Theatre. The Colon season was officially opened this year by the President of the Republic on May 23, and can now be heard by the great majority of the population of Argentina as well as by listeners in Chile, Uruguay and southern Brazil. A wide repertory of classic Italian, German and Russian opera has been presented in addition to a few modern Argentine works. The new studios are built below ground level and close to the Colon Theatre and are completely sound insulated. From the broadcasters point of view the economy and ease of operation have set up new standards. The audio frequency response does not vary more than one decibel between 30 and 10,000 cycles. The audio distortion is less than 5 per cent even at complete modulation. Provisions have been made for increasing the output of the 50 kilowatt transmitter to 500 kw by the addition of a 500 kw amplifier. The results obtained have more than equalled expectations.

The Smithsonian Institution

THE report of the secretary of the Smithsonian Institution for the year ended June 30, 1937, refers to the improvement of the National Zoological Park by the completion of three new exhibition buildings, a machine shop, a garage and new heating and electric installations. An expedition to Sumatra to obtain specimens of the interesting animals of that region for the National Zoo was still in the field, but reports indicated that it was highly successful. In the Division of Radiation and Organisms, notable advances have been made in the studies of photo synthesis phototropism and the action of ultra violet rays on plant growth. The Astrophysical Observatory has continued its measurements of the solar constant of radiation and a new method has been devised in place of the 'short method' reduction of observations used since 1923 in which a flaw was discovered. The Smithsonian radio programme a weekly half hour presentation of the Institution's researches and activities, continued with undiminished popularity, and accessions to the Library for the year number 11 469 mostly in exchange for the publications of the Institution. Appendixes include the report of the United States National Museum the National Collection of Fine Arts the Freer Gallery of Art and of the several divisions of the Institution.

Smallpox Vaccination in an Indian Epidemic

A STRIKING instance of the protection against smallpox afforded by vaccination is given in the annual report for 1936 of the All India Institute of Hygiene and Public Health, Calcutta, recently published. During the smallpox epidemic that occurred in the first quarter of 1936, there were 604 infants and children less than five years of age on the roll of the Maternity and Child Welfare Section of the Institute. Of these children 434 were vaccinated before or during the epidemic, and 170 were not vaccinated. Of the unvaccinated 42 developed the disease, a case incidence of 24 7 per cent, of whom 17 died, a mortality of 10 per cent for the group or of 38 5 per cent of the cases. In the vaccinated group, 10 developed the disease in less than a week after vaccination and before protection had developed of whom 7 died. Excluding these cases, of the remaining 424 vaccinated efficiently only 3 contracted the disease and all recovered an incidence of 0 7 per cent with mortality *nil*.

Gastro-Enteritis Conveyed by Raw Milk

AN outbreak of food poisoning occurred at Wilton, in Wiltshire, in October 1936 and was limited to consumers—chiefly children—of a particular supply of bottled raw milk (A Report on an Outbreak of Food Poisoning due to Salmonella, Type 'Dublin' and Conveyed by Raw Milk. By E T Conybeare and L H D Thornton. Reps on Pub Health and Med. Subjects, No 82. Ministry of Health, 1938. H M Stationery Office 2*d* net). The attack of illness commenced in 12–24 hours after consumption of the milk, the chief symptoms being headache, nausea and vomiting, and later diarrhœa, persisting for 1–3 days, and though the attacks were severe, there were no deaths. As the outbreak was not recognized for some days, bacteriological examination of the patients proved negative. However, from a specimen of the milk delivered on October 29, a *Salmonella* food poisoning organism was isolated, afterwards identified as being a 'Dublin' type, and four days later the same organisms was again isolated from milk supplied by the same producer. Confirmatory evidence was obtained by serological tests of the blood of nine convalescents, whose blood showed specific agglutination for type Dublin in high dilution. Examination by agglutination tests of the herd of 51 cows supplying the milk picked out three cows with a high agglutination for the 'Dublin' type. Specimens of milk and dung from these three cows were examined. The milk from all three and the dung from two were negative, but from the dung of the third animal a heavy growth of *Salmonella* Dublin type was obtained, and this carrier cow was removed from the herd, and no further trouble ensued. It is remarked that no amount of care in milking and distribution of such a raw milk could prevent it from being a danger to the consumer.

Insulators

A SEVEN-PAGE article on "Recent Developments in Electrical Insulating Materials" by Dr. L. Hartshorn (*J. Sci. Inst.*, July) will prove of great use to constructors of electrical apparatus and will serve as a base from which research on the properties of insulating materials advocated by the Radio Research Board may operate. The author describes the properties of ebonite, of loaded ebonites, of synthetic resins which can be readily moulded or used to bond laminated material into insulating boards, and when of the hydrocarbon type have dielectric constants little more than 2 and power factors so low as 2×10^{-4}. Ceramics provide insulators of the steatite group depending mainly on magnesium silicate, and of the rutile group, principally titanium dioxide, used in the construction of condensers. After shaping, both are fired and cannot afterwards be worked without difficulty. They are apt to absorb moisture which alters their properties. Certain waxes, for example, the chloronaphthalenes, have high dielectric constants and fairly low power factors. A table of dielectric constants, power factors, resistivities, mechanical and electrical strengths and softening temperatures for nearly thirty insulators is given.

Photography in X-Ray Departments

THE brochure on "X-Ray Materials and Accessories", published by Messrs. Kodak, Ltd., might well contain the word 'photographic' did not the name of Kodak at once conjure up the word; its forty pages are devoted to a description of photographic supplies for medical and dental X-ray work. Routine work demands rigid control of variables for its quick effectiveness, and this firm has realized that, provided the actual exposures are reasonably correct, the development of X-ray films can be standardized by the use of reliable reagents, proper timing and regulation of the working temperatures. In the planning of X-ray departments, insufficient attention is sometimes given to the developing and printing rooms, where laborious hours are spent in semi-darkness. Efficient planning should reduce these hours to a minimum, and the experience of Messrs. Kodak is at the service of those planning and being responsible for the photographic work in X-ray departments.

Handbook of International Organizations

AN English edition of the Handbook of International Organizations has now been issued by the Secretariat of the League of Nations. This volume of nearly 500 pages gives the particulars of nearly 760 international organizations, including addresses, names of officers, notes on finance, objects and activities. International bureaux under the direction of the League, official central bureaux and private associations and federations in so far as they have international objects and are not run for profit are included. These organizations are classified in the following groups to facilitate reference: politics and international relations; religion; arts and sciences; education; students and university organizations; medicine and hygiene; law and administration; press; feminism; labour and professions; agriculture; economics and finance; trade and industry; communications and transit; sport and touring; and miscellaneous. The utility of the volume is increased by the provision of a subject index, an alphabetical index and a geographical index. The latter indicates that 183 of the organizations have their seats in France and 140 in Switzerland, Great Britain coming next with 78 organizations and Belgium being fourth with 77.

Recent Earthquakes

THE violent earth tremors which were experienced on Monday, September 5, over a considerable area about fifty miles south of Algiers (*The Times*, Sept. 7) cannot be said to have affected an area where earthquakes of destructive intensity are usual. Small tremors are, however, quite common, especially where the land shelves steeply to the ocean deeps. Between 1911 and 1931, Mme. A. Hée listed 586 tremors, distributed in twenty-two different zones, only four of which reached destructive intensity. The observatory of Alger Bouzaréah is actively engaged in recording and studying these local earthquakes, and we anticipate more information at a later date. An earth tremor shook Colombo, in Ceylon, early on Sunday, September 11, but no damage is reported (*The Times*, Sept. 12). In this zone severe earthquakes are practically unknown. Slight earthquakes are common along a line through Madras passing south-south-west near the southern edge of the Deccan of India, and these are often in sympathy with larger ones occurring in northern India, a fact which may be attributable to the strained condition of the peninsula. The Ceylon tremor was most probably a local surface shock due to slipping along a fault. Another strong shock was recorded by the Stuttgart Seismological Station on Sept. 7d. 4h. 15m.

(*Continued on p. 533*)

NATURE

SUPPLEMENT

Vol. 142 SATURDAY, SEPTEMBER 17, 1938 No. 3594

BRITISH ASSOCIATION DISCUSSIONS

Significance of the Swanscombe Skull

THE repertoire of the human palæontologist has recently been augmented by the discovery of portions of a fossil skull at Swanscombe, in Kent. The importance of this find was given recognition by allotting a morning session of Section H (Anthropology) for its discussion.

The Swanscombe 'skull' actually consists of two bones only, the occipital and left parietal, both of which are extremely well preserved. Their interest is related to the fact that they were found in interglacial deposits containing a Middle Acheulean industry, and that their antiquity is about as well attested by geological and archæological evidence as that of any human fossil is ever likely to be. To Mr A. T. Marston belongs the honour of having discovered the two bones of the Swanscombe skull. He came upon them at separate times, in June 1935 and March 1936, 24 ft. below the surface in the well stratified gravels of the Barnfield Pit at Swanscombe. The parietal bone was actually found by Mr. Marston *in situ*. Although separated by a distance of 8 yards, the bones are practically unworn, and articulate perfectly with each other. Moreover, they show the same state of preservation as the fossil mammal bones with which they were associated.

The deposits at Barnfield Pit are the Middle Gravels belonging to the 100-ft. terrace of the Thames; they are later in date than the Great Chalky Boulder Clay, and they are definitely interglacial deposits. Prof. W. B. R. King is of opinion that they were laid down between the Great Eastern glaciation of East Anglia and the cold period represented by the main Combe Rock of the Thames valley. This conclusion is borne out by Hinton's study of the associated fauna. *Elephas antiquus*, *Rhinoceros megarhinus*, *Rhinoceros hemitoechus* and *Dama clactoniana* bear witness to an interglacial facies. There were also found associated with the human skull bones remains of *Cervus elaphus*, *Bos primigenius* and *Equus caballus*.

The archæological associations of the Swanscombe skull have been studied by C. F. C. Hawkes. The flint implements from both upper and lower levels of the Middle Gravels (including the channel in which the skull bones were found) belong without doubt to the Early Middle Acheulean hand-axe industry (Acheulean III of Breuil). The complete absence of any sign of a distinct Levallois industry makes it impossible to allocate these implements to a later Acheulean phase. It is interesting to note that, in the Somme valley, deposits containing a Middle Acheulean industry are commonly assigned to so early a date as the Mindel-Riss interglacial period, and this corresponds to Zeuner's interpretation, on geological grounds, of the Barnfield Pit deposits.

It is unfortunate that while the geological, archæological and faunal evidence related to the Swanscombe find is so complete, the skull itself is very incomplete. Clearly it would be unbecoming for an anatomist to attempt to draw any far-reaching conclusions, in regard to the skull as a whole, from the study of an occipital and one parietal bone. Since the sutures remain still unobliterated, the bones evidently are those of quite a young individual. The age of the latter is estimated to have been twenty to twenty-five years. Since, also, the muscular impressions are rather poorly marked in relation to the size and thickness of the skull, the sex of the individual is judged to have been more probably female than male. First inspection reveals at once that—apart from their unusual thickness—the bones are quite closely comparable with those of a modern human skull. The probable cranial capacity—as inferred by comparative studies of recent human skulls whose parietal and occipital bones show similar dimensions and curvatures—has been estimated by Morant to be 1 325 c c This figure of course is conjectural but it remains certain that the cranial capacity of the Swanscombe skull was well within the range of variation of modern man

Since the two bones articulate perfectly with each other the various dimensions and indexes of the back part of the skull can be compared accurately with those of recent skulls The result of such a study leads to the interesting conclusion that the Swanscombe skull is astonishingly similar in all its main metrical features to the average of available series of modern skulls The height of the skull (basi bregmatic) and the maximum bi parietal width are indeed rather greater than the corresponding measurements of female British skulls The inclination of the plane of the foramen magnum shows nothing exceptional The occipital bone is rather unusually broad but even this character falls within the range of variation of recent British skulls

A minute study of the morphological features of the Swanscombe bones shows only two characters which may be considered of unusual significance These are the general thickness of the bones and the extension backwards of the sphenoidal air sinuses into the basi occipital This latter feature certainly does occur occasionally in modern human skulls but it must at least be very rare for it to be found in a skull so young as the Swanscombe fossil Possibly it indicates a rather strong development of the accessory nasal air sinus system as a whole which may have been associated with a fairly massive development of the facial region of the skull The thickness of the bones although it can be readily matched at some points in recent skulls appears to be exceptional in certain regions such as the cerebellar fossa of the occipital bone and the antero inferior angle of the parietal In this character the Swanscombe fossil shows an interesting resemblance to the Piltdown skull Indeed Sir Arthur Keith believes that the two are very closely related morphologically However since the remains of both are so fragmentary this cannot be confirmed or refuted

Lastly the endocranial cast of the Swanscombe bones calls for consideration This shows clearly that the brain was quite richly convoluted and it provides no certain evidence that the convolutional pattern was any more primitive than that of modern human brains Reference should perhaps be made to a curved furrow in the right occipital region of the cast which might be interpreted as a lunate (or simian) sulcus of a very primitive type Apart however from the general difficulty of identifying sulcal impressions on endocranial casts of human skulls this furrow (if indeed it does represent a sulcus at all) may equally well be interpreted as what the late Sir Grafton Elliot Smith termed a pseudo lunate sulcus that is a sulcus sometimes found in the occipital lobe of modern human brains which merely simulates a sulcus of the simian type The endocranial cast shows localized expansions over the parietal and temporal lobes which have been described in casts of certain other fossil human skulls and which have been regarded by some authorities as having a special significance in the later stages of the evolution of the human brain However similar localized eminences are sometimes to be seen on endocranial casts of modern human skulls hence little importance can be attached to them There is indeed little doubt that the endocranial cast of the Swanscombe skull would quite well pass for that of a modern skull It indicates clearly that the brain of Middle Acheulean man had already acquired a morphological status comparable with that of modern man a conclusion which is somewhat remarkable in view of the fact that he is commonly presumed on geological evidence to have lived during the Mindel Riss interglacial period the antiquity of which according to Zeuner s geochronological data must be reckoned at about 250 000 years

It is necessary to emphasize that we have no sure evidence regarding the construction of the front part of the skull in the Swanscombe fossil The frontal region and the face and jaws *may* have shown unusual features which would quite definitely separate Swanscombe man from *Homo sapiens* On the other hand it is reasonable to suppose that if these features had been of an extreme type they would certainly be reflected in the anatomy of the occipital and parietal bones Morant has shown that *Homo neanderthalensis* can be distinguished from *Homo sapiens* by the metrical characters of the parietal and occipital bones alone This however is not the case with the Swanscombe bones

In summary it may be stated that *on the evidence of the fragments available* the remains of the Swanscombe skull suggest that Acheulean man was not distinguishable on morphological grounds from *Homo sapiens* This conclusion is by no means at variance with the implications of recent discoveries of fossil man such as the Ehringsdorf skull the Steinheim skull and the Mt Carmel skeletons for these have already provided evidence that there existed in Europe in pre Mousterian times a type of mankind approximating much more closely to *Homo sapiens* than the Neanderthal type which is characteristically associated with the later Mousterian culture

W E Le G C

Ritual

IN the symposium on ritual held by Section H (Anthropology) at Cambridge on August 23 several points of interest emerged All the speakers agreed in rejecting the shallow view mentioned only to refute it by Mr A M Hocart that ritual is primarily a matter of the emotions On the contrary it is likely to be disorganized and made degenerate by the presence of too much emotion although the utter absence of such a motive force may render it like every other human activity a dead and mechanical thing no longer of significance

Instance after instance may be given and was indeed given especially by Mr Hocart in the first contribution to the discussion of ritual being built up and elaborated by the cool it might almost be said the scientifically logical working of relatively enlightened minds those of the noble or more especially the priestly class of a race on its way to civilization for as Mrs Chadwick rightly insisted in her address one of the most fruitful supplies of material is the rites of barbarous peoples whose ceremonial is not written down and so is perhaps less likely to become a fossil When an emotional wave sweeps up from the lower and less enlightened strata of the people the dignified structure which has been erected is all too likely to be disintegrated and even to degenerate into the merest grunts and howls the beast like expressions of primary emotions fear or what not Yet at the same time it should be remembered (a point incidentally made by Prof H J Rose) that some of the highest manifestations of the religious life whereof we have any record transcend ritual expression by as much as these outbursts of primitivism fall below it

Once ritual has started from whatever source its contents and immediate intention may vary considerably It may have for its sole or its principal object the setting forth of some piece of traditional lore perhaps (again the point was Mrs Chadwick s) the whole or the principal learning of the people to whom it belongs There is such a thing as instructing a barbarous folk by means of a religious ceremony with a complicated rite In New Zealand for example in parts of Polynesia among one or two peoples of Africa the priests are genuinely the educators of their flock the scholars and teachers of the nation and their rites have apparently for at least one of their objects the production of a suitable emotional state among the hearers preparatory to impressing on their minds the doctrines which it is thought important that they should know It is not necessary that what the average European would consider religious instruction should then follow there are rites including chants or other literary forms which have a not inconsiderable historical content though not everyone perhaps would be so optimistic as Mrs Chadwick as to the amount of the history of illiterate peoples which we can now recover from these products of their literary and religious authorities

A characteristic and important form of ritual is that which has for its contents a myth This was the subject of Prof S H Hooke s address wherein he dealt cautiously with some highly controversial points There are of course myths which are purely etiological existing for no other purpose than to explain why such and such a piece of ritual is gone through They are generally pure speculation and have nothing to do with the real origin and purport of the rite But there are others (Prof Hooke instanced the stories of Ishtar and Tammuz of the Creation and of the Deluge) which are veritably the content of ritual it existing to set them forth not they to explain it The line is often vague and hard to draw but it is there and can be perceived if the examiner is expert enough

Prof Rose dealt mostly with magic as a content of certain forms of ritual He used the word in Frazer s sense without accepting Frazer s theories of its relation in time to religion There are actions of man intended to have a direct effect upon some thing in his environment (especially something quite outside his real control such as the weather) without invoking the active or passive concurrence of any power superior to man or different from him Ritual (an example from ancient Rome was given—the ceremonial of the Lupercalia) may consist of such actions arranged like all rites in a pattern or complex intended and supposed to be more effectual than a single action of the kind would be Unlike those ritualists who dramatically set forth the doings of gods or heroes (although there is little doubt that such actions as theirs may also be magical the re doing of some mythical deed which was powerful of old in hopes that it may be efficacious to day) operators like the Roman Luperci were doing things meant to be as practical and perhaps as little mystic as the actions of the most commonplace workman who digs a drain that water may run away or builds a fence that beasts may be kept out They made themselves temporarily into goats in order to put the desirable lustihood of the goat into their little Palatine community and at the same time to scare away the undesirable qualities of the wolf the really formidable and reputedly uncanny enemy of their flocks and herds to say nothing of their children

Summing up all that was said it seems to be fairly well made out that ritual is a complex phenomenon not to be explained away by any over simple formula psychological or other and that its purpose once it is established and indeed in its establishment may vary within very considerable limits That its various kinds may interact upon each other and any given ritual may have been produced by cool priestly reasoning modified by the enthusiasms of the laity be originally magical in its intent strengthened to that end by the addition of a venerable myth and finally misunderstood as being somehow pleasing to a god who had perhaps nothing whatever to do with it at first is a proposition which none of the speakers tried to controvert though more than one showed that he was ready if need be to subscribe to it

The 'Middle Palæolithic'

IN the course of the recent meeting of the British Association at Cambridge Section H (Anthropology) held a symposium on the Middle Palæolithic While it cannot be said that the question was completely dismissed in one afternoon certain important points were dealt with

The expression Middle Palæolithic has itself become ambiguous and is no longer used by the majority of prehistorians At the same time it appears in some of the older literature and its retention has now and again led to unfortunate misunderstandings Originally it was somewhat loosely used to denote those western European cultures which follow immediately after the Micoquian and precede the Aurignacian These cultures are more properly described as the later phases of the Levalloisian—Levallois V VI VII—and the true Mousterian—that is to say the culture of the La Chapelle aux Saints variety of Neanderthal man But clearly used thus the term Middle Palæolithic was not properly speaking an expression of time like Middle Pleistocene and it was obviously unsatisfactory arbitrarily to cut across an evolving culture like the Levalloisian The content of the phrase has therefore grown to include all the cultures before the Aurignacian the industries of which were for the most part made from flakes as is the case with the Mousterian and Levalloisian in contradistinction to the *coup-de poing* core tool culture or cultures

These flake tool industries are not all similar they seem to have been the products of allied though slightly differing cultures Even in Europe alone there are not a few and to them distinct names have been given Cromerian Clactonian Levalloisian Tayacian Weimar Mousterian etc Their distribution was sometimes fairly wide sometimes very restricted each of them had a beginning evolved and came to an end their period of existence was sometimes long sometimes short all were not contemporary but many of them overlapped in time Some of them were in part contemporary with the wholly different *coup de poing* culture or cultures but distribution maps show that these two great culture groups civilizations or culture cycles[*] are quite distinct though a line of contact occurs between them in north eastern France and Belgium and in south eastern England Speaking generally one can say that the cultures comprising the flake tool civilization are found from the North Sea to China and those of the core tool civilization in Western Europe only and southwards over most of Africa It would seem that we are thus faced with the fact that as early as a period preceding the Upper Palæolithic and in fact forming the Lower Palæolithic there existed in the world at least two quite distinct civilizations or culture cycles each made up of a greater or smaller number of differing though allied cultures The question of nomenclature is therefore of the greatest importance

Our orthodox terminology is based on that propounded during the last century by Gabriel de Mortillet when describing the sequence of cultures found in France From the foregoing it would seem now to be quite erroneous to name a culture of the flake tool civilization found outside France by the French name—unless for some reason it appeared probable that the two cultures concerned were not merely allied but identical The term Mousterian for example should on these grounds be restricted to the French culture the industries of which are so well known and are incidentally the products of a particular branch of Neanderthal man It simply confuses the issue to use the name to describe allied industries found elsewhere in Europe the product of differing though related cultures simply because both belong to the same culture cycle Still worse is it to use this term (or perhaps equally such terms as Clactonian etc) to describe industries found in such far flung parts of the world as South Africa—where perhaps the very excellent work of Mr A L Armstrong in S Rhodesia provides a case in point—or India In the same way the term Moravian should be applied to the culture belonging to the Upper Palæolithic civilization in Moravia which though more or less contemporary with the Magdalenian of France and clearly related to it yet differs from it in many essential ways

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[*] I retain the term civilisation because it has been used in previous publications but I am inclined to agree with the opinion expressed to me some time ago by Prof. Gordon Childe that the term 'culture cycle which has no popular connotation, would be more satisfactory

Sir Arthur Keith has come to an interestingly similar conclusion from the point of view of the physical anthropologist For the period under review he recognizes in Europe a general type *Homo neanderthalensis* But in various parts of the Continent he distinguishes various modifications the Chapellian Ehringsdorfian Krapinian while outside Europe he equally distinguishes a Palestinian The number of these modifications may well be increased as knowledge increases and will indeed probably be found to coincide with the different cultures of the civilization But all the time it can be said that the civilization or culture cycle as a whole is the product of an undifferentiated *Homo neanderthalensis*

In actual practice a nomenclature may take the form of terms denoting (*a*) time such as early middle or late Pleistocene (*b*) typology and technology which are generally descriptive terms like blade and burin core flake etc and (*c*) culture which are generally place names like Mousterian Acheulean etc The wrong use by prehistorians of culture names to describe techniques or time spans is in almost every case to be deplored In this connexion we are grateful to Miss Garrod for a good example of the dangers of determining culture or age solely from typological and technological considerations The flake tool industries from Ehringsdorf and also from Taubach which she has recently been studying are on geological and faunal grounds definitely earlier in date than the true Mousterian yet she points out they do resemble very closely the later industries of that culture in France

Flake tool industries occur profusely in East Anglian gravels and certain gravels of the Lower Thames area have also yielded thousands of specimens The problem of their exact horizon and date is one for the quaternary geologist towards the solution of which such investigators as Messrs King Oakley Zeuner and Paterson are strenuously working—but a lack of clarity in the archæologist s nomenclature will here only make confusion worse confounded

MILES C BURKITT

Animal Locomotion

A SERIES of papers read at a symposium in Section D (Zoology) of the British Association at Cambridge on August 23 brought into prominence the recent progress which has been made in the study of animal locomotion The movement of a fish an insect or a bird present problems in kinematics which are closely related to those of a torpedo or aeroplane and it is therefore not surprising that they have been or are being solved by methods more familiar to engineers than to zoologists

From observations of the behaviour in a wind tunnel of a carefully prepared model Dr J E Harris has been able to express the functions of the paired and unpaired fins of a dogfish in terms which give a relatively precise hydrodynamical picture of the whole system He has shown also that the well known transition from an asymmetrical heterocercal tail to one in which the dorsal and ventral flukes are equally developed can be correlated with the development of a swim bladder and with a change in the function of the pectoral fins The latter structures are essentially 'elevating planes in the dogfish whereas in many teleosts they have become modified into a very efficient braking system for a fish carrying out a rectilinear glide There seems little doubt that the changes in position and size of the various fins which have occurred during evolution are to be correlated with the operation of comparatively simple hydrodynamical principles

A very successful application of aeronautical principles to animal flight has recently been made by Dr F S J Hollick By a variety of ingenious methods he has been able to demonstrate the precise movements executed by the wings of a fly during active unrestricted flight The use of an extremely delicate system of balances has made it possible to demonstrate the direction magnitude and point of action of the forces acting on the body of the fly when its wings are in motion A combination of these data with those made on the reflex effect of a moving optical image has enabled Dr Hollick to give a convincing picture of the manner in which a fly on approaching the ceiling of a room is able to change its direction of motion through 180° in a vertical plane and so attach its feet to the ceiling It is to be hoped that the publication of these interesting and important experiments will not be unduly delayed. It would be of great interest to extend this work to a study of bird flight, particularly in view of Mr Horton-Smith's recent observations on the flight of gulls.

It may, perhaps, be claimed that the main problems of soaring flight of birds are approaching solution, although definite observations concerning the function of the bastard wing and other anti-stalling devices are as yet few in number The study of 'flapping' flight presents much greater difficulties. Mr. Horton-Smith's photographs, obtained by high-speed cinematography, show clearly the detailed movements of the wings of gulls during both phases of their beat, and open up the possibility of applying aeronautical methods of analysis with hope of success. There can be little doubt that a careful investigation of the properties of various types of wings when exposed to air currents of known strength and direction would yield valuable results It is of interest to note that a suitable wind tunnel has recently been built in the Zoological Department at Cambridge by Mr. R. Brown, whose work, together with that of Mr. Horton-Smith, will be followed with interest

To the biologist, a solution of the mechanical problems of animal locomotion is a prelude to a study of the physiological principles which control the co-ordination of the locomotory muscles. The discussion at Cambridge largely centred on an assessment of the role of environmental stimuli in the maintenance of a locomotory rhythm. The evidence presented by Prof J. Gray and Dr. H. W Lissmann shows that in many, if not in all, terrestrial invertebrates the maintenance of an ambulatory rhythm is dependent upon a background of tactile stimulation from the substratum In the absence of such stimulation, the ambulatory rhythm either ceases or gives place to a swimming rhythm of totally different nature to itself. In a few instances, notably the nemertine *Cerebratulus*, one region of the body may exhibit a typically terrestrial pattern of movement whereas another, if submerged in water, may execute a swimming rhythm of different nature and frequency. The role of environmental stimuli as pace-makers for the various phases of an ambulatory cycle is clearly defined in many invertebrates, and in forms such as the myriapods, the phase difference between adjacent limbs is determined by environmental factors At the same time, the persistence of an ambulatory rhythm in the desensitized limbs of vertebrates (first observed by Sherrington and by Graham Brown) demonstrates that in vertebrates, in any event, all environmental stimuli probably operate on bilaterally arranged centres in the spinal cord, which are capable of displaying a rhythm so long as both sides are receiving an approximately equal intensity of stimulation, whether the source of this stimulation be central or peripheral Under natural conditions, the locomotory centres are probably responding to stimuli from both these sources . when the animal is walking, the peripheral stimuli are dominant both in intensity and in qualitative effect ; when the animal is swimming, the central stimuli are probably of primary importance

So far as is known, no invertebrate central nervous system can display a locomotory rhythm after complete isolation from the periphery, but experiments with the common leech (*Hirudo medicinalis*) show that the whole nerve cord can exhibit a co-ordinated electrical rhythm so long as a limited number of ganglia at one end of the animal retain their connexions with active musculature.

The Mechanism of Evolution

THE discussion on the mechanism of evolution, which occupied Sections K (Botany) and D (Zoology), meeting together, for the whole of August 19 at Cambridge, was an important event.

Taken together with a discussion on "Natural Selection" held by the Royal Society about a year ago, and one on the "Irreversibility of Evolution" at the Christmas meeting of the Society of Experimental Biology, it marks the end of that long period during which biologists in general had lost interest in the subject, because it seemed incapable of investigation by quantitative or experimental methods. This great change has been brought about by the recent developments in genetics and in nuclear cytology.

The discussion included certain contributions which stated some of the conditions which have resulted from organic evolution in such a manner that they could be discussed Dr. J. S. Huxley spoke on "Character Gradients", showing that in many cases, especially among birds, but also in mammals, insects and plants, characters are found to vary regularly in a definite way with distance from a selected starting point. Thus the length of the wing in migratory birds tends to become greater in collections made farther and farther north. The change is small but significant, about

1 per cent for 1° or 2° C. of mean temperature For such regular character gradients Huxley has coined the term 'cline' (see NATURE of July 30, p. 219) He suggested that such clines have in general an adaptive significance, and that the usually recognized geographical races merely represent special abstractions from them.

Prof. A. E. Trueman gave an admirable account of the views held by the majority of palæontologists as to the course of evolution It is commonly observed in fossil materials that evolutionary change, whether it be in minor matters or in fundamental structures, often proceeds in a definite direction common to many allied stocks, and that in consequence similar forms (homœomorphs), which need not be contemporaneous, are produced in such stocks

In some cases this orthogenetic or programme evolution may serve an adaptive end, but in others it seems to be unrelated to the environment and to have arisen from some restriction of the directions of variation possible to the stock

Trueman emphasized the fact that this conception of the course of evolution is merely a statement of inferred fact and does not imply any such mystical belief in a planned evolution dependent on internal factors as is often supposed to be connoted by the term 'orthogenesis'.

Dr. P. D. F. Murray, discussing "Consequential Evolution", attributed some cases of 'orthogenesis', for example, the appearance at different times in different stocks of *Titanotheres* of horns at the same points on the skull and their subsequent enlargement with time, to the effect of heterogonic growth in animals the body size of which is steadily becoming greater. The factors, genes perhaps, which determine the horns were present throughout the series, but they could not be expressed below a limiting body weight, and once expressed, develop in accordance with Huxley's formula.

Captain C Diver spoke on "Polymorphism"; he pointed out that this term is often used of such cases as those found in mimetic butterflies or in the land snails of the genus *Cepæa*, where a number of easily recognizable and discontinuous varieties of a single species occur in the same population. Such cases are necessarily restricted to those in which the variable characters are readily visible, but the condition presumably exists in many species where it affects physiological or other characters which cannot be seen directly. This apparent discontinuity between the polymorphic forms of certain species, however, grades imperceptibly into a continuous variation, and can only exist if all the polymorphic forms are in equilibrium with their environment.

Species apparently differ very greatly in their variability; in *Cepæa* there is a very wide discontinuous series of patterns and colours, occurring in parallel form in two distinct species in England and being hereditable. In the common water snail *Limnæa peregra*, there is no polymorphism in the ordinary sense, but there is a very wide variability, some of the conditions being transmitted by inheritance whilst others have no known relationship to any factors of environment or breeding. In the plant, *Plantago maritima*, we have a case in which polymorphism is combined with a considerable ecological plasticity

Mr J. Z. Young, in a witty and illuminating address, considered the broader features of the evolutionary process He pointed out that all life depends on the isolation from an environment of an individual which differs in its chemical and physical condition from it, and that this individual, which is necessarily dependent on its surroundings for all its supplies, can only be maintained by the expenditure of energy In this conception perhaps lies a meaning of the distinction between higher and lower organisms The lower organisms differ as little as possible from their environment, so that their irreducible expenditure of energy on maintenance is as small as possible, the higher inhabit more and more difficult environments, from which their own internal environment differs more and more greatly, the work which has to be done in maintaining the differences becoming progressively heavier.

It was suggested that this power of colonizing difficult ecological niches, and the increasing number of biological tricks which go with it, is a test of a high organism

The original Darwinian explanation of evolution by the "preservation of favoured races in the struggle for existence" has as its primary postulate a differential death-rate, natural selection favouring the survival—perhaps as individuals, perhaps as stocks—of those variants which best fit the circumstances in which they are living It has, in practice, proved extremely difficult to show by direct observation, on a scale sufficiently large to allow the necessary statistical treatment to be applied to the data collected, that this selective death-rate does exist.

The explanation of this difficulty has been given by the work of Prof. J. B. S Haldane He has shown that a very small selective advantage applied to one of two allelomorphic characters will, in what, from a geological point of view, is a small number of generations, produce very large effects.

In the discussion, Prof. R. A. Fisher pointed out that the accuracy obtainable in well designed and conducted field trials of crops, which afford a very close parallel, is far too little to show a selective advantage of a size which in Nature would have an enormous influence. But the possibility which now exists of predicting the proportions in which characters with a Mendelian inheritance present in a population should occur in the absence of selection, makes it possible by an analysis of large collections made from an interbreeding population to show the existence of natural selection and even to measure its intensity

Prof Fisher pointed out that polymorphic species, of the type described by Captain Diver in *Cepæa*, provide an exceptional opportunity of estimating the intensity of such selective agencies By analysis of data of populations of grouse locusts collected by Prof Nabours, he was able to show that certain dominant characters must possess a selective advantage of more than five per cent to outweigh certain genetic disadvantages which they possess, in order that they may occur in the proportion they do in the collections

The afternoon session was devoted to the more restricted field of species formation and the isolation on which it may often or always depend

Dr E B Worthington pointed out that the effects of isolation can best be studied in such limited environments as those presented by fresh waters Such areas may be geographically completely separated from one another and in such the presence of a high selection pressure by predators which may be expected to act most intensely on the not completely equilibrated intermediate stages in species formation will reduce the rate of evolution

But geographical isolation may involve and pass into the ecological isolation discussed by Dr W B Turrill He produced examples of speciation correlated with ecological isolation, and perhaps sometimes initiated by it

Dr W H Thorpe dealt with the special case of ecological isolation presented by the restriction of certain parasitic insects to one host and of other insects to one food plant The isolation so brought about may lead to the production of forms which, whilst they are morphologically almost indistinguishable, may be sterile when crossed He described experiments which showed that this restriction to definite hosts or food plants may depend on the 'conditioning' effect of the odours smelt by the insects on emergence, and that it is possible in some degree to condition such insects to quite unfamiliar odours

Perhaps the most generally important and interesting modes of isolation of certain individuals which may represent a potential new species are those which arise from internal factors genetically determined These internal factors may act in many ways they may depend on a different time of maturity of the eggs and sperms in the two groups considered, or on a mechanical inadaptation preventing mating or on a failure of the mating instinct, or in known cases in plants on an inappropriate rate of growth of the pollen tube on the stigma of the other race But all these things are most unlikely to depend on the action of a single gene, which could arise by one single mutation , they involve the interaction of a group of genes which even if it came into existence accidentally would immediately fall apart again unless it were held together by isolation

Probably the most common and certainly the most satisfactorily established modes in which such isolation may arise are those which depend on modifications in the chromosome complement of the nucleus Polyploidy may very generally lead to sterility between the parent and the new form, even when the latter is self fertile, by preventing the successful pairing of chromosomes in meiosis But such accidents as the inversion of a short length of a chromosome, or the detachment of a part of one chromosome and its subsequent adhesion to another not only lead to sterility, partial or complete, between the abnormal form and its parent, but also produce changes in the phenotype, the adult individual, even without any actual gene mutation The general position was stated by Dr C D Darlington, and some special cases were explained by Dr D G Catcheside

Finally Dr S C Harland gave a most illuminating account of the genetics of cotton He showed that wild cottons are to be found in most continents and that whilst some of them have thirteen chromosomes, others, including all the cultivated forms, possess double that number But he then went on to show that by crossing domesticated cottons with 13 chromosome species from America and Asia, the nature of the tetraploidy can be analysed, and that it has become clear that the condition has not arisen by a mere doubling but represents the addition to one another of the chromosomes of both the American and the Asiatic types A future conclusion is that plants of very similar structure may owe their characters to quite different non homologous genes Dr Harland also showed that a gene introduced by crossing into a novel environment may mutate at an exceptionally high rate

The whole discussion—although some important principles, mutation pressure for example, were not referred to—gave a very vivid picture of the present position of our knowledge of the mechanism of evolution It brought out the immense extent to which the recent very rapid advances in genetics and in cytology have removed some old stumbling blocks, and made it possible to discuss the whole subject anew and even to design experiments intended to solve problems now for the first time capable of being posed in definite terms

D M. S W

Post-Glacial History of the Fenland

THE Fenland Research Committee was established in 1932 under the presidency of Sir Albert C Seward and an attempt to synthesize the main results of its activities was made in a joint discussion held at Cambridge by Section C (Geology) and Section K (Botany) which may be briefly summarized as follows

The deposits in which the history of that region is recorded have been examined in drains in excavations made on specially selected sites and in natural exposures eroded by the sea along the coast These deposits consist of vast sheets of marine silts and fen peats interleaved with one another The peats are most fully developed towards the landward side where they tend to become rich in forest debris and often enclose the stumps and boles of fallen trees On the seaward side they thin away into insignificance between marine silts The general story of the region is therefore one of changes in the relative levels of land and sea resulting sometimes in periods of daily inundation by the tides sometimes in periods when the ground was covered by fen brushwood or forest

The floor upon which the deposits lie comes up to the surface around the margins of the fen country and in low hills which in prehistoric times rose up as islands in the watery waste These islands which often provided sites for human habitation became partially buried under the gradually accumulating silts and peats Excavations on one such site near Shippea Hill station have shown that successive generations left relics of their culture on the dry ground or dropped them in the adjoining fen The latter have been preserved in the peat and have furnished evidence for establishing a correlation between the physical changes and the stages in human culture

The earliest post glacial deposits found consist of peat lying along the valleys excavated in the underlying floor The composition of this peat points to the existence of woods consisting mainly of birch and pine growing on the adjoining higher ground and indicates a climate that was warm and dry About 5500 B C the climate became more moist and remained so until about 2000 B C During this time the area became occupied by sedgy fens in which peat was formed and by patches of brushwood on drier ground and was fringed by forests in which alders were common The opening of this period coincided with the dawning of the New Stone Age and the coming of Mesolithic man The later formed peat, however, yields traces of a more typically neolithic culture In this respect as well as in its composition this peat resembles that seen at the lowest spring tide on the coast between Skegness and Mablethorpe with which it may be regarded as being in part at least contemporaneous

There now intervened a time of slow subsidence during which the sea inundated much of the peat covered area and buried it under an accumulation of silts and clays which have yielded foraminifera and diatoms of brackish water type On the coast the corresponding deposits are eight to ten feet thick and are crowded with the remains of salt marsh plants a fact which shows that the subsidence that made the inundations possible proceeded very slowly Eventually it ceased and the saltmarsh gave place to fen and to conditions favourable to the formation of peat In the vicinity of Ingoldmells north of Skegness the ground became sufficiently dry for the growth of brushwood but remained sufficiently near to sea level for sea water to penetrate inland along tidal channels This combination of conditions favoured the establishment of numerous primitive salt workings The debris from these has yielded pottery fragments characteristic of the early iron age thus fixing a date about 400 B C for the complete cessation of the slow subsidence described above

Archæological evidence based upon the distribution of Bronze Age finds in the Fenland is strikingly in accord with the course of physical events outlined above During the Early Bronze Age settlement was relatively dense especially in the south With the passage of time a gradual evacuation took place which reached its culmination in the Early Iron Age There is little doubt that this movement of population was associated with the gradual extension of unfavourable conditions produced by the encroachment of high tides

The almost complete absence of later Iron Age man from both the fen and marsh land is an unexplained mystery At least so far as the latter region is concerned subsidence had ceased before the opening of the Iron Age and the level remained practically stationary until the last century of the Roman occupation for the small Roman site at Ingoldmells Point which was occupied during the first three centuries lay close to the same level as that of the salt workings Moreover as pointed out by Mr C W Phillips agriculture of a native type was carried on extensively in the Fenland during the first century and continued until the fourth There seems to be no reason therefore why Iron Age man should not have occupied the area during the preceding centuries

In the coastal exposures the saltworks debris and the Roman site are covered by marine silts and clays yielding the shells of such organisms as the cockle the oyster and *Scorbicularia* which normally live just above or below the lowest springtide levels As the tidal range is here as much as 20 ft it is evident that a rapid subsidence of that amount took place at the close of and immediately after the Roman occupation This must have rendered extensive areas uninhabitable That this was the case also in the Fenland is proved by evidence forthcoming from Welney which shows that sea floods occurred there at the end of the second century Mr Phillips in summing up the archæological evidence says In Anglo Saxon times this region was again a wilderness indicating that this state of affairs must have become worse and remained so for centuries H H S

Magnetic Alloys and Problems of Metallic Structure*

THF general character of the variation of magnetization of ferromagnetics with field is well known Different materials differ widely in their low field characteristics and in recent years there have been enormous advances in the production of materials with improved properties for particular technical applications For permanent magnet materials for example the value of $(BH)_{\max}$ on the demagnetization curve (a measure of the effectiveness being approximately inversely proportional to the volume of material required to produce a given external field in a given volume) is greater by a factor of about 5 in the modern iron nickel aluminium alloys (developed since 1931) than in tungsten steel the best permanent magnet material available twenty years ago For soft magnetic materials the improvements have been no less spectacular notably through the development of iron nickel alloys For the most part the improved materials have been the result of systematic empirical research An understanding of the factors determinative of magnetic characteristics is however clearly desirable not only from a purely scientific point of view but also from the point of view of the control and further development of technically desirable properties In this article a brief account is given of the present outlook on the general theoretical problems involved and also of recent experimental work illustrative of the manner in which the fundamental problems may be attacked

Many of the properties of ferromagnetics can be formally correlated by supposing that the elementary magnets electron spins are acted on by a quasi magnetic molecular field proportional to the intensity of magnetization This gives rise to spontaneous magnetization decreasing with increasing temperature to zero at the Curie point Ordinarily the spontaneous magnetization is unidirectional only over limited regions domains and the effect of an external field is to align the directions of magnetization of the domains Except near the Curie point the magnitude of the intrinsic magnetization is not appreciably changed so that the ordinary saturation magnetization provides a measure of the spontaneous magnetization A basic characteristic of ferromagnetics is the variation with temperature of the spontaneous magnetization The number of effective spins per atom is given by the saturation magnetization at low temperatures while from the Curie temperature an estimate can be made of the magnitude of the quantum mechanical interchange interaction which gives rise to the molecular field effects The effective spins in the ferromagnetic metals iron cobalt and nickel correspond to the number of holes in the incompletely filled electronic energy bands in the metals associated with the *d* electron states in the free atoms Owing to the manner of overlapping of bands the number of effective spins per atom will not in general be integral in accordance with observation Moreover the effect on the saturation magnetization of additions of a second element is readily interpreted at least in the simpler cases as corresponding to the filling up of the holes in the unfilled band by loosely bound electrons of the added element

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* This article incorporates some of the material presented at a symposium in Section A (Mathematical and Physical Sciences) of the British Association at the Cambridge meeting on Magnetic Alloys and X Ray Structure held on August 19 in which the following speakers took part Prof W L Bragg Dr E C Stoner Dr A J Bradley Dr W Sucksmith, Mr D A Oliver Prof W Gerlach A general survey of the field by industrial and university workers is given in Magnetism (London Institute of Physics 1938) Recent developments in magnetic materials are comprehensively reviewed by C E Webb (*J Inst Elec Eng* 82 303 1938 Magnetization curves are fully discussed in a series of lectures collected and edited by R Becker Probleme der technischen Magnetisierungskurve (Berlin Springer 1938) For the X ray study of the iron nickel-aluminium system see A J Bradley and A Taylor *Proc Roy Soc* A 166 353 (1938)

The form of the magnetization curves depends in a complicated way on a number of secondary effects the elucidation of which is linked up with that of the status of domains The hypothesis of domains is fully confirmed by experiments on the Barkhausen effect which show that the irreversible changes of magnetization on the steep parts of the magnetization curves are essentially discontinuous the discontinuities corresponding to reversals or changes of direction through large angles of the electron spins associated with aggregates of atoms ordinarily much smaller than crystalline grains but containing as many as 10^{16} to 10^{18} atoms

In an ideal single crystal the direction of magnetization of a domain would be along one or other of the equivalent easy axes of the crystal for iron along a cube edge The effective crystalline anisotropy is however greatly modified by strain and in ordinary polycrystalline material the course of magnetization is largely conditioned by local strain inhomogeneities The strain distribution is probably largely determinative of the magnetic domain structure In the initial part of the magnetization curve the increase of magnetization may be attributed to reversible shifts of domain boundaries the shifts being greater and the initial permeability higher the smaller the strain gradients and the smaller the magnetostriction When a boundary reaches a position of maximum potential energy a comparatively large irreversible shift, corresponding to a Barkhausen discontinuity can occur the necessary field depending on the local strain amplitude The connexion with coercivity is obvious In the final stages of magnetization there is a gradual turning of the directions of magnetization of the domains towards the direction of the field

Much still remains to be done in the quantitative development of these ideas though formulæ which have been derived showing an inverse proportionality between maximum initial permeability and magnetostriction are in satisfactory agreement with experiment For high coercivity large internal strains are necessary These can be most effectively produced in heterogeneous alloys of the dispersion hardening type

The mode of experimental attack, on problems of the magnetic properties of alloys may be illustrated by reference to recent work on iron nickel aluminium permanent magnet material With the ternary alloys the most effective composition is approximately Fe_2NiAl Both quenching and very slow cooling give a material with comparatively low coercivity, high coercivity being obtained by a carefully controlled intermediate rate of cooling A first requirement in the understanding of alloy properties is a knowledge of the phases present Following earlier work a very comprehensive X ray study of the Fe Ni Al system involving the preparation and examination of nearly 150 alloys has been carried out by Bradley This enables the phase boundaries in the room temperature ternary diagram to be accurately mapped A special study was made of the Fe_2NiAl alloy At high temperatures this is a single body centred cubic phase as shown by the examination of quenched specimens On slow cooling it breaks up into two body centred phases $Fe_{20}NiAl$ (nearly pure iron) and $Fe_2Ni\,Al$ with slightly different lattice spacings On cooling at the rate appropriate for the development of maximum coercivity the segregation is incomplete and the state corresponds to the occurrence of small islands of iron rich material held in the parent lattice spacing and consequently under great strain

The magnetic properties of the alloys used by Bradley are under investigation by Sucksmith who is examining the temperature variation of the saturation magnetization An extraordinarily interesting series of curves has been obtained which will be of the greatest value for consideration in relation to the X ray data The annealed Fe_2NiAl material gives a curve which agrees closely in form with that for pure iron with the same Curie temperature and a maximum magnetization about half as great The quenched material gives a curve which at low temperatures is similar to that for Fe_3Ni diluted with aluminium (tending to a Curie point at about 400° C) but at high temperatures as annealing proceeds it approaches the curve for the annealed material

Of other recent work on these permanent magnet materials may be mentioned that of Oliver who has found that cooling in a magnetic field results in an increase of remanence of about 8 per cent The effect which is large enough to be of possible technological value may be linked up with the increase of permeability of ferro nickels under similar conditions investigated by Bozorth and Dillinger Extensive work has also been carried out on the effect of impurities and on tolerance limits of composition

Ferromagnetism is usually regarded as a somewhat specialized subject partly because ferromagnetic properties are confined to a comparatively small number of substances Many general problems of the metallic state can however be approached most effectively through the study of ferromagnetics just because a readily investigated index of the internal state is provided by the magnetic characteristics The basic magnetic properties give very direct indications of the state of the electrons in the metal and of the character of the interactions these indications can be carried over to metals generally The low field behaviour provides indications of the nature and distribution of internal strain irregularities There is no reason for supposing that domains as regions of uniform strain are peculiar to ferromagnetics they are rendered apparent only because of the associated magnetic effects The more complete study of low field properties should form a promising line of approach to the general problem of structure sensitive properties Ferromagnetic alloys combine points of immediate interest to workers in many different fields industrial and academic experimental and theoretical and it may be hoped that further co operation between them will result in rapid progress in connexion with problems not only of magnetic alloys but also of metallic structure generally E C S

Nuclear Physics

THE discussion on nuclear physics arranged to take place in Section A (Mathematical and Physical Sciences) on August 18 was introduced by Prof Niels Bohr of Copenhagen who gave an account of the new ideas in nuclear theory which have developed under his guidance during the last few years The old nuclear theory attempted to explain the interactions of fast particles with nuclei by considering the behaviour of single particles inside the nucleus rather on the same lines as in the theory of the outer electronic system This picture gave a satisfactory account ot the penetration of charged particles into light nuclei but failed to account for many phenomena in particular the large probability of capture of slow neutrons by nuclei relative to the probability of elastic scattering These difficulties have been removed by the realization that owing to the tight packing of particles within the nucleus there is a great facility of energy exchange between the particles In consequence when a particle penetrates a nucleus its energy is rapidly distributed amongst all the particles resulting in a general increase in nuclear temperature The nucleus then remains in the excited state until sufficient energy is again concentrated on one particle for evaporation or escape to occur Alternatively the state of excitation may decay by emission of radiation but owing to the high symmetry of charge distribution dipole radiation is in general unlikely and the decay period consequently long The intermediate nucleus thus exists for a period long compared with the time which would have been taken for the incident particle to traverse the system unhindered

The study of the properties of this intermediate nucleus its states of excitation and rates of decay is the point of greatest interest to day in nuclear physics Prof Bohr showed how much guidance as to its properties can be obtained from simple mechanical models Thus the system behaves in many respects like a drop of fluid and the states of excitation can be compared with the oscillations in volume and shape of a sphere under the influence of its elasticity and surface tension The experimentally established result that the distance between excited levels diminishes rapidly with increasing excitation energy suggests also that nuclear frequencies can be formed from a linear combination of a few fundamental frequencies The level distribution is therefore of a similar character to that of the quantum states of a solid body and suggestive analogies occur between the absorption of infra red radiation in solids and the absorption of high energy γ rays by nuclei In such a way the results of Prof Bothe on the wide variations in efficiency of disintegration of different elements by such rays might be explained

The energies of the stationary states can be obtained from experiments of the type described by Mr P I Dee and Prof W Bothe It is observed that many nuclear processes show resonance effects —that is they occur with maximum intensity for a particular range of energy of the incident particle This resonance is explained by the sum of the energy of the incident particle and the original nucleus coinciding with the energy of a stationary state of the compound nucleus The compound nucleus may decay either by the emission of charged particles neutrons or γ rays and in consequence the intensity of the emission of such radiations will show resonance maxima as the energy of the bombarding particle is changed The Cavendish Laboratory experiments determined the intensity and energy of the γ rays emitted when beryllium boron carbon and fluorine are bombarded by protons Resonance maxima were observed for beryllium at 350 and 670 kilovolts for boron at 180 650 850 and 950 kilovolts for the carbon isotope of mass 12 at 480 kilovolts, for the carbon isotope of mass 13 at 570 kilovolts and for fluorine at 330 470, 590, 670 860 920 kilovolts The fluorine experiments are particularly interesting in showing the closeness of the levels of ^{20}Ne when excited to 13 5 million volts A further point of interest is the breadth' of the different nuclear states Sharply defined energy states and sharp resonances occur when the lifetime of the state is long that is when the probability of decay is small In the above cases the resonance occurs because decay of the excited nucleus by particle emission is improbable The experiments determine only an upper limit to the breadth of the states owing to the spread in the energy of the incident particles (about 20 kilovolts)

Prof Bothe s experiments measured the intensity of emission of α particles neutrons and γ rays from the same intermediate nucleus He found that although some resonance levels are observed for all the radiations others occur only for one type of decay a result which introduces some difficulty for the view that the different radiations are competing methods of decay from the same nuclear state

Another method of determining energy levels of nuclei depends on observing the energies of the different groups of particles emitted when an excited nucleus returns to stability Thus when fluorine is bombarded by deuterons the compound nucleus ^{21}Ne emits four groups of α particles the most energetic group occurring in a transition to the ground state of ^{17}O and the other groups in transition to excited states of ^{17}O Thus excited states in ^{17}O at 0 83 2 95 3 77 and 4 49 million volts are found One of these was already known to be produced when oxygen is bombarded by deuterons two have been determined from experiments by Gilbert and by Bothe on the disintegration of neon by neutrons Thus different methods of formation of a nucleus show in general the same excited states

In some nuclear reactions the residual nucleus may be left in a metastable excited state in which it has only a small chance of decay by γ ray emission This may occur when the angular momentum of the metastable state differs by several units of $h/2\pi$ from that of the ground state We may then have two nuclei of the same mass and charge but with different properties Dr N Feather described cases of such isomerism' in the pair uranium Z and uranium X_2 and in ^{106}Ag In the decay of these nuclei when transition to the ground state is improbable, the nucleus usually loses its energy of excitation by transitions to one or more intermediate states so that several quanta are emitted in succession Experiments of Feather and Dunworth have shown that two quanta are emitted in succession from uranium Z and four or five in succession from the long lived isomer ^{106}Ag

Other evidence for the formation of isomeric metastable states was presented by Dr M Goldhaber Experiments carried out in collaboration with Mr R D Hill and Dr L Szilard had shown that a metastable excited state of ^{115}In designated by ^{115}In* of 4 1 hr half life time can be formed by bombarding indium with fast neutrons of as low as 2 5 m e v energy (D + D) but not noticeably with photo neutrons from radium plus beryllium which have energies of a few hundred thousand electron volts It was shown by successive chemical separations that the same radioactive isotope ^{115}In* is also formed when ^{115}Cd (2 5 days) decays emitting negative electrons ^{115}Cd was obtained by the reactions ^{116}Cd (n 2n) and ^{114}Cd (n γ) ^{115}In* (4 1 hr) can be easily studied free from ^{11} In (2 3 hr) previously reported by Cork and Thornton which is found in these experiments to have a 4 hr cadmium parent The properties of ^{115}In* are of great interest and preliminary investigations show that it emits negative electrons of 550 + 100 k v maximum energy as well as γ rays consisting of a hard component of 320 ± 50 k v energy and a soft component probably K radiation of indium It is therefore likely that ^{115}In* decays in three different ways partly into its stable isobaric neighbour ^{115}Sn with emission of β rays and partly into ^{115}In whereby the excitation energy is emitted sometimes in the form of γ rays and sometimes by internal conversion

A quite independent line of attack on excited states of nuclei was reported by Mr S Devons who has studied the scattering of α particles by helium, carbon nitrogen oxygen and fluorine The α particles scattered through a fixed angle were detected by an annular counter and the numbers recorded as a function of α particle energy In place of the smooth curves obtained in the earlier experiments where resolving power was small very well defined resonance peaks now appeared the different peaks corresponding to the different wave components by which the incident particle could be represented the energies giving the excited states of the compound nuclei

New experimental methods for the determination of the resonance levels occurring with neutron capture were reported by Dr P B Moon and Prof C D Ellis The method developed by Dr Moon and Dr C E Wynn Williams produces pulses of deuterons by modulating the input to a source of deuterons The deuterons in turn produce pulses of neutrons and these neutrons produce disintegrations at a fixed distance from the source. If then the time of the disintegration is recorded by a cathode ray oscillograph, the time taken by the neutron to travel from its source is determined and thus its velocity is found. It is therefore possible to determine with much more precision than hitherto the energies of neutrons producing particle disintegrations. This method is similar in principle to work recently reported by Alvarez in which the output of the Berkeley cyclotron was modulated

Prof. Ellis reported a simpler method of determining resonance levels in nuclei in which a lead or bismuth absorber is placed at varying points in a pile of paraffin plates separating the source from the neutron detector. Maxima in the yield of the detector are observed as the absorber position is changed By substitution of a boron absorber for the lead or bismuth, the energies of the absorption bands can be determined Thus two levels have been found for bismuth at 1 and 10 volts and a level in lead at 11–12 volts.

Dr J. D. Cockcroft and Mr. Dee described the new Cavendish Laboratory equipment for nuclear research which has been provided by the benefaction of Lord Austin. A High Voltage Laboratory has been equipped with generators for 1·2 and 2 million volts, and a vacuum tube for accelerating particles by 1·2 million volts has been in operation for a year A tube for 2 million volts has just been erected and is going through its trials satisfactorily. A cyclotron has also been built to produce deuterons of 12 million volts energy The apparatus includes a 50-ton magnet and a 100 kilowatt short-wave oscillator of accurately controlled frequency The assembly of the apparatus has just been completed, and the first indications of a 'beam' of deuterons has been obtained with the apparatus adjusted to produce 10 million-volt particles

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Low Temperature Physics

FOR many years, interest in low temperature physics was largely confined to the phenomenon of superconductivity During the past four years, however, new phenomena have received attention, and at the session of Section A (Physics) on August 22 devoted to low temperature physics, comparatively little time was devoted to superconductivity. Attention was concentrated instead upon the Debye-Giauque effect, that is, the cooling of certain paramagnetic substances by adiabatic demagnetization, and upon the curious phenomenon of liquid helium II

As Dr. H. B G. Casimir pointed out in his discourse, the problems of low temperature physics fall into three categories: (1) non-magnetic insulators; (2) magnetic insulators; and (3) metals.

The phenomena to be observed in the first category are mainly extensions of those appearing at higher temperatures, such as specific heat, thermal conductivity, etc. Measurements of such phenomena agree well with theories developed by Debye, Born, Peierls and others In general, it may be said that, with one great exception (and always excepting possible future discoveries), this branch of low temperature physics is concise and definite, and that there remain only further technical measurements to be made. The great exception is liquid helium II.

The low temperature modification of liquid helium known as liquid helium II was discovered a little more than ten years ago by Onnes. Two theories have been put forward to explain its peculiar properties, neither of which has been disproved, although the weight of evidence in favour of either is not very great. What may be called the order-disorder crystalline theory, to which contributions have been made by Simon, F. London, Fröhlich, Jones and Keesom, gives a successful interpretation of the negative expansion coefficient, the high and discontinuous specific heat, and the momentum transfer which accompanies heat flow. The fact that the substance has a very small viscosity, however, makes the validity of such a crystalline theory seem doubtful.

F London has proposed alternatively that helium be treated as a degenerate Bose-Einstein gas. The discontinuity in the specific heat can be explained if certain assumptions are made concerning atomic interactions. Tiza has enlarged the theory to explain the flow and conductivity phenomena which are observed. In the Bose-Einstein picture, liquid helium II is composed of a great many 'condensed' atoms in the ground state, that is, a 'super-fluid' of no viscosity, and a few atoms in high energy states, in other words, a 'gas'. The pressure-independent capillary flow observed for the substance would then be governed by the rate of heat gain or loss in flowing in and out of a reservoir. This theory, too, has been neither proved nor disproved so far. Heat flow and fluid flow are, however, closely bound together, and are further complicated by the rapid transfer of liquid helium II in the form of surface films on every surface immersed in the liquid This means that although the experiments on the problem are quite simple and classical in type, they are invariably exceedingly difficult of true interpretation.

The second category of substances differs from the first in that the cessation of influence of thermal vibrations in the crystal lattices results in greatly enhanced magnetic effects. The phenomenon of absorbing interest is the remarkably low temperature observed on adiabatic demagnetization of paramagnetic salts. Although the effect was predicted by Debye several years before it was discovered by Giauque, many details of the process are still difficult to interpret Prof Van Vleck dwelt on several of these in his discourse on the magnetic theory of the process, and paid particular attention to the appearance of ferromagnetism in the salts at very low temperatures

Measurements on the absolute temperature scale below 1° K as determined from thermodynamic measurements on magnetically cooled salts were described by Prof. F Simon The accuracy of the measurements is quite high, but it is possible that they may be in error by 5 per cent at 0·1° K These can be compared with the temperature as determined from the susceptibility measurements, which are those actually used in any demagnetization experiments Since the temperature measured in this way depends by virtue of the demagnetizing factor on the shape of the specimen, Prof Simon has suggested that until the absolute scale is measured more exactly, temperatures measured magnetically should be reduced to those determined for a spherical specimen and should be designated by the symbol T^*

The process of adiabatic demagnetization can be most simply described as follows. At a sufficiently low temperature (1° K) the energy content of a paramagnetic salt, such as iron ammonium alum, is mainly composed of the disorder of the magnetic ions. Isothermal magnetization to, say, 10,000 gauss, lowers the entropy of the salt at that temperature by reducing the disorder of the ions. Adiabatic demagnetization then does not alter the entropy, and hence the temperature is reduced to the neighbourhood of 0·05° K. The disturbing effects are the interactions of the magnetic ions with themselves and with the lattice. The second can be reduced by choosing a substance such as cæsium titanium alum, and the first by iron ammonium alum in which the ions form a small part of a very large molecule, and it can be somewhat further reduced by dilution of the salt so that the ions are still more separated from each other One obtains an optimum value in this way, since too much dilution lowers the specific heat of the ions in relation to that of the rest of the substance

A possible lower limit to temperatures obtained in this way might be put at 0·001° K. If we consider, however, the possible future use of the nuclear magnetic moments as a means of cooling, a two-stage process using a paramagnetic salt to cool a metal with a suitable nuclear moment which in turn is adiabatically demagnetized, it is possible that even lower temperatures might be realized

Up to the present time, comparatively little has been done in the way of using magnetic cooling to reduce the temperature of other substances. Now that the absolute temperature scale is fairly well established, however, and we know that within a few seconds at most after demagnetization the lattice of the salt is in thermal equilibrium with the ions, we can expect much more investigation of other physical properties in the temperature range from 0·05° to 1° K

In the third category of substances, that of metals, the theory built up by Sommerfeld, Bloch, Peierls, and others fails to explain the sudden appearance of electrical superconductivity in certain metals at low temperatures, although it does allow the resistance to approach zero at the absolute zero in an ideally pure metal In spite of the great amount of data available on superconductivity, it remains almost completely mysterious Many theories have been submitted to account for it but have failed, although a very promising phenomenological theory by F. London appears to be quite satisfactory within the scope of its application It is almost certain that one cannot consider superconductivity as a one-electron problem, and that it must instead be treated as concerned with electron groups.

Considered thermodynamically, however, certain features, such as the 'threshold curve', that is, the temperature variation of the critical field for destruction of superconductivity, do admit of successful analysis, as has been shown by Gorter and Casimir. But the true nature of superconductivity still eludes us Here again, although the experiments are in general simple, the difficulties of exact interpretation are very great. In spite of the fact that an enormous mass of data on superconductivity is at hand, a good deal of it is rather haphazard, as is natural when one is dealing with a mysterious phenomenon. Many more experiments must be carefully made under conditions of known metal purity in order that the mass of apparently disconnected small effects may be either proved spurious or fitted into the picture.

J. F. ALLEN.

Repercussions of Synthetic Organic Chemistry on Biology and Medicine

THE recent discussion* on Repercussions of Synthetic Organic Chemistry on Biology and Medicine held on August 23 under the auspices of Section B (Chemistry) of the British Association at the Cambridge meeting directs attention to one of the most striking features of modern organic chemistry namely its increasing preoccupation with naturally occurring substances of biological importance The reasons for this change of heart on the part of the chemist long divorced from biology are too varied to be dealt with here but there can be little doubt that the development of microchemical technique has done much to render it possible In a discussion such as that at Cambridge it was impossible to cover more than a fraction of the investigations in this field but from the subjects actually chosen by the various speakers it is possible to obtain a general view of the ways in which organic chemistry is affecting biology and medicine

Intensive research in many centres on the nature of the various sex hormones has led to results of great interest All these compounds belong to that group of natural products containing the ring skeleton of the sterols Three classes of sex hormones are now well defined the œstrone group the androsterone testosterone group and the progesterone group Several natural compounds of the first group are known these have primarily the power to produce in female animals the changes in the reproductive tract characteristic of the time of ovulation (œstrogenic activity) The same is true of the second group the members of which can stimulate the atrophic accessory organs and secondary sexual characters of castrated animals (androgenic activity) but in the third group progesterone is the only known naturally occurring substance which produces to any marked degree progestational changes in the female reproductive tract

Synthetic closely related substances are known having similar biological activity to hormones of all three groups Synthesis in the sterol sex hormone group of course refers to partial synthesis from other natural substances since the fundamental ring system of the sterols has not yet been synthesized The testing of a large number of synthetic substances related to the natural hormones has brought out a variety of points of great interest to chemists and biologists alike It has been found for example that only derivatives of androstane are androgenic and that the degree of activity depends largely on the nature of the substituents in positions 3 5 and 17 in the nucleus (I) and on the stereochemical configuration of the compounds Here as in other groups of physiologically active substances stereoisomers differ markedly in activity

The structural differences between members of all three classes of sex hormones are relatively small and biological investigations carried out with the natural and synthetic substances have brought to light the surprising fact that multiple activity is common in the sex hormone group Thus it has been established that in the above series of androgenic substances many show weak œstrogenic and some weak progesterone like activity

Work on the isolation of sex hormones from natural sources too has shown that male and female animals differ in the proportion of the various sex hormones rather than in their nature The very close relationship between the various physiologically active steroids has been even further emphasized by the recent series of investigations on the hormones of the adrenal cortex Efforts to isolate the cortical hormone capable of maintaining life in adrenalectomized animals have led to the isolation from adrenal cortex of at least five different compounds possessing this property in varying degree and it is probable that others will yet be isolated All these substances are sterol derivatives resembling the sex hormones in structure Deoxycorticosterone the most active substance so far obtained differs from progesterone only by having an additional hydroxyl group and even shows some progesterone like activity

In fields other than hormone chemistry too considerable advances have been made in the determination of the structural features necessary for the exhibition of a particular effect by a given compound Following on the isolation and identification of the hydrocarbons in coal tar which have the power of causing cancer a large number of polycyclic hydrocarbons have been synthesized and examined for carcinogenic properties Of these the most potent and best investigated are derivatives of 1 2 benzanthracene (II) In mono alkyl derivatives of this hydrocarbon carcinogenic power is possessed in increasing degree by those bearing the substituent in positions 6 9 5 and 10 respectively In the case of poly alkyl derivatives substituents present in these positions appear to reinforce one another, yielding some of the most potent carcinogenic agents at present known. To this group of 1 : 2-benzanthracene derivatives belong 3 : 4-benzpyrene, a substance undoubtedly responsible for skin cancer among coal tar workers, and methyl cholanthrene. The carcinogenic activity of the latter substance is noteworthy as it can be prepared in the laboratory from cholesterol and the bile acids, substances normally present in the body. There is some structural resemblance between many carcinogenic substances and members of the sterol-sex-hormone group, and the continuance of such investigations may bring us closer to a knowledge of the cause of cancer.

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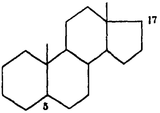
* Speakers at the discussion were Sir F Gowland Hopkins Prof E C Dodds Dr A S Parkes, Prof L Ruzicka Prof J W Cook Prof T Reichstein Prof A R Todd



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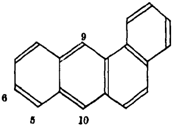

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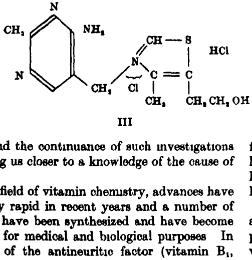

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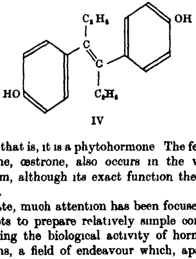

IV

In the field of vitamin chemistry, advances have been very rapid in recent years and a number of vitamins have been synthesized and have become available for medical and biological purposes In the case of the antineuritic factor (vitamin B_1, aneurin), discussed at Cambridge, the availability of the synthetic vitamin has led to the discovery of many hitherto unsuspected uses in clinical practice, while the work at present being carried out on the part played by it in carbohydrate metabolism is giving us a clearer insight into its function in animal organisms. Many investigations have also been made with the view of ascertaining the structural details necessary for vitamin activity. In the case of aneurin (III), the investigations so far indicate a high degree of structural specificity, for apart from alteration in the nature and position of the alkyl group on the pyrimidine ring, little structural change in the molecule is possible without complete loss of activity. It would appear that less variation in structure is possible than in the case of the sex hormones A high degree of structural specificity seems to be a feature of many vitamins

A point brought into prominence by the work on aneurin is that our present classification of certain natural substances as 'vitamins' and of others as 'hormones' appears to be rather arbitrary, and recent work shows that a distinction between the two groups cannot always be upheld. For example, biological experiments have shown that aneurin, while it functions as a vitamin in animals, appears to be essential to plants as a root-growth factor, that is, it is a phytohormone The female sex hormone, œstrone, also occurs in the vegetable kingdom, although its exact function there is not known.

Of late, much attention has been focused on the attempts to prepare relatively simple compounds possessing the biological activity of hormones or vitamins, a field of endeavour which, apart from theoretical importance, has an obvious practical interest in medicine In experiments on the synthesis of œstrogens, striking results have already been obtained By following out a scheme of simplification of the œstrone molecule, substances have been arrived at, the œstrogenic activity of which, astonishingly enough, far outstrips that of the natural hormone. To mention a particular case, the compound 4 : 4′-dihydroxy-α · β-diethylstilbene (IV), also known as stilbœstrol, has an œstrogenic power about ten times as great as that of œstrone The compound at first sight appears to be wholly unlike the sex hormones in structure, but, theoretically at least, its conversion into a substance with a chrysene skeleton might be readily achieved by a double ring closure Whether or not this possibility has a bearing on its biological activity it is too early to say In any event this imitation of the effect of a hormone by a series of synthetic substances foreign to the body opens up a field with great possibilities Medical and biological investigation of the properties of stilbœstrol are as yet incomplete but present indications are that it has all the properties of an œstrogenic hormone It would thus seem to be an artificial hormone like substance of a type entirely different from say synthalin which although lowering the blood sugar like insulin nevertheless does so in an entirely different manner from the hormone

Generally speaking there appear to be two types of investigation carried on by the organic chemist which have a direct effect on biology and medicine One of these deals with the isolation structural identification and synthesis of substances responsible for particular biological effects and the determination of the structural features in these compounds essential to activity The other is concerned with the synthesis of simple compounds which will exhibit the same biological action as natural hormones and vitamins Bearing in mind the old lock and key theory of physiological action we might regard the first type as a search for Nature s keys and the second as an effort to prepare skeleton keys to serve similar ends

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Physical Chemistry of Clay

IT is a remarkable tribute to the liberal outlook of Section B (Chemistry) of the British Association that the four principal contributors to the discussion on clays held on August 22 at Cambridge were physicists The basic principles governing the chemistry of the silicates are as Prof W L Bragg explained clearly revealed in their crystal structure Every silicon atom is surrounded by four oxygen atoms in tetrahedral arrangement In olivine the (SiO_4) groups are separate while in silica and the feldspars each oxygen is a component of two tetrahedra Between these extremes we find the pyroxenes and amphiboles in which the tetrahedra are linked by common oxygens into parallel chains and minerals like mica in which the tetrahedra are linked into parallel sheets

Kaolinite is the best crystallized clay and it appears reasonably certain from the work of Gruner and others that it contains sheets of linked tetrahedra Three of the four oxygens of each tetrahedron are shared and these oxygens form the base of the sheet The middle layer contains the unshared oxygens plus half their number of hydroxyls and the top layer consists entirely of hydroxyls Between the middle and top layers are aluminium atoms surrounded in octohedral symmetry by four hydroxyls and two oxygens The structure may be represented thus

$$O_6\ Si_4\ O_4OH\ Al_4\ (OH)_6$$

Montmorillonite the principal clay mineral in bentonite and fullers earth gives rather poor X ray powder diagrams and single crystals large enough to be examined in detail have not yet been obtained for X ray examination Dr G Nagelschmidt explained that the mica-like structure proposed by Hoffmann Endel and Wilm is probably correct but it cannot be regarded as established as the X ray evidence is insufficient Other tests can however be applied The ideal composition as exhibited by pyrophyllite is

$$O_6\ Si_4\ O_4OH\ Al_4\ O_4OH\ Si_4\ O_6$$

Several authors have reported the loss in weight in the neighbourhood of 500° C to be less than the 4 per cent that would bring the clay to $Si_4Al_2O_{11}$ but some recent measurements on fractionated bentonite are in agreement with this prediction A critical study of the technique of dehydration is desirable The chemical composition of montmorillonite is rather variable but the silicon content never exceeds that of pyrophyllite In view of the established structure of mica it is reasonable to suppose that enough aluminium is present replacing silicon to complete the layers of linked tetrahedra and enough iron and magnesium are present in the central layer to replace aluminium The substitutions of aluminium for silicon and magnesium for aluminium cause the lattice sheets to be negatively charged and cations must be present to preserve electrical neutrality In a number of cases that have been worked out in detail, this structure satisfactorily accounts for the cations found A few cases appear not to fit and these require closer examination

A striking characteristic of montmorillonite is that the spacing of successive lattice sheets varies reversibly according to the relative humidity the intervening water layer varying from nothing to four molecules deep The balancing cations are held in these water layers only by electrostatic forces and are readily exchangeable for others carrying an equal charge The thickness of the water layer at a given relative humidity depends on the kind of cation that is present.

The fact that the number of exchangeable ions held by a clay depends upon the hydrogen ion concentration of the clay shows, as Dr. R. K Schofield pointed out, that clay particles carry other electric charges besides those arising from isomorphous replacements. There are evidently 'spots' on the particles which are charged or uncharged according to the reaction of the medium. They are of two kinds : acidic spots, where negative charges can develop through the dissociation of hydrogen ions, and basic spots, where positive charges can develop through the combination of hydrogen ions. The process in the case of the acidic spots is probably

$$\equiv \mathrm{Si} - \mathrm{OH} \rightleftarrows \equiv \mathrm{Si} - \overset{-}{\mathrm{O}} + \mathrm{H}^+$$

the silicon atoms being those situated at the edges of the silicon-oxygen layer The chemical nature of the basic spots is uncertain. They are not found in the clay minerals so far identified, but are frequent in the common clays The equilibrium is possibly

$$- \overset{+}{\mathrm{Al}} - \mathrm{OH} \rightleftarrows - \mathrm{Al} = \mathrm{O} + \mathrm{H}^+$$

and may be due to an overcrowding in the octohedral layers. In certain clays the number of basic groups exceeds that of the negative charges due to isomorphous replacements. These exhibit well-defined iso-electric points.

The forces which hold the successive lattice sheets together appear to be of three kinds. In the case of pyrophyllite and talc, both the faces of the sheets consist of oxygens shared between silicons, and only very weak residual fields are available to hold one sheet to the next. In kaolinite one face consists of oxygen and the other of hydroxyls. The layers are stacked with the oxygen layer of one sheet facing the hydroxyl layer of the next In this case, Prof. J D. Bernal explained that 'hydroxyl bonds' must here be regarded as providing the principal linkages. When the sheets are charged, the balancing ions act as ties. In mica the attractive force is strong enough to keep water out, but in montmorillonite, with fewer isomorphous replacements, water at high relative humidities can partially separate the sheets The development of thixotropy in clay suspensions within a certain range of salt concentration is doubtless connected in some way with this effect, but Prof E. K Rideal mentioned cases where this behaviour seemed to be due to a small amount of the clay that had dissolved. Observations on the behaviour of clays towards water were made by Dr E. W. Russell and Mr. H H Macey.

Problems of Crop Production

IN devoting a session on August 22 to problems of crop production, Section M (Agriculture) was dealing with one broad aspect of a wider question—the place of science in the advancement of British agriculture. More than simple efficiency of production is implied by advancement. It means also the development and extension of farming to the fullest economic degree and, if demonstrably necessary in the national interest, to a degree beyond the limit set by financial economics. Now advancement in the industry at large, like success on the individual farm, is dependent first on policy and next on technical farming efficiency. Science can promote efficiency both by providing new knowledge and by helping farmers to make the best use of existing knowledge ; that is, by research and by education.

It must have been in the minds of those who listened to this discussion to ask whether science's contribution must be limited to technical efficiency or whether it might not have a part in making national agricultural policy. Views put forward at an earlier session, when employment on the land was discussed, plainly inclined to the idea that in applying itself to agriculture, science must take national policy as it finds it and be content to work within its limitations But ever since the end of the Great War, protagonists, some scientific, some lay, have claimed for science a strong share in government, including the shaping of policy It may be regretted that, when discussing the part of science in agricultural advancement, the Section did not boldly debate the question what part, if any, science could take in shaping agricultural policy

The title under which this discussion took place is significant—the practical problems of crop production. In conferences connected with science and agriculture it is usual to deal only with current experimental work So much is this the case that discussion as to what are the main problems of crop production very rarely occurs Yet it is the great problems of farming practice which agricultural science is under obligation to try to solve. In its efforts it constantly has to take up special problems in pure science But the final objective must always be to help the agricultural industry.

The plan of discussion classified the problems of crop production under husbandry practices, crop varieties, and damage by pests and diseases The question of crop varieties may seem almost wholly for the plant breeder In fact, however, it creates producer problems wherever crops are grown under even moderately intensive conditions The basic consideration is which variety of the crop concerned will pay best With modifications in special cases, yield first and next quality of produce, determine remunerativeness Many farmers still cling pathetically to the hope of finding in some new variety a means of getting higher yields without greater effort on their own part In undeveloped agricultures it may be fairly easy for the breeder to satisfy this hope But with crops already highly improved, like British cereals, the plant breeder can do no more than produce varieties which will give higher yields—*in a way that the older varieties cannot*—under a higher level of husbandry That is, the breeder can help the farmer to raise the level of output, but cannot solve for him the problem of raising or maintaining soil fertility

The old question of the importance of high botanical uniformity of type among the plants in a field has aroused a new, more critical, interest Among its many farming and genetic aspects, influence on quality of produce attracts most attention It seems evident, indeed, that the whole question of quality ought to be re examined The farmer may be expected to concern himself about quality, whether in choosing the variety or in husbandry practices only in measure as he is paid for quality But what is this measure ? Discussion revealed a feeling that modern household taste and modern processing technique are so developing as to divest quality of some of its importance in many crop products and further, that to guide the farmer and to ensure reasonable price recognition of quality, experimentally determined standards will have to be specified Farmer and agricultural scientist cannot alone deal with this matter , consuming interests have a part to play and, in some cases, an urgent problem—to find out more clearly what they themselves require in quality of crop products

The variety problem, from a plant breeding point of view, brought up a question which, though never under direct discussion, gloomily intruded itself more than once upon Section M—the question of Britain's agricultural policy To produce a new variety by hybridizing may take fully fifteen years Who is to say whether in fifteen years' time mangolds, swedes, turnips, kales, beans, peas will have dropped to the small acreage their decline of the past years suggests ? Yet on this turns the wisdom of undertaking expensive breeding work on them Their future place depends on the extent to which meat and milk are to be produced from arable land or from grass , and this question is perhaps as big as any in the future of our agricultural policy It involves cereals, too, in the matter both of grain and of straw, and manifestly bears fundamentally on grasses and clovers It is thus a prime determiner of the major practical problems not only of breeding but also of husbandry, both crop and animal

In husbandry practices the problems of urgency are recognized to be not new questions but old ones made important by new resources, such as mechanical power , by new conditions, such as world surplus in staples like wheat and sugar , by economic pressure under which land drainage has fallen into decay and cash crops have displaced livestock on arable land, in some minds to the permanent detriment of soil fertility

The readiest example of such problems is cultivations They include ploughing, cultivating, sub soiling, harrowing, hoeing, rolling Whether their source of power be tractor, horse or the bullock or hand tool of tropical countries, the modern cultivator has begun to ask himself questions about them What, exactly, is their effect on soil and crop and, thus, to what extent are they necessary ? Local custom once told a farmer how often to plough for a root crop and whether to plough fleet, medium or deep He asks now whether anything is gained by cultivations beyond the minimum necessary to make a seed bed bury large rubbish and kill weeds The tea planter in India or Ceylon, the sugar beet grower in Britain and his rival in tropical sugar cane countries, and indeed the grower of almost any crop anywhere, recognizes here a pressing question

Maintenance of soil fertility is a problem of no less wide application but much greater gravity Its crux is commonly held to be soil organic matter, and discussion showed sign of return to the view that the old, uncompromising rotational farming is the only sure foundation for maintaining soil fertility Land drainage also came under review This is overshadowed by the sorry fact that in present conditions owners and tenants cannot afford to restore or replace the old land drains which have been vital to British farming since about 1840–60 Tractor power has made a new contribution to mole draining, but there remains the great difficulty that we have but crude ideas as to the influence of depth, distance apart, and orientation of drains It was held that the final solution of these practical problems could only be found in a full knowledge of water movement in various soils

Past experiment on cultivations and on the control of fertility by fertilizers, manures and farming systems, reveals a conception of problems not acceptable from the point of view taken in this discussion It was formerly the object of experiment to find out the effect of any treatment on the immediately following crop and on that alone Now the practical problem is widely accepted to be the cumulative effect of these methods and treatments on the soil and on the yield of all the crops throughout a rotation

Science cannot solve the exact problems which confront the farmer It has to ascertain the scientific questions by which the practical problem is made up and to deal with these In the case of cultivations and maintenance of fertility the simplest kind of investigation would be field trials to measure the effect of various treatments on crop yield Such measurements would not give understanding or point the way to further progress Here the questions for science are how each cultivation or other treatment influences the soil and directly or through the soil the crop These influences can only be measured by the plant itself That is a developmental study must be made to determine how at each point in plant life treatment influences growth and development and thus ultimately final yield To make developmental studies under field conditions is exceedingly difficult Plant physiology could do a service to agricultural experimentation by devising measures or indexes of growth and development suitable for field use

In dealing with pests and diseases of crops the natural tendency towards vigorous offensive may overcome business common sense Prominence was given in the discussion to the need for careful estimates of extent and nature of damage to crops To find a method of control or prevention is not the full solution of the practical problem how much can profitably be spent in applying the method remains in many cases a problem also

Of plant parasites—insect fungus or other—the types most to be dreaded are those capable of lingering in the soil for several years Examples are take all (*Ophiobolus graminis*) of wheat and eelworm of potatoes or sugar beet No direct means of destruction is known in any of these cases though indirect methods sometimes biologically fascinating are coming within view Safety lies at present in avoidance in a policy of temperance In fact what was said from the husbandry point of view in the discussion about the merits of uncompromising rotation was effectively reinforced by considerations of disease The apparently steady increase of take all foot root and similar diseases in cereals in many parts of the world was declared to arise from the tendency to lessen the interval between one corn crop and the next Correspondingly the tendency and the temptation to grow successive crops of early potatoes or sugar beet has already created a problem of geographic extent and of gravity which few realize Restriction on freedom of cropping—in the past a matter of statute law and leases—has its severest importance as a matter of biologic law and herein lie perhaps the greatest problems of plant pathology

Present Aspects of Plant Virus Research

THE discussion on present aspects of plant virus research held on August 23 by Section K (Botany) at Cambridge covered the whole range of plant virus work from the properties of purified virus proteins to the propagation of healthy potato stocks

Recent work by Dr Kenneth M Smith and Mr W D MacClement on the natural modes of dissemination of plant viruses has shown that the ld idea of an insect vector as essential for the pread of a virus from plant to plant is true only o a limited extent Some of the best known viruses apparently have no insect vector and ther means of dissemination must exist *Solanum* virus I spreads by the contact of diseased and healthy leaves especially when agitated by wind *Solanum* virus II which is found in the roots of apparently healthy glasshouse plants and does not normally enter the aerial organs is disseminated in at least two ways It has been isolated from the sludge in glasshouse tanks and may be introduced to the soil during watering Experiments with plants grown in air proof chambers have shown that it also spreads from pot to pot by air borne particles of infected plant material This virus and *Nicotiana* virus I have both been recovered from the air one hour after being atomized into it When the former has been atomized into the air of an air proof chamber the plants grown in it under sterile conditions have become infected while those in an adjacent chamber which was not atomized remained healthy *Lycopersicum* virus 4 could be recovered from the air only for 5–10 minutes after atomizing while *Solanum* virus I could not be recovered from the air at all

The problem of multiplication of adequate stocks of healthy potatoes has occupied Dr R N Salaman s attention for many years At present only a third of the potato acreage in England is planted with approximately clean seed and this leads to a reduction in actual yield as compared with possible of some two tons per acre for the remaining two thirds Future policy in regard to the potato crop should aim at obtaining maximum tonnage per acre by the use of healthy seed and by the suppression of ground keepers always a fertile source of virus infection

In the fight against virus disease the use of carrier varieties is to be deprecated There is little hope of obtaining in the near future either genetic or acquired immunity to the serious virus diseases leaf roll and leaf drop streak and only drastic reorganization of the potato seed trade offers hope of ameliorating the situation A scheme was outlined by which really virus free seed available at Cambridge should be multiplied first in moist wind swept areas on the west coasts of Scotland and Ireland then grown in the present good seed growing districts and finally distributed to the ware producing regions of England This scheme would include perpetual replenishment of the seed stocks from healthy sources and would afford a prospect of ultimately eliminating loss due to virus disease

The methods of virus purification originally applied to tobacco mosaic have now been extended by Mr F C Bawden and his co workers to potato virus *X* tomato bushy stunt and cucumber viruses 3 and 4 In principle they consist in heating the infective sap to 60° C (which coagulates most of the normal plant proteins) and precipitating the virus protein from the supernatant by addition of ammonium sulphate Final elimination of host proteins is accomplished by digestion with proteolytic enzymes which do not attack the virus protein All the above viruses yield nucleoproteins with very uniform analyses Final proof that these proteins are pure viruses is impossible to obtain at present but heterogeneity of the purified products cannot be shown by ultracentrifugation or other means The slight loss of infective power shown by some of them is attributed to aggregation of particles Thus in the host plant tobacco mosaic probably exists in the form of approximately spherical particles In the purified protein these aggregate to form long rods imparting to the solutions optical properties such as anisotropy of flow commonly associated with crystalline structure This virus does not crystallize *in vitro* but the virus of tomato bushy stunt does so in the form of rhombic dodecahedra

The origin of potato viruses in Great Britain is probably to be sought in their introduction from South America with the ancestors of the domestic potato In a study of the virus content of fifty nine cultivated potato varieties from Puño South Peru Dr R W G Dennis has discovered evidence of the presence of viruses resembling British *X F G B C* and leaf roll Viruses *A* and *Y* have not so far been found in South American material but there exists in Peruvian potatoes a number of viruses differing from any known in Furope Only eleven of the varieties studied were found to be healthy Investigation of the photo periodic reactions of South Peruvian potatoes shows that there is no reason on that ground for the conclusion that the domestic potato and its viruses could not have been derived from the plateau region of Peru and Bolivia

Horizons in Animal Production

THE discussion on animal production in Section M (Agriculture) of the British Association at Cambridge on August 23 had one excellent result it demonstrated very clearly indeed the inseparableness of the three main constituents—animal husbandry (the feeding and management of livestock) animal breeding and disease control Gone it would seem are the days when the animal nutritionist claimed that feeding was more important than breeding or the geneticist that breeding was more important than feeding or the animal pathologist that control of disease was a laboratory problem divorced alike from heredity and husbandry This is not to say that specialists in each of the three fields have so far been wasting their time for there is plenty of evidence to show that in explaining and improving existing practices they have done very necessary work The animal geneticist for example although he has been unable to direct the emergence of strikingly new and improved types of livestock has been able to interpret the mechanisms of heredity to define the prerequisites for successful in breeding and to examine the significance of mutations

There is too the welcome sign that no longer is a specialist in one field prone to dismiss an unsolved problem by deciding that the solution lies in another field the time has come when further advance can be hoped for only by co operation and by studying the animal as a creature living in a given environment and in relation to the demands made in it by society

The separation of the problems of animal production into those requiring immediate attention and those that can be dealt with only on a long term basis can easily be made Into the first category come measures for disease control and measures for increasing efficiency of production through improvements in feeding and management already established but not generally adopted Prof R Rae believes that in recent agricultural legislation (the Agricultural Act and the Livestock Industry Act both of 1937) there exists the machinery for immediate improvement in both spheres if the interpretation of the Acts is courageous and intelligent This is especially the case where the organization of producers for marketing purposes provides also the organization for stimulating improvement in the quality of the produce For example without the Milk Marketing Board the guaranteed extra payment for milk from herds free from tuberculosis would be impossible This payment is already acting as a considerable incentive to the eradication of tuberculosis As Dr J Hammond pointed out it is much wiser to pay producers to improve their business in this way than as in the past to allow them to rear diseased stock and to earn compensation by slaughtering it The question of food supplies for animals in the event of war is also a problem of the present in this connexion the newer methods of making silage from our grassland merit attention

The problem of disseminating the results of research is to day as important as any problem requiring research The gap between the enlightened practice of the few and the mediocre practice of the many worries all who observe it It is admittedly a problem affecting the whole of farming practice and about it Prof R G Stapledon had much to say An improvement in rural education is of first importance so that farm labour may be recruited from the ranks of the best rather than from those who are left when the brightest have migrated to town jobs The rural schools recently started in Cambridgeshire and elsewhere aim to solve this problem and if those leaving school could begin a definite apprenticeship on the land (as suggested by Prof Rae) the quality of farm labour could be raised to meet the more specialized requirements which it must now fulfil

For the present there is hope of improving the efficiency of production by the spread of quite simple schemes (of which the food recording schemes for pigs and dairy cows are examples) that provide very valuable yard sticks The producer is not given an abstract counsel of perfection he has his enterprise—his herd of pigs or milking cows—carefully costed for him and with the help of a skilled supervisor is able to compare his ability as a manager of livestock with that of his neighbours and to discover directions for improvements Producers grouped into marketing organizations with monopolistic powers are under a moral obligation to the State to make such schemes general

The material in a paper on animal diseases by Dr E L Taylor provides a convenient bridge for crossing from the problems of immediate importance to those of the future It illustrates too the nature of the new approach In the past there has been a tendency to study all diseases in a pathological laboratory but Dr Taylor defined disease as a flaw in the environment Dealing chiefly with the worm parasites (which cause enormous loss and are of special importance to the sheep industry) he showed the close relation between the health of the animal its environment and its tolerance of parasites For example the age of the animal and its plane of nutrition are important factors young growing sheep do not have the resistance of mature sheep and under nourished mature sheep quickly lose their tolerance A sheep may pass as many as 200 000 worm eggs and be in normal health if its constitution is reduced (for example by poor nutrition) the number may increase to 9 000 000 per day The circle is vicious pastures become infested and all sheep suffer While in rare cases specific medicines may effect cures for such a disease there is the much simpler and cheaper cure of good husbandry Improved pastures and rotational grazing provide a better plane of nutrition and another species of livestock—cattle for example not susceptible to sheep parasites can be employed to clear up sheep grazings

In human medicine the part played by improved housing sanitation and nutrition in eradicating disease is now generally recognized In animal production it is certain that improved methods of feeding and management will yield comparable results The hope is real that the new State veterinary service will provide veterinary husbandmen rather than veterinary pathologists

The futures of animal nutrition and animal genetics are going to be closely related to the prosecution of anatomical and physiological research Almost all applied problems can be resolved into terms of the anatomy and physiology of relative growth of reproduction and of endocrinology It may seem a far cry from these to society's demand for small succulent joints of meat rashers of bacon with the right proportion of muscle to fat, eggs of satisfactory weight and milk of better quality or to the desire of the producer to breed and feed livestock that will meet these demands and yet remain fit and profitable but the connexion exists In the field of meat production Dr Hammond has shown the great possibilities of altering the proportions and quality of the carcass by varying the shape of the growth curve Even in closely in bred animals of a pure breed an astonishing flexibility in their response to varying planes of nutrition has been demonstrated This exploitation of the animal as it grows promises great advances over the old methods of measurement of "live-weight gain per unit of food consumed". Prof. F A E. Crew maintains that it is this flexibility (or "degree of modifiability" as he calls it) which must be established for our existing breeds and types of livestock before the geneticist can play his full part

The importance of further research in the physiology of reproduction is emphasized by the incidence of sterility in livestock, much of which is certainly not pathological, and by the economic need of maintaining and increasing fertility. In this field the use of sex hormones is bound to play a large part—Prof. Crew's forecast of the syringe replacing the seasons is apt. The work at Reading on the lactogenic hormones indicates great potentialities in the sphere of milk-production

The discovery of a new technique is usually of fundamental importance, and that of artificial insemination is no exception The improvement of the quality of livestock in Great Britain is greatly hampered by the small size of the breeding-units. For example, one half of the quantity of 'wholesale' milk dealt with by the Milk Marketing Board comes from herds containing ten cows or less The owners of such small herds cannot afford to buy a sire of adequate merit, and in fact the majority use non-pedigree animals. The result is that much of the home-bred stock is unsatisfactory and new stock has to be purchased This practice, besides being most inefficient, often is responsible for the introduction of disease. Through the development of artificial insemination, there is the prospect that the small herd may benefit from the use of sires at present confined to the larger herds, where their services are far from being fully exploited

The evolution of breeds of livestock existing to-day has been directed by breeders working closely with a constantly improving environment and to a definite purpose There is every indication that the process can be continued and accelerated, and that more can participate in it

JOSEPH EDWARDS

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58 s with suggested epicentre in Formosa, but no confirmation has yet been obtained

Prontosil

Messrs Bayer Products, Ltd, Africa House, Kingsway, London, W C 2, have issued a booklet surveying the chemotherapy of 'Prontosil', the trade name of three varieties of the sulphonamide series of drugs Prontosil has been found to possess active properties against human infections caused by the bacterial streptococci, and to be of great service in the treatment of puerperal fever and certain forms of blood poisoning It also appears to be of service in the treatment of meningitis caused by the meningococcus and in some other infections The booklet gives a useful summary of the experimental work that has been done on the physiological action of Prontosil, and of its use in treatment A bibliography of some two hundred of the more important references is appended Although a trade production, this booklet gives a fair presentation on the subject of Prontosil'

Appointments in the Colonial Service

The following appointments and promotions have recently been made in the Colonial Service G W Anderson, to be agricultural officer, Kenya, G K G Campbell, to be agricultural officer, Nigeria, L J S Littlejohn, to be botanist and plant pathologist, Cyprus, S M McCombe, to be agricultural officer, Uganda, C W R McCreary, to be agricultural officer, Nyasaland, P R Stephenson, to be entomologist, Uganda, J Barker, to be nutritional investigator, Nyasaland, E Collins, to be Government analyst, Mauritius, J P Glasgow, to be field officer, Tsetse Research Department, Tanganyika Territory, R L Stafford, to be assistant meteorologist, Nigeria, H E B Williams, to be sleeping sickness control officer, Nigeria, J A Fawdry, inspector of mines, Tanganyika Territory, to be chief inspector of mines, Northern Rhodesia, W G Beaton, veterinary research officer, to be senior veterinary officer, Nigeria, N Clarke, veterinary officer, to be senior veterinary officer, Nigeria, R Dunwoody, veterinary officer, to be senior veterinary officer, Nigeria, A B Ackland, chief clerk, Agricultural Department, to be produce inspector, Agricultural Department, Fiji, P W Briggs, agricultural officer and ginnery inspector, Tanganyika Territory, to be agricultural officer and ginnery inspector, Uganda, R W Hamilton, chief inspector of antiquities, to be director of antiquities Palestine, W O Harvey, game ranger, Tanganyika Territory, to be deputy game warden, Selangor and Negri Sembilan, Federated Malay States, H L Manning, assistant agricultural officer, British Honduras, to be plant breeder in charge of the Cotton Experiment Station, St Vincent (under the Empire Cotton Growing Corporation)

Announcements

As we go to press, confirmation has reached us of an announcement made a few days ago that Dr S B Nicholson, using the 100-inch reflector at Pasadena, has discovered two new satellites of Jupiter The objects are extremely faint, the estimated magnitude being 19 No particulars are yet available as to their orbits

Prof Florence Barbara Seibert, assistant professor of biochemistry, Henry Phipps Institute of the University of Pennsylvania, Philadelphia, has received the Trudeau Medal in recognition of her research on the chemistry of protein molecules derived from the tubercle bacillus Prof Seibert is the first woman to receive the Trudeau Medal

Dr Hermann Fink, professor of the biochemistry and technology of fermentation in the University of Basle, has been awarded the Scheele Medal of the Stockholm Chemical Society

Dr Hans Herensky of Johannesburg has been given the Leibnitz Gold Medal of the Prussian Academy of Sciences and Dr Georg von Bokesy of Budapest the Leibnitz Silver Medal

Prof H Frieser, of Dresden, has become editor of the *Zeitschrift fur wissenschaftliche Photographie, Photophysik und Photochemie* published by Joh Ambr Barth, of Leipzig, previously edited by him with Prof Schaum, of Giessen

A Neo Hippocratic Congress will be held in Marseilles on September 29 under the presidency of Dr Cornil, dean of the faculty of medicine Further information may be obtained from Dr Martiny, 10 rue Alfred Roll, Paris

An International Balneological Association has recently been founded in Budapest The first meeting will be held in Germany this year, the next in France in 1940, and the third in Italy in 1942, during the world exhibition

We have received vol 9 of 'Studies from the Connaught Laboratories, University of Toronto" (The University of Toronto Press, 1938), edited by the director, Dr J G FitzGerald In this volume are bound together reprints of fifty papers, published in different journals during 1937 from the Connaught Laboratories and University of Toronto The papers cover a wide range of subjects, from public health and pathology to biochemistry and physiology A brief inspection of the volume gives a good idea of the activities of the Toronto School A list of the papers included is given at the beginning of the volume, but there is no subject or author index, which would add to its value as a work of reference

Erratum In the letter entitled 'Control of Insects by Methallyl Chloride', by Dr C J Briejèr, in Nature of June 18, p 1099, the third line under the formula "Mixtures of its vapour with air are not explosive in concentrations of 105–339 gm per cub m", should read, "Mixtures of its vapour with air are explosive in concentrations of 105–339 gm per cub m."

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 540

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

The Law of Error

DR J NEYMAN, in his review[1] of Karl Pearson s Grammar of Science , which was republished on my suggestion, quotes a passage from my recent paper[2] on the law of errors as a remarkable illustration of the confusion of the perceptual and the conceptual spheres of thought The whole of my work on probability is based on the recognition of the distinction between description and inference, the neglect of which is responsible for much confusion in current statistical and physical theory Inference, in my opinion, begins at an even earlier stage than Pearson states in the ' Grammar In the passage quoted it should be clear that I am speaking wholly in the inferential sphere An actual set of observations is necessarily discrete and cannot be described by any continuous law of error But it may provide means of saying which of several continuous laws is the more probable on the data

Dr Neyman says that observations are irrelevant to the truth of a mathematical theorem I agree But a theorem that rests on the postulate that an error is the resultant of many comparable and independent components is not wholly mathematical, and can apply only to errors that do satisfy those conditions, and the observed distribution of errors is relevant to whether those conditions are satisfied For this reason I think that many elaborate experimental investigations to test for example, the binomial and χ^2 distributions, are misinterpreted They do not test whether the distributions would hold in the conditions postulated in their proofs, they test whether those conditions have been satisfied in the design of the experiment But in the case of the mathematical 'proof' of the normal law of error, it is not shown, or even true, that the law holds for all possible errors *even if the conditions postulated in the proof are satisfied*

On the other hand, the law of error, whatever it is, is a description of a distribution of chance, not of any set of observational facts It is the exception, not the rule, for a set of observations to be sufficiently numerous even to distinguish between the normal and triangular distributions of chance, and if any law is asserted from some set that is sufficiently numerous, and then the method of combining the data that it implies is applied to another set that is not sufficiently numerous, inductive inference is used So also is the hypothesis that the actual discrete observations have been derived from *some* continuous law of chance, and that the discreteness is due only to the fact that the number of observations is finite

Considering that I have been insisting on the distinction between description and inference for nearly twenty years, I think that I might have been spared the accusation of confusing them

I think that the time has come also for a protest against the statement that continues to be made in statistical writings that a prior probability is a frequency So far as I am aware, the principle of inverse probability was stated by Bayes eighty years before the first statements of any frequency definition, by Leslie Ellis and Cournot A frequency definition was certainly not used by Bayes or Laplace, and Wrinch and I showed in 1919 that it would not suffice as a basis even for direct methods What is done in direct methods is that an inference from a hypothesis to the observations (which can be made on the hypothesis that chances exist, without the circumlocution of a frequency definition to provide an unsatisfactory justification) is converted at the end by a verbal argument into an inference from the observations to the hypothesis, what the principle of inverse probability does is to replace this verbal argument by a symbolic statement To convert either into a prediction of a long run frequency involves a use of Bernoulli s theorem, the conditions for the applicability of which need very careful statement, which they scarcely ever receive

HAROLD JEFFREYS

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Cambridge

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[1] NATURE 142 229 (1938)

[2] *Phil Trans Roy Soc* A 237 231 271 (1938)

Effects of Be-D Radiations upon *Vicia Faba*

THE retarding action of neutron rays upon the roots of wheat seedlings has been reported by R E Zirkle, P C Aebersold and E R Dempster[1], and recently by R E Zirkle and I Lampe[2], but the daily growth of individual seedlings after irradiation has not been reported yet In the present experiments, the lengths of individual roots of *Vicia Faba*, which were exposed to radiations produced by bombarding a beryllium target with 2 8 Mev deuterons from the cyclotron of this laboratory, were measured day by day after the exposure

Three days before irradiation, the seeds were submerged in distilled water for one day and then planted in sawdust saturated with sterilized tap water, in a dark thermostat at 30° C, where they were allowed to remain exactly for two days before irradiation Then, only those individuals the primary roots of which were from 15 mm to 25 mm long were selected for the experiments For irradiation, two of these seedlings were planted in a small glass box filled with sawdust, and were placed in the dark observation chamber of the cyclotron, where they were exposed to the beryllium deuteron radiation for one hour at a distance of 6 5 cm from the beryllium target, the deuteron current being 10 microamperes During the same period two more seedlings, planted in another glass box, were placed for control in a dark chamber which was kept distant from the cyclotron After the exposure, the irradiated seedlings together with the controls were put on a wooden plate, floating on tap water in a two litre glass beaker, and their roots were placed separately in glass tubes, which were hanging down from the plate into the water The beaker was kept in the dark thermostat at 30° C, and the lengths of the main roots were measured every 24 hours after the exposure

The average growths in length of the main roots of fifty irradiated seedlings during the intervals of 24, 48, 72 and 96 hours respectively after the beginning of irradiation, are given in the second row (R) of the accompanying table, and σ is the standard error of mean For comparison, the corresponding data of fifty non irradiated controls are given in the third row (C) of the same table From the standard errors obtained, we can see a clear retardation of growth even in 24 hours after irradiation The ratio R/C decreases with the lapse of time after the exposure, and becomes 46 per cent after a period of 92 hours Further, we found that side roots never appeared in the irradiated specimens within 4 days, while in controls 94 per cent of the individuals have sprouted lateral roots by this time

Period after radiation	24 hr	48 hr	72 hr	96 hr
R (length in mm)	16 7 (σ = 0 8)	22 7 (σ = 1 0)	24 5 (σ 1 2)	24 7 (σ = 1 0)
C (length in mm)	23 7 (σ = 0 8)	39 5 (σ = 1 0)	48 9 (σ 1 3)	52 9 (σ = 1 4)
R/C (per cent)	70 4	5 4	50 3	46 9

While we were carrying out these experiments, retarding actions of X rays upon the main root of the same species were determined, in exactly the same manner, by Misses M Sudô and S Imai in the laboratory of one of us (M N) According to their experiments, the ratio R/C at an interval of 4 days after one hour irradiation with X rays (160 kv, 0 5 mm Cu, 0 5 mm Al) for calculated doses of 200 r, 300 r and 400 r are 59, 52 and 40 per cent respectively The intensity of our beryllium deuteron radiations under the present conditions thus corresponds to about 6 r/min of X rays when measured by the retarding action in 4 days after the exposure on the main root of *Vicia Faba*

In conclusion, our thanks are due to Prof S Nishikawa, Dr Y Nishina and other members of the Nishikawa laboratory as well as of this laboratory for their kind suggestions and valuable assistance, especially in connexion with the operation of the cyclotron We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipment used for the cyclotron, and the Mitsui Ho-onkwai Foundation, Tokyo Electric Light Company and Tôyogû Tercentenary Memorial Endowment for financial support

MASANORI NAKAIDZUMI
KÔITI MURATI

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July 13

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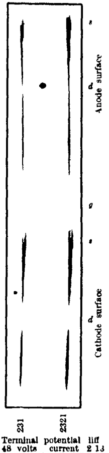
[1] Zirkle, R E Aebersold, P C and Dempster, E R *Amer J Cancer*, [illegible], 556 (1937)

[2] Zirkle, R E, and Lampe, I, *Amer J Roent*, [illegible] 613 (1938)

Pure Stark Effect observed in Metallic Arcs

IT has been generally accepted that in an arc the observation of the pure Stark effect can scarcely be expected, as the drop in potential in the immediate neighbourhood of the electrodes is of the order of the ionization potential of the gas and the dark space is so thin (10^{-8} cm or less) that its detection is extremely difficult, the uncontrollable fluctuation of the arc and the effects due to pressure and inter ionic fields may give rise to further complexities, which manifest themselves in the anomalous behaviour (diffuse broadening or shift) of spectral lines



Terminal potential diff 48 volts current 2 13 amp arc length 3 5 mm

In spite of these expectations we have now succeeded, by proper choice of arcing conditions in observing the pure Stark effect for a number of lines of iron copper silver, nickel and aluminium, most of which belong to the spark type An enlarged reproduction of a small segment of the spectrogram of silver is given in the accompanying illustration

Important points to be noted, as the results of the present investigation are (1) that in a steady metallic arc there can exist at least two regions *s*, where the field intensity is so great that the pure Stark effect can be observed namely at a certain distance (c 1 5 mm) from the lower (positive or negative) electrode and in the immediate neighbourhood of the upper electrode, (2) that there are fairly large drops of potential occurring in *two* steps at *each* electrode, the indication of which is the appearance of the spark lines and so there are three points along the arc where the field intensity becomes a minimum—at two regions *d* about 0 8 mm distant from the electrodes and at the centre *g* of the arc, (3) that, when the pressure is reduced, no essential change is produced in the potential distribution along the arc, (4) that as the length of the arc is varied, the length of the region *g* changes linearly with it, while the behaviour of the lines near the electrodes remains the same

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An Application of a New Limitation in Physical Theory

IN attempts to understand the relation between the quantum theory and the theories of relativity and electro magnetism, a certain limitation, applicable to the motion of a particle of electromagnetic mass m_0 and of charge e, is brought to light It appears that the expression ($m_0c^2d\tau - e/c\Sigma\varphi_m dx^m$) can assume only those values which are multiples of Planck's constant[1].

$d\tau$ is an element of proper time associated with the track of the particle, dx^m is a component of displacement and φ_m is a component of electromagnetic potential An interesting result is obtained if this be applied to an electron in an electrostatic field of potential Ne/r This is the case with an electron in an atomic orbit where N is the number of the atom The above condition then implies $(m_0c^2\sqrt{1-\beta^2} - Ne^2/r)\, dt \nless h$ where $\beta = v/c$ v being the velocity of the particle, and where account is taken of the fact that the nuclear and electronic charges are of opposite sign If we consider the case of the K level of an atom and make use of Sommerfeld s value for Ne^2/r which may be regarded as a sufficient approximation we obtain $m_0c^2\,(\sqrt{1-\beta^2} - \beta^2/\sqrt{1\ \ \beta^2})\, dt \nless h$ In this case $\beta = N\alpha$ where α is the fine structure constant $2\pi e^2/hc$ We note that as β approaches the value $1/\sqrt{2}$ the factor of dt approaches zero very rapidly and the limitation states that the least possible value of dt is very large We interpret this as an indication of the breakdown of the description of the charge as a particle in motion This gives a clue to the nature of the limitation It provides us at each point of space and time with a criterion for the dynamical description of an electric charge

In this particular example the limitation is interpreted to mean that the K level does not exist when $\beta = N\alpha \gg 1/\sqrt{2}$

The condition appears to be similar to a condition of stability, the K ring at a certain point becoming completely unstable

The value of N which results from this equation is very close to 97, and we conclude that atoms with numbers up to 96 may possess a complete set of energy levels beginning with the K level Beyond this, K levels do not exist and nuclei of a larger number would possess energy layers beginning at a higher level[2]

The condition $\beta \ngtr 1/\sqrt{2}$ can be expressed by stating that electrons in atomic orbits have de Broglie wave lengths greater than h/m_0c It is interesting to note in conclusion that in the example considered we find another relation involving the fine structure constant to add to the considerable number already known

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July 30

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[1] Flint *Proc Roy Soc* A 159 45 (1937)

[2] Flint and Richardson *Proc Roy Soc* A 117 637 (1928)

Ultra-Violet Band System of Silicon Monotelluride

FOLLOWING up the recent observations of ultraviolet band systems of SiS[1] and SiSe[2] in heavy current discharges through silica tubes containing aluminium sulphide and aluminium selenide respectively, I have now applied an analogous method for the development of the corresponding system of SiTe In this case, a 2 5 amp A C discharge has been passed through a powdered mixture of aluminium and tellurium in a silica tube The system lies between λ 3307 and λ 3831, having its 0 → 0 band at λ 3496 4

As guides to the identification of the SiTe system there are not only the progressive changes in the system origins and vibrational coefficients of SiO, SiS and SiSe, but also the data for the corresponding system, B ← X, of SnS, which has the same number of electrons (66) as SiTe There is, indeed, a remarkable similarity between the expressions for these two systems, just as there is between those for the corresponding systems of the lighter isoelectronic pair, GeS and SiSe (48 electrons), thus

$$\left.\begin{aligned}\nu_{\text{GeS}} &= 32889\ 5+(375\ 0u' -1\ 51u'^2)-(575\ 8u''-1\ 80u''^2)\\ \nu_{\text{SiSe}} &= 32448\ 7+(404\ 3u' -3\ 24u'^2)-(580\ 0u''-1\ 78u''^2)\end{aligned}\right\}$$

$$\left.\begin{aligned}\nu_{\text{SnS}} &= 28337\ 9+(331\ 9u' -1\ 25u'^2)-(487\ 7u''-1\ 34u''^2)\\ \nu_{\text{SiTe}} &\ \ \ 28665\ 9+(333\ 4u' -0\ 54u'^2\ \ 0\ 05u'^3)\ \ (480\ 7u''\ \ 1\ 30u''^2)\end{aligned}\right\}$$

where, as usual, u stands for $v + \frac{1}{2}$

The values of $I_M I_X/E_e$ and ω_e/ω_e'' for SiTe are 20 6 and 0 694 respectively which are of the same orders of magnitude as those previously found for SiS and SiSe The ratio (ω_e of SiTe)/(ω_e of SiSe) takes the values 0 824 and 0 829 for the excited and ground states respectively As expected, these are greater than those for (ω_e of SiSe)/(ω_e of SiS) namely, 0 790 and 0 774 respectively, which, again are greater than those for (ω_e of SiS)/(ω_e of SiO), namely, 0 602 and 0 604 respectively A similar change is found[3] in the corresponding ratios of coefficients in the case of PbTe PbSe, PbS and PbO

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Aug 8

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[1] Barrow R F and Jevons W NATURE 141 833 (1938)

[2] Barrow R F NATURE 142 [434] (1938)

[3] Barrow R F and Jevons W forthcoming paper

Band Spectrum of Helium

WHEN helium at a pressure of about 25 mm of mercury is excited in such a way as to produce the line spectrum and the band spectrum in comparable intensity, McCallum and Wills[1] find that the band spectrum persists much longer than the line spectrum after the excitation is removed They show a spectrogram of the discharge, taken 1/600 sec after the discharge had been interrupted, in which the line spectrum has disappeared while the band spectrum is still of approximately the same intensity as that from the discharge before interruption

From this persistence of the band spectrum McCallum and Wills infer that either the helium molecules formed in the discharge have a life of the order of 1/600 sec or, more probably, they are formed after interruption of the discharge by the collision of a metastable atom with a neutral atom

That the latter inference is correct is shown by the recent work of Arnot and M'Ewen[2], who have investigated the formation of helium molecules by the balanced space charge method, and have shown that the helium molecule is formed in the ionized state by the attachment of a metastable atom in the $1s2s$, ^3S state of 19 77 volts energy to a normal atom This paper was published after McCallum and Wills's letter was communicated

F L ARNOT

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Aug 18

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[1] McCallum S P and Wills M. S NATURE 142 252 (1938)

[2] Arnot F L and M Ewen M B *Proc Roy Soc* A 166, 543 (1938)

Fundamental Physical Structure

THE suggestion by Dr. Drysdale, in NATURE of August 13, that by resorting to the experiments and equations of Ampère relating to the forces between current-carrying conductors, magnetism may be eliminated from fundamental physical concepts, reminds me that in the course of conversation with the late Sir Horace Lamb some years ago, he remarked that it would greatly simplify mathematical treatment if we could dispense with the duality of electricity and magnetism and concentrate on one of them, as Ampère appeared to have done. The hint was the more impressive because Sir Horace, in his 'Hydrodynamics", had set forth the vortex theory so convincingly.

What Dr. Drysdale now does is to substitute the force corresponding to the product of charge and velocity of a proton or electron, for Ampère's current-element force, thus eliminating the magnetic link. It is difficult to dissociate permeability from what Dr. Drysdale designates 'magnetic considerations", but presumably it would take its place as a general variable in the concept.

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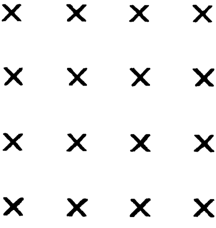
A Binocular Illusion

I WAS much interested in Sir Richard Paget's letter in NATURE of July 9, as I have observed the converse effect, in which a 'suspended image' may be seen *behind* the pattern viewed.

The effect may be obtained by drawing a simple pattern (for example, of crosses, as in the enclosed sketch) enlarged so as to give a suitable interval between the elements; this is rather less than the distance between the eyes (in my case, two inches for an eye interval of two and a half inches). The pattern is held at a suitable distance—about twelve inches—and the eyes relaxed; having persuaded the blurred images to coincide so that one element is superposed on its neighbour's image, the eyes are focused *without* losing this superposition, that is, without turning them inwards to their original position. The illusion of a magnified image behind the object is assisted if the eyes are permitted to move over the pattern or blinked, or if the pattern is moved slowly towards and away from the observer.



A chessboard held diagonally is a suitable pattern, but the illusion is much more striking with an object such as wire netting, and I have found a window pane of frosted glass with a pattern of stellate clear patches (at the appropriate interval) very effective indeed; the most favourable conditions, however, require a little practice and patience.

The optics of this phenomenon are of course similar to those of Sir Richard's version. The eyes are focused for an object at a certain distance, but the angle subtended by their respective lines of sight is appropriate to an object at a greater distance.

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Antarctica and Glacial Ages

As geologist to the British Graham Land Expedition, I should like to direct attention to certain misstatements which appear in Prof. E. W. MacBride's recent article[1] concerning the geological discoveries which our expedition made in the Antarctic.

Prof. MacBride states: "The part [of Antarctica] so far principally studied is that directly south of South America, in which lies the inlet known as the Ross Sea." A glance at the map will show that the Ross Sea is some 100°–120° of longitude west of South America. Our expedition was working in what is commonly referred to as the West Antarctic, which is south of South America but very many miles from the Ross Sea. Further, Prof. MacBride states that we collected from the Beardmore glacier erratic rocks 'of the Gondwana age, with coal seams carrying characteristic fern plants". He probably has in mind the Permo-Carboniferous plant remains which were collected by Captain Scott's polar party from the region of the Beardmore Glacier, and which were described by Sir Albert Seward. The Beardmore Glacier is nearly 2,000 miles from the region we visited. The only plant bearing deposits we found were from the eastern shore of Alexander the First Land, and are probably Middle Jurassic but certainly not Permo-Carboniferous or 'Gondwana' in age. As a result of Prof. MacBride's misstatements it is difficult to understand what geographical relation he assumes the Antarctic Permo-Carboniferous deposits bear to the presumed continent of Gondwanaland. Consequently it is doubtful how far the arguments which he bases on their distribution may be regarded as relevant.

Prof. MacBride states that Antarctica entirely escaped the "Gondwana ice age", but since no rocks of Permo-Carboniferous or Gondwana age have yet been found in West Antarctica (which, it should be remembered, is markedly dissimilar from the region round the Ross Sea both as regards the geological formations that occur and their tectonic structure), no certain conclusions can be drawn as to the climate of this part of the continent in 'Gondwana' times.

In recent years many lines of evidence have accumulated to suggest that during past geological ages various parts of the earth's crust drifted relative to one another and to the axis of the earth. The widespread distribution of a characteristic Permo-Carboniferous flora throughout many lands, which are now widely separated, is of particular significance. There is also evidence to show, as Prof. MacBride points out, that drifting may still be going on at the present day, at all events in certain parts of the world. It is hard to escape the conclusion that continental drift is one important contributory cause of the Permo Carboniferous and other pre Pleistocene glacial epochs, but to claim, as Prof MacBride does, that drift into high latitudes affords a complete explanation of all glacial phenomena previous to the Pleistocene is surely to propose a too facile solution for a highly complicated group of problems which further information can alone clarify

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July 28

NATURE 142 97 99 (July 16 1938)

IN answer to the criticisms of the Rev W L S Fleming I have frankly to admit two foolish mistakes in nomenclature For Ross Sea read Weddell Sea,' and the height of land from which the Beardmore Glacier takes its origin is of course a few projecting peaks which are *not* Erebus and Terror

The mistakes in nomenclature leave my argument quite unaffected indeed since then I have measured on *The Times* map the actual breadth of the ice shelf If, as Dr Stephenson assures me, the Beardmore Glacier is 200 miles long, the breadth of ice shelf to be added is 1 200 miles This gives 1 400 miles as the length of the ice flow and nothing in the Pleistocene ice flows approached this

With regard to the fossils from the rocks beneath the ice sheet, I thought that all knowledge of these was gathered from the erratics which Scott brought back I am delighted to learn that Jurassic strata are exposed in one place and that these show no signs of glaciation It is of course conceivable that, while one part of Gondwanaland escaped Gondwana glaciation, another part did not do so—but this is not a likely supposition

My conception of the Gondwana ice age is as follows In Permo Carboniferous times there was one huge southern continent, lying in temperate regions to the north and east of the South Pole In this continent there was a characteristic flora which enables portions of it to be recognized wherever they are

In Permo Carboniferous times it drifted southward over the pole At that time Australia and Antarctica lay at its northern edge As the drift continued, both Australia and Antarctica broke off and remained in the temperate zone The rest of the continent as it reached the pole underwent severe glaciation, after which in Cretaceous times it broke into three great fragments, namely, South America, South Africa, the Deccan of India, in all of which traces of this ice age can be seen Sir Thomas Holland has said that these traces can be detected in portions of the north of India, so far did the drift go on At a later period the same drift affected Antarctica and led, as I said, to its present condition

Mr Fleming, while agreeing generally with the theory of continental drift, says that it is a rash thing to make it account for all the ice ages It certainly does not account for the Pleistocene ice age, as I said But besides the Pleistocene there are only two well authenticated ice ages in the history of the earth, the Pre Cambrian and the Gondwana So far as I can find out, there are no traces of the Pre Cambrian ice age in the southern hemisphere Beds supposed to belong to this ice age in India have been recently shown to be relics of the Gondwana ice-age

E W MACBRIDE

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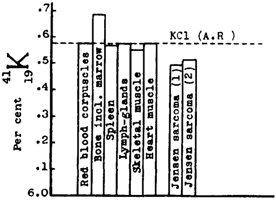
Isotopic Constitution of Potassium in Normal and Tumour Tissue

WITH the idea that the isotopic constitution of potassium contained in tumour tissue might be somewhat different from that present in normal tissue comparative investigations in this field have been undertaken The abundance ratio $^{39}_{19}K/^{41}_{19}K$, and thereby, practically, the concentration of the heavy isotope $^{41}_{19}K$, was estimated in potassium present in the ashes of various kinds of normal and tumour tissue, the measurements being carried out by means of a mass spectrograph previously described in detail[1,2]

A selection of the results so far obtained is illustrated in the accompanying figure, showing the percentage of $^{41}_{19}K$ in potassium contained in Jensen rat sarcoma and in some normal rat tissues of mesodermal and mesochymal origin, including red blood corpuscles It will be seen that the content of $^{41}_{19}K$ in potassium present in red blood corpuscles as well as in spleen, lymph glands and heart muscle, was the same as, or very close to, that in mineral potassium contained in ordinary potassium chloride (A R) In contrast the $^{41}_{19}K$ content in potassium present in bone, including marrow, showed an increase by about 1 7 per cent This deviation was probably due to the marrow alone and confirmed similar results previously obtained with marrow from other animal species[2] The $^{41}_{19}K$ content in potassium from skeletal muscle showed a doubtful decrease of about 0 4 per cent Ashes for these determinations were prepared from mixed tissues taken from an equal number of males and females The average animal weight, corresponding to each tissue, was between 210 gm and 225 gm



CONCENTRATION OF $^{41}_{19}K$ IN POTASSIUM CONTAINED IN JENSEN RAT SARCOMA AND SOME NORMAL RAT TISSUES

In comparison with the above results it was found that the relative $^{41}_{19}K$ content in Jensen rat sarcoma was distinctly low Two samples of ash from tumours obtained by subcutaneous inoculation are here considered The tumours constituting sample (1) had an average weight of about 15 gm and were taken, 18 days after inoculation, from animals having an average weight similar to those considered above, the tumours constituting sample (2) had an average weight of about 14 gm and were taken, 14 days after inoculation, from animals having a much lower average weight The potassium in sample (1) contained about 1 3 per cent and that in sample (2) about 1 0 per cent less $^{41}_{19}$K than mineral potassium Both living and necrotic parts of tumour were utilized in the preparation of these samples, but two other samples prepared from only living parts showed approximately the same percentage

Similar slight deviations were obtained in potassium from mouse sarcoma 37 S and from some forms of human cancer tissue , so far no corresponding normal tissue has been taken for comparison, except human bone marrow, which gave results similar to rat bone marrow

Detailed accounts of our investigations will appear elsewhere

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Aug 8

Brewer A K J *Amer Chem Soc* **58** 365 (1936)
Brewer A K J *Amer Chem Soc* **59** 869 (1937)

Active Group of Papain

FROM their work on the active group of papain Bersin[1] and Purr[2] concluded that the SH group was essential for the hydrolysis of gelatin by the enzyme the activity disappearing with the oxidation of the SH to the SS form

We have already shown that the papaya latex is rich in SH compounds (about 2 per cent) and that about a tenth of it is glutathione[3] This observation led us to the examination of the activation of papain

An aqueous extract of the fresh latex, previously extracted with ether, was treated with hydrogen peroxide to oxidize all the SH to the SS as shown by the nitroprusside test, and then precipitated with alcohol, washed with absolute alcohol and dried in vacuum This preparation, while being completely inactive towards peptone, retained its capacity to hydrolyse gelatin Its gelatinase activity was comparable to that of the preparation activated by hydrogen cyanide or glutathione Its optimum *p*H was in the neighbourhood of 3 far below the value (4 6–5 0) reported in the literature for papain The reaction mixture before and after incubation did not answer the nitroprusside test The results obtained are tabulated below

(250 mgm gelatin or peptone + 250 mgm of SS prepn in 20 c c of buffered solution *p*H 3 Temp 38° C Time of incubation 20 hr The activity is measured by the increase in formol titration of 2 c c of the reaction mixture against 0 1 *N* caustic soda)

		Gelatin	Peptone
1	SS preparation in citrate buffer	0 25	0 00
2	in acetate buffer	0 27	0 01
3	+hydrogen cyanide	0 38	0 30
4	+glutathione	0 48	0 46
5	+maleic acid	0 26	0 00
6	+iodoacetic acid	0 00	0 00

Maleic acid, which has recently been shown to inhibit the activity of enzymes the activity of which depends on the presence of the SH group[4], is without effect on the gelatinase activity of the preparation Iodoacetic acid inhibits the activity irreversibly

These results indicate that for the gelatinase activity of papain the SH group is not necessary ; other groups which react irreversibly with iodoacetic acid appear to be essential At the same time, it is evident that the SH group is essential for 'peptonase' activity.

We have also got evidence that the papain hydrolysis of the protein takes place in two definite stages, first to peptone and then to simpler amino acids , the activation mechanism being specific for the two stages

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July 29

[1] Bersin *Hoppe Seyl Z* **222** 1 7 (1933)
[2] Purr *Biochem J* **29** 5 (1935)
[3] Ganapathy and Sastri *Curr Sci* **6** 330 (1938)
[4] Morgan and Friedmann *Biochem J* **32** 862 (1938)

Excretion from Leguminous Root Nodules

IN previous communications[1 2 3] I have reported my inability to detect appreciable excretion of nitrogenous substances from root nodules of leguminous plants and thus to confirm the results obtained by Virtanen During the past summer further trials have been carried out with soya bean (4 varieties) pea (5 varieties) and broad bean Three rooting media have been employed namely (*a*) a coarse quartz sand composed of particles of diameter mostly in the region of 0 5 mm (*b*) a fine quartz sand of particles diameter 0 1 0 3 mm and (*c*) a very fine quarry sand of particles 0 1 mm and less (*b*) appears to be very similar to the sand used by Virtanen Open and closed containers have been used while the tests for excretion consisted of analysis of rooting medium and of barley plants grown in association with the legumes

Satisfactory growth and fixation were shown by the legumes, but in no instance was evidence of excretion obtained The pea varieties included Torstai and Concordia inoculated with bacillus strain *HX*, combinations which in Virtanen s experiments gave vigorous excretion I have repeated Virtanen s arrangements and conditions so far as is practicable and yet have obtained very different results It is clear that apart from the possible influence of factors such as identity of legume bacterial strain and adsorptive capacity of rooting medium some other factor has a controlling effect on excretion Wilson and his collaborators[4 5], recently reached a similar conclusion from their Wisconsin experiments and advanced evidence that excretion depends on the maintenance of a certain relation between rate of photosynthesis and of fixation, and for this reason is liable to be affected by light intensity and temperature These factors were *not* subject to close control in my experiments The soya beans were grown in a lean to greenhouse partly shaded by trees, with a day temperature of 65–75° F The other legumes were placed outside on dry days in a position where they received a maximum of six hours sunshine daily No difference in excretion has emerged in these experiments between soya bean and the so called cool weather legumes, negative results having been obtained in all cases

G BOND

Department of Botany
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Glasgow Aug 25

[1] Bond NATURE **139** 675 (1937)
[2] Bond NATURE **140** 683 (1937)
[3] Bond *Ann Bot* (N S) **2** (1938)
[4] Wilson and Burton *J Agric Sci* **28** 307 (1938)
[5] Wilson and Wyss *Proc Soil Sci Soc* 289 (1937)

The Mexican Loggerhead Turtle in Europe

THE Mexican loggerhead turtle, *Colpochelys kempi* Garman, is distinguished from *Caretta caretta* (Linné) by its colour, in possessing four enlarged infra marginals instead of three on each side, and its smaller size A native of the Gulf of Mexico and adjacent waters, it is so localized that few if any European museums possess specimens Hence its appearance off the west coast of Ireland is of unusual interest

Two specimens so obtained in 1928 and 1934 are now in the National Museum at Dublin and are No 92—1928 and No 108—1934 respectively The straight carapace length of the former is 256 mm, of the latter 245 mm These will be dealt with more fully by me in the *Irish Naturalists Journal*

The presence of *Colpochelys kempi* in these waters suggests that the common *Caretta caretta* which appears off Ireland is also derived from American waters, and not from the neighbouring south European seas This opinion is further supported by a *Caretta caretta* in the Whitby Museum with the label Washed aboard ss *Ethelfreda* North Atlantic 1926

It is thus very probable that the presence of *Caretta caretta* (Linné) in European waters is mainly if not entirely due to currents, for no definite breeding grounds exist on the European coast as on the American side of the Atlantic

The possibilities of sea turtles as current indicators would thus appear to be considerable, and it is to be hoped that their importance in this respect will receive due recognition

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Aug 24

Visual Image Produced by a Photoflash Bulb

A LUMINOUS visual image, very closely resembling some 'ball lightning' observed at high altitudes, may be produced by the firing, without warning, of a photoflash bulb just beyond the limit of an observer s normal field of vision

The optical illusion produced will be described by the observer as a greenish or reddish ball that wandered into his field of vision from the side, became smaller and changed colour near its centre (right in front) and finally faded and vanished No two persons will give identical reports

From the foregoing, it is suggested that certain (not all) reports of ball lightning' are actually descriptions of an optical illusion (probably a sort of after image) produced by a brilliant lightning flash somewhere just outside the observer's visual field

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Boulder, Colorado

Points from Foregoing Letters

COMMENTING on Dr Neyman's remarks in a recent review of Pearson s Grammar of Science , Dr Harold Jeffreys states that the law of errors is a description of a distribution of chance, not of observational facts It does not hold for all possible errors, even if the conditions postulated in the proof are satisfied He also points out that the principle of 'inverse probability' was stated long before any 'frequency definition

An appreciable retardation in the growth of the roots of broad bean seedlings, after exposure in a cyclotron chamber to radiations from a beryllium target bombarded with a deuteron current of 10 microamperes, is reported by Prof M Nakaidzumi and K Murati

An enlarged reproduction of the lines 2317 and 2321 A in the arc spectrum of silver, obtained under special arcing conditions, and showing splitting due to the electric field (Stark effect) is submitted by Dr J Huruiti and Prof T Hori Their investigation throws light on the distribution of the potential drop and field intensity within the arc

By applying a new limitation, arising from quantum relativity relations, to an electron moving orbitally in an electrostatic field, Dr H T Flint obtains a condition of stability which indicates that in atoms with atomic numbers larger than 96 the *K* level cannot exist

R F Barrow reports the observation and vibrational analysis of the ultra violet band system of SiTe corresponding to the SiSe, SiS and SiO systems already described by him and Dr W Jevons

A binocular illusion in which a regular pattern, by suitable adjusting, appears enlarged and suspended behind the actual pattern, is described by J D Morton

The Rev W L S Fleming corrects certain points to which Prof MacBride referred in his article on "Antarctica and Glacial Ages ' concerning the British Graham Land Expedition s geological discoveries No rocks of Gondwana ' age have yet been found in West Antarctica and there is no evidence as to what climate this part of the world experienced during the ' Gondwana ice age Existing evidence does not justify the conclusion that continental drift affords a complete explanation of all pre Pleistocene glacial phenomena Prof E W MacBride admits two errors in nomenclature, but claims that by substituting "Weddell Sea" for ' Ross Sea ', the argument is unaffected

The isotopic constitution of potassium contained in tumour tissue and normal tissue, mainly from the rat, has been studied by Dr A Lasnitzki and Dr A K Brewer Distinct, although slight, deviations from the norm were obtained with the potassium present in tumour tissue and bone marrow The percentage of $^{41}_{19}$K was decreased in the former case, increased in the latter

C V Ganapathy and B N Sastri state that if the sulphydril group SH of the enzyme papain is oxidized by hydrogen peroxide, the enzyme loses its power to act upon peptone, but retains its hydrolysing power on gelatine, indicating that for gelatinase activity the SH group is not necessary

Further experiments with sand cultures of soya bean, pea and broad bean carried out by Dr G Bond fail to confirm appreciable excretion of nitrogenous substances from these root nodules

Research Items

Standards of Living in Africa

THE problem of raising the standard of living in native Africa with special reference to the contribution to its solution which may be made by the anthropologist has been the subject of consideration by Dr Margaret Read in the light of recent experience among the Ngoni of Nyasaland (International Institute of African Languages and Cultures *Mem* 16 1938 Oxford University Press Pp 56 Price 1s) Apart from the difficulty of a quantitative evaluation of the present standard of living in a community existing partly on a subsistence economy partly on a money economy the problem of raising the standard calls for a deeper analysis probing to the values which govern present consumption and the incentives which determine present production—in other words study of institutions Study of Ngoni institutions shows that in the past economic activities were dependent upon and organized through the social system of the people In the changes due to cultural contact it is the economic life which has been altered most radically The native authorities though deprived of most of their traditional means of wealth are expected to promote schemes of native welfare more or less on European lines The fundamental difficulty is that economic progress cannot be dissociated from political and social development if either are to be maintained In a brief survey of cattle keeping agriculture and the paramount chief's market it is shown that there is no automatic reaction to environment nor is there any automatic or uniform reaction to culture change introduced by Europeans The Ngoni have resisted the suggestion of a commercial attitude towards cattle Their organization of agriculture and distribution of its proceeds have collapsed owing chiefly to forces outside their control, but in the paramount chief's market he has created deliberately a new form of activity which though based on an old traditional relationship, meets some of the new needs of the people The variation in the reactions of the people to efforts to improve their welfare suggests the usefulness of careful preliminary inquiry before introducing innovations such as farm schools and co operative societies Economic progress must be in line with political development if either are to achieve stability and permanence

Manuring of Soft Fruits

Two interesting investigations on the manuring of soft fruits have recently been recorded (*J Pom and Hort Sci*, 16, 1938) The first, by T Wallace, concerns black currants, and the second, by T Wallace and V G Vaidya, refers to strawberries The black currants, variety Baldwin, were given a series of manurial treatments consisting of farmyard manure, no manure, complete artificials, and complete artificials less nitrogen, phosphorus and potassium respectively The order of crop yields was the same as that for vigour, namely, farmyard manure, complete artificials, omit nitrogen, omit phosphorus, omit potassium Severe attacks of *Pseudopeziza Ribis* occurred each year potash deficiency appears to have decreased susceptibility to this fungus whilst deficiencies of nitrogen and potassium tended to increase it The strawberries, variety Royal Sovereign were given three dung treatments complete organic manures containing shoddy and dried blood respectively as sources of nitrogen dried blood without potash complete artificials and no manure Dung produced greatest vigour though the results from shoddy and complete artificials were similar Dried blood manure with and without potash gave relatively poor vigour and the yields from these plots were low Evidently dried blood is a poor source of nitrogen for strawberries The largest yields occurred on the dung plots Manuring did not affect the ripening season the proportions of marketable fruit in the crop or the incidence of pests and diseases

Seasonal Transmission of Cassava Mosaic

A SHORT paper by Dr H H Storey and R F W Nichols (*East African Agri J* 3 No 6 446–449 May 1938) describes a field experiment upon the transmission of cassava mosaic a virus disease Infection experiments were repeated at continuous monthly intervals for two years and it is thereby established that virus transmission is greatest from February to May and least from August to October in East Africa This would doubtless have some relation with the insect population of the area, but the practical result emerges that planting of cassava in June is most beneficial since the main period of growth is made when virus transmission is at a minimum

Separation of Mixtures of Gases and Isotopes

A NEW method for the separation of mixtures of gases which can be applied to the separation of mixtures of gaseous isotopes is described by K Clusius and G Dickel (*Naturwiss* 26 546 1938) A vertical hot surface (an electrically heated wire was used) is placed opposite a cold surface The gas mixture is between the two The various processes of thermal diffusion and convection result in a concentration of the heavier component of the mixture at the bottom of the apparatus and of the lighter one at the top Using an apparatus 65 cm long and a temperature difference between the surfaces of 300° a mixture containing 25 per cent bromine and 75 per cent helium was completely separated With an apparatus 1 metre long and a temperature difference of 600° pure carbon dioxide was obtained from a mixture of 40 per cent carbon dioxide and 60 per cent hydrogen With normal neon in an apparatus 2 6 metres long and a temperature difference of 600°, the proportion of isotopes in the gas drawn off at the bottom of the apparatus was ^{20}Ne 68 4 per cent, ^{21}Ne 0 6 per cent, ^{22}Ne 31 0 per cent whereas normal neon contains ^{20}Ne 90 0 per cent ^{21}Ne 0 3 per cent ^{22}Ne 9 7 per cent When normal hydrogen chloride containing 23 per cent $H^{37}Cl$ and 77 per cent $H^{35}Cl$ was used, the concentration of $H^{37}Cl$ in the gas obtained at the base of the apparatus was increased to 40 per cent The atomic weight of the chlorine in this mixture is 35 56, 0 10 units greater than the international value of 35 457

Protection of Telephone Circuits

To the *Strowger Journal* of July published by the Automatic Telephone and Electric Co Ltd of Liverpool, Mr T B D Terroni communicates an instructive paper on the protection of telephone circuits from inductive interference He first refers to the excessive voltages which occur on telephone lines due to faults on power transmission lines These induced voltages are sometimes of sufficient magnitude to be a danger to telephone employees and to cause great damage to telephone apparatus This type of problem occurs on railway systems where privately owned telephone lines run parallel to the track close to the main high tension distribution network The telephone lines are used for telephony, signalling and the remote control of sub stations from a main control station The danger can be obviated by means of a large inductive coil, called a drainage coil, connected between the two wires of a telephone line with its mid point in contact with the earth A further source of disturbance arises from the fluctuations of the earth potentials near a power station, when an earth fault occurs The fault acts as a source of power and the station earth acts as a sink so that currents flow through the earth The potential of the earth in the vicinity of the power station may be so high as 3,000 volts above the earth potential at some distance away When British P O lines are hired to operate between 132 kv grid sub stations and a central indicating station trouble is obviated by terminating all the P O circuits in special isolating transformers Cable circuits are much more immune from lightning induction trouble than overhead lines In desert areas open wire lines are known to experience high voltages as the result of sand storms The voltages appearing in the telephone loop are probably due to the charging up of the two conductors by the highly charged particles of sand The use of neon arresters to discharge these potentials to earth give rise to acoustic shock in the telephone receiver This is due to the repeated discharges of the lines to earth through the neon tubes, which do not necessarily flash simultaneously This is remedied by using the new atmite protectors

Atomic Weight of Carbon

E Moles and A Escribano have recently re determined the atomic weight of carbon (*Comptes rendus*, **207**, 66, 1938) The method involved the determination of the limiting densities of carbon dioxide and oxygen, this being carried out by adsorbing known volumes of the gases on charcoal at the temperature of liquid air, the charcoal being weighed before and after the adsorption The determinations were made at 760 mm and 380 mm pressure, and the limiting density was obtained by extrapolating to zero pressure assuming the variation to be linear The values obtained for the limiting densities were oxygen 1 427644 gm per litre, carbon dioxide, 1 963340 gm per litre This gives 44 0074 for the molecular weight of carbon dioxide, and 12 0074 for the atomic weight of carbon This is almost identical with the value obtained by Moles and Salazar in 1934 from the ratio CO O_2, but differs slightly from the value (12 010) accepted by the Committee on Atomic Weights of the International Union of Chemistry the eighth report of which is just published (*J Chem Soc*, 1101, 1938)

New Transformation Product in the Trans-Uranium Series

PREVIOUS work has shown that the irradiation of uranium with neutrons gives rise to three transformation series the first two of which have been followed as far as eka platinum (atomic number 96) and eka osmium (atomic number 94) respectively whilst the nature of their emitted radiation makes it possible to assume that eka gold (atomic number 97) and eka iridium (atomic number 95) respectively are further produced In the third series a β radiating uranium of half life 23 min only has been detected, which possibly gives rise to eka rhenium The three series may be summarized as follows (1) ^{92}U $+ n \rightarrow (^{92}\text{U} + n)$ $\xrightarrow[10\text{ sec}]{\beta}$ ^{93}eka Re $\xrightarrow[2\ 2\text{ min}]{\beta}$ ^{94}eka Os $\xrightarrow[59\text{ min}]{\beta}$ ^{95}eka Ir $\xrightarrow[66\text{ hr}]{\beta}$ ^{96}eka Pt $\xrightarrow[2\ 5\text{ hr}]{\beta}$ ^{97}eka Au ?, (2) ^{92}U $+ n \rightarrow (^{92}\text{U} + n)$ $\xrightarrow[40\text{ sec}]{\beta}$ ^{93}eka Re $\xrightarrow[16\text{ min}]{\beta}$ ^{94}eka Os $\xrightarrow[5\ 6\text{ hr}]{\beta}$ ^{95}eka Ir ? (3) ^{92}U $+ n \rightarrow (^{92}\text{U} + n)$ $\xrightarrow[23\text{ min}]{\beta}$ ^{93}eka Re ? The transformation products in the first two series are isomeric nuclei, those in the second series being always of longer half life than in the first This led Hahn Meitner and Strassmann (*Naturwiss*, **26** 475 1938) to look for an activity of eka iridium in the second series of long half life, since the eka iridium of the first series has a half life of 66 hr By irradiating 10–20 gm of uranium for some months with neutrons within paraffin, and examining the products, the existence of a new transformation product with a half life of about 60 days was indicated The genetic position of this product is still uncertain, but it would appear to be the eka iridium of the second series that was sought

Evolution of Eclipsing Binaries

DR ZDENĚK KOPAL has recently published a paper (*Mon Not Roy Astro Soc* **98** 8, June 1938) in which he examines the fission theory of the origin of binaries and also the question of an evolutionary progression or of a statical interpretation as suggested by their physical properties It is well known that the ratio r_1/r_2 where r_1 and r_2 denote the radii of the primary and secondary, respectively, decreases with an increase in the separation of the components Thus in the closest systems the primary is much larger than the secondary, the reverse being true in the widest systems, and the present separation is a rough criterion of the stage of evolution, provided the components were originally in contact A difficulty arises here The total angular momentum of the system resides chiefly in the orbital momentum and as separation can be effected only by internal action, such as tidal friction, there is little scope for such taking place at the expense of the rotational momenta of the constituent stars It appears that the eclipsing systems must have larger stores of angular momenta in the rotation of their components than can be obtained on the assumption that they rotate as rigid bodies with constant Keplerian angular velocities It is suggested that the interior may rotate more rapidly than the surface layers If this took place, so that rotational and orbital momenta are comparable, observational facts are not essentially incompatible with the fission theory

Sixteenth International Physiological Congress

FOUR successive international congresses, on cytology, physiology, veterinary science and history, respectively, have been held in Zurich this year. Each physiologist who had given his address, found in his room a packet containing a badge with his name on it, a list of members with local and home addresses, a small book dealing with the life and work of Albrecht von Haller, a copy of a special number of the *Schweizer Medizinischer Wochenschrift*, a book of abstracts of communications (if this had not been sent in advance), a history of the congresses, and travel folders about Switzerland and Zurich.

The Congress met without any formalities in the hall of the University on the evening of August 14. The president, Prof. W. R. Hess, opened the congress next morning in the 'Auditorium Maximum' of the Technische Hochschule. After welcoming the members of the Congress, he thanked Dr. K. J. Franklin and the Physiological Society of Great Britain and Ireland for making it possible to distribute the "Short History of the International Congresses of Physiologists" to all those present, and said that he thought that this would be of great value in fixing the tradition of these congresses (cf. NATURE, July 30, p. 222). This year marked the truly physiological hemicentenary of the first Congress, which was conceived in 1888 and met a year later, and the president expressed the gratitude of those present to the founders. Five survivors of the first congress were present, and telegrams of greetings and gratitude were approved by the meeting and dispatched forthwith to others who could not come. The meeting stood in silence to express its sorrow for the loss of those physiologists who had died in recent years, with particular mention of Pavlov, Johansson, Fredericq, Haldane, Cremer, Macleod and Abel. The president hoped that the present Congress would be worthy of the high ideals of its early predecessors.

The rector of the University of Zurich, Prof. E. Howald, welcomed the Congress in German on behalf of all the seven Swiss universities, and added that he was happy to be able to say that, in this particular matter, the universities were unanimous. The Congress was also welcomed in two other official Swiss languages—French and Italian.

Prof. L. Lapicque spoke in honour of the jubilee as a member of the first Congress. He was glad to see so many young people carrying on the work of physiology, and happy to think that once this work had been published and distributed to the libraries of the world it would live, although more concrete things might be destroyed. Since the last congress, the political situation had become less stable, and the Congress was fortunate in meeting in a country that was famous for its international atmosphere.

Sir Henry Dale spoke on behalf of all in English, which experience had taught him to be one of the unofficial languages of Switzerland. He thanked the president, and those others who had spoken in welcome. He thanked Prof. E. Rothlin, and those others who had organized the Congress. They had done much to re-establish the early traditions of friendly informality described by Dr. Franklin. Physiological congresses should not be associated with formal official receptions, and members should represent nothing but devotion to physiology and friendship for other physiologists. Switzerland had been proposed as a place for the first Congress because it was central, hospitable and attractive. The sixteenth Congress was glad to be able to meet in Switzerland not only for these reasons, but also because of the great scientific achievements of Swiss physiologists.

The scientific meetings started on Monday afternoon, and continued each morning and afternoon until Friday, with a break on Wednesday afternoon, which was devoted to an expedition on the Zurichsee to Rapperswil. Meetings were held simultaneously in five large lecture rooms in the Technische Hochschule, which is extraordinarily well adapted for the holding of congresses. The afternoons were mostly devoted to arranged discussions on chosen subjects—an innovation which was generally considered a great success. Each discussion was opened by two chosen speakers, and an abstract of their contributions was circulated some weeks in advance. They were followed by other speakers, most of whose contributions were also abstracted in a second volume circulated just before the Congress. At intervals the discussion became general, and arrangements were made by which it was possible for the chairman to invite particularly obstinate disputants to withdraw to another room so that the meeting might continue. There were also in the original programme about 330 individual communications, summaries of most of which were contained in the second volume of abstracts. These were grouped according to subject, and the discussions which arose were sometimes as interesting as the arranged discussions, and were continued in neighbouring cafés or in the *Studentenheim*, where meals were provided for the members of the Congress.

There were about fifty demonstrations, half of which were permanently on view, and the other half were each shown twice. The programme also contained twenty-seven films, some of them coloured, which were each to be shown twice between 5 and 6.15 p.m. on different days.

It is difficult to give an account of the scientific results announced at such a congress. The book of abstracts gives an interesting cross-section of the physiological thought of the day, but it takes some time to read it all, and there are probably few who could criticize it all. Papers which sound very good in abstract often sound less good when they have been criticized in the meetings. No one person could attend more than about a fifth of the meetings, and it is difficult even to be certain which papers have actually been delivered. The following papers, however, deserve special mention for various reasons.

Prof. W. R. Hess demonstrated ingenious and interesting methods for stimulating or destroying subcortical areas of the brain and observing the results. H. Theorell advanced a formula for the prosthetic group in cytochrome *c*. V. Menkin described the isolation from inflammatory exudates of a crystalline polypeptide 'leukotaxine', which increases permeability and attracts leucocytes. W. Feldberg and C. H. Kellaway presented evidence that the response of cells to injury is partly due to the liberation of lysocithin R J Williams described the isolation and properties of pantothenic acid—a universal growth stimulant present in all cells J F Toennies presented evidence that sensory stimulation may evoke a reflex which leads to the appearance of antidromic impulses in dorsal spinal roots A v Muralt demonstrated an apparatus which plunges nerve trunks into liquid air while impulses are actually passing, so that various evanescent effects of the impulses can be detected F Schutz demonstrated an apparatus for studying adsorption on foam, which may be useful in separating substances of physiological importance J S Fruton described the results of the study of the action of various proteinases on simple peptides, which show that they may act specifically on the link between one particular pair of amino acids A C Ivy demonstrated the masculinization of female rat embryos by the injection of male hormone into the mother during pregnancy and also the reverse effect on male embryos Another demonstration showed the same effect as the result of the injection of the embryos themselves by laparotomy E H Venning and J S L Browne described the results of a study of the physiology of progesterone by estimating its excretion product in the urine R D Wright and H W Florey described interesting experiments on the secretion of the colon L A Maynard, C M McCay and G Sperling demonstrated experiments in which rats lived longer than normal rats and retained their youthful appearance, when they were fed on a diet which was deficient in calories, but otherwise complete

The most popular discussions were on urinary excretion, the chemical transmission of nervous impulses steroids, the adrenal cortex and the hypophysis It was unfortunate that the last two of these discussions were held simultaneously

The pharmacologists held a special meeting at which they discussed the scope and future of their science Sir Henry Dale accused them of not taking an active interest in the important new remedies which are being introduced so rapidly, and of leaving the practical application of hormones, vitamins and chemotherapeutic agents to physiologists, biochemists and pathologists, who often have no medical training Various speakers replied that pharmacological teaching does in fact keep up to date, and that pharmacological research is more likely to be fruitful if pharmacologists are allowed to study what interests them, than if they are diverted to the study of the practical applications of the work of others Pharmacology has been handicapped because it has been regarded as a handmaid of medicine Its proper scope includes not only the study of the scientific basis of therapeutics, but also more general problems of how drugs act methods of assay and standardization, the absorption and fate of drugs, factors determining the intensity of their action and their toxic effects not only on man but also on other forms of life such as insects weeds worms protozoa, and bacteria The pharmacologist must know something of many sciences, but diversity of interests has been stimulating in the past and is likely to be so in the future

On Thursday evening the members of the Congress were divided into groups with common interests, and entertained to dinner in various parts of Zurich Interesting speeches of welcome and of gratitude were made and there were various other postprandial entertainments

The final meeting was held on Friday afternoon Prof A V Hill presented the report of the permanent International Committee Prof L A Orbeli was elected to succeed Pavlov on this committee and there was some general discussion of procedure Sir Henry Dale on behalf of the Physiological Society, invited the Congress to meet in England in 1941 and this invitation was accepted Prof Houssay put forward an invitation to Buenos Aires in 1944 which was received with enthusiasm

The Swiss committee is to be warmly congratulated on the arrangements for this Congress, which were simple and worked smoothly and without delay Membership was limited to genuine physiologists approved as such by national committees, so that the temporary physiologists who have attended some recent congresses were excluded, but this arrangement is unfortunately open to abuse since it makes it possible for genuine physiologists to be excluded for political reasons About 1 100 members registered, and they were officially accompanied by 260 other persons There were no Russians, but most other nations were well represented A number of Spaniards, including Prof Negrin, were able to come

J H Gaddum

Twelfth International Horticultural Congress

THE formal opening of the Twelfth International Horticultural Congress took place at 11 a m on August 12 in the Plenary Hall of the Congress Building (Kroll Opera House), Berlin, when the president, Herr R Walther Darré, Reich Minister for Food and Agriculture and Reich Peasant Leader gave a speech of warm welcome to all members, who represented about fifty nations Addresses were also delivered by Herr Johannes Boettner, managing president, Prof F Angelini, first vice president of the Congress, and Dr J J L van Rijn, vice president of the International Institute for Agriculture, Rome The British delegation was headed by Dr H V Taylor, of the Ministry of Agriculture, and included Sir Arthur Hill, Sir Frank Stockdale, Colonel F R Durham, R G Hatton (East Malling), F J Chittenden and Dr M A H Tincker (Wisley)

In view of the numerous and varied horticultural problems to be discussed during the week, twenty sections were set up embracing all branches of horticulture, such as growing of fruits and vegetables, nurseries, nomenclature, park and garden planning, education, physiology, etc As it was quite impossible to attend all the sectional meetings, the present account cannot claim to be complete, and mention can be made only of the few sections visited In the Section of Education great interest was shown in the international exchange of young gardeners. M Tubart outlined the existing position and made proposals for the further extension of the system In the general discussion that followed, Sir Arthur Hill gave an account of the system of exchanges in operation at Kew The first exchange was with Italy fifteen years ago and exchanges have since been made with Germany, France Belgium, Holland Denmark Norway Sweden United States Canada South Africa Australia and New Zealand

In the Section of Nomenclature under the chairmanship of Dozent A Thorsrud of Norway it was obvious that there was a real desire to arrive at practical rules for the horticulturists and there seemed to be very general agreement Unlike the proceedings at the International Botanical Congresses however the voting on the nomenclature proposals is restricted to the members of the Permanent Committee in closed session There was a very general feeling that some standard list of names of horticultural plants should be published and Miss M I Green (Kew) gave an account of the work of the Special Committee on the Correct Names of Economic Plants (including Horticultural Plants), appointed at the International Botanical Congress Amsterdam 1935 This Committee will publish a list of the correct names of economic plants in accordance with the International Rules which list will remain in force for ten years even if any of those names are in the meantime found to be not in accordance with the Rules This will be an important factor in stabilising plant nomenclature

On Monday August 15 Colonel F R Durham secretary of the Royal Horticultural Society gave a special report on the object and purpose of exhibitions and trials of new varieties in regard to the advancement of horticultural breeding and showed what a stimulating effect exhibitions and trials upon plant breeding have on modern horticulture

In addition to the more serious work of the Congress, a very varied programme of excursions and entertainments was arranged and, as the large attendances showed was much appreciated by the members Visits were paid to various biological institutions such as the Reich Biological Institute for Agriculture and Forestry the Experiment and Research Institute for Horticulture and the Botanic Garden Dahlem Botanists attending the Congress were very glad to have the pleasure of renewing their associations with the Dahlem Herbarium and Gardens where they were given a hearty welcome by the director Prof L Diels and his staff Many motor coach trips were arranged and visits were paid to well known nurseries such as that of Herr L Späth at Retzin and of Herr K Forster at Bornim

An item of feature of special interest was the exhibition entitled 500 years of German Gardening organized by the Reich Ministry of Food and Agriculture This was held in the Prussian State Library and illustrated the history of German garden flowers fruits and vegetables and the development of the style of German gardens from 1400 to 1900 Interesting illustrations from ancient books manuscripts and prints were on view also drawings engravings and oil paintings The whole exhibit was extremely well planned and repaid careful study

No account of the Congress would be complete without a word of admiration for the decorations at the Congress Buildings—there was a wealth of beautiful flowers to be seen everywhere The names of the various halls were indications of the decorations within such as the Tropical Hall the Rose Hall the Larkspur Hall and the Fruit Hall The thanks and congratulations of all members are due to the organizers of this very successful congress

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Institution of Gas Engineers

THE seventy fifth annual meeting of the Institution of Gas Engineers was held in London on May 31–June 3 when Sir David Milne Watson received the Birmingham Medal in recognition of his encouragement of research bearing on the manufacture and utilization of gas* In his presidential address Mr H C Smith of Tottenham stated that the gas industry is under statutory obligation subject to penalties to supply gas of declared calorific value prescribed purity and minimum pressure, whereas those who sell its raw material—coal—are encouraged by statute to raise the price of coal without any obligation as to its quality He said that more than one million tons of useless material which might have been removed from the coal at the collieries had in 1937 been delivered to the gas works to the detriment of both the carbonizer and the user of coke He suggested that legislation concerning the coal industry should not stop at machinery for raising prices, but should impose obligations to supply coal of prescribed and regular quality

Mr E V Evans discussing the processing of coal said that the gas industry might be at the start of a new and greater era The industry carbonizes coal primarily for the production of gas, and the by products—especially coke—are subsidized at the expense of the gas For this reason together with legal restrictions the gas must be sold at prices which make it a luxury fuel Before it can take its place as a staple fuel gas must be freed from this burden, as is the case where it is a by product of the manufacture of metallurgical coke The ideal it has long been recognized would be to convert coal into a gaseous fuel of high calorific value Experience where natural gas and cheap coke oven gas are available shows that the advantages of such a fuel lead to an enormous expansion in its use During the last three years the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds has been examining the gasification of coal under pressure It has been established that coal can be hydrogenated to yield gas and some liquid fuel without combustible residue under quite moderate pressures such as are current in steam boiler practice The results leave no doubt that the complete gasification of the ash free coal to form a high grade gas is technically feasible and it remains to establish its economic future

A paper by Dr F J Eaton on the uses of coke revealed the rapid expansion in the consumption of gas coke since scientific study had shown what merits were to be found in this somewhat neglected smokeless fuel and how they could be turned to advantage

H J H

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* Institution of Gas Engineers 75th Annual General Meeting, London 31st May to 3rd June 1938 No 177 Official Programme Pp 16 No 178 Annual Reports and Accounts of the Council of the Institution of Gas Engineers Pp 44 No 179 Presidential Address By H C Smith, Pp 24 No 180 Considerations upon the Processing of Coal By E V Evans Pp 40 (Institution of Gas Engineers) 2s

Royal Photographic Society's Annual Exhibition

THE eighty third annual exhibition of the Royal Photographic Society at 35 Russell Square, London, will remain open until October 8

Several photographs are shown of the tracks formed by elementary particles ejected by disrupting atoms embedded in the emulsion The spacing of the grains in a track is characteristic of the particle and its energy Among the examples shown are the tracks of α particles ejected by cosmic rays and neutrons the α particles from thorium C and tracks due to protons and deuterons Another interesting photograph shows the identification of the radioactive isotope of samarium from the direct deposits of the isotopes by a mass spectrograph on the photographic emulsion Short tracks are to be seen under the isotope of mass 148

The recent theory of latent image formation by Gurney and Mott is illustrated by a series of diagrams representing the electronic and ionic processes involved Of particular interest is the photograph showing the destruction by red light of the unformed latent image at low temperatures, thus demonstrating the existence of trapped electrons

A series of ripple tank photographs illustrates the diffraction and interference effects of waves and some direct photographs of optical interference fringes are designed to show the variation of fringe width with colour Two photographs demonstrate a method of estimating the amount of odoriferous vapour given off by a flower by comparing its action with that of camphor vapour on the appearance of a talc covered pool of mercury as a monomolecular layer of the vapour forms on its surface

One of the most interesting exhibits is a 15 ft solar spectrum taken on Kodachrome film at the Mount Wilson Observatory Other astronomical exhibits include photographs of the sun s corona and prominences taken during the total eclipse of June 8, 1937 A number of very fine cloud photographs show the formation of thunderclouds and the appearance of a line squall

The use of photography in aerial survey is illustrated by photographs taken with a nine lens air camera which covers up to 300 square miles at one exposure Another aerial photograph shows the presence of archæological remains by faint markings in the soil which may be quite indistinguishable to an observer on the ground Some high speed photographs are on view one of a revolver firing taken at an exposure of two millionths of a second

A series of twenty two wedge spectrograms exhibited by Ilford Limited show that it is possible to sensitize emulsions in any selected region over a considerable range of the spectrum Kodak Limited have an interesting exhibit showing the image of a spectrum on Kodachrome film at each stage of the processing Another exhibit shows the technical basis of the Kodak wash off relief colour printing process

The exhibition also includes a number of photomicrographs of biological botanical and metallurgical subjects and others demonstrating the value of photomicrography in the detection of forgeries and other criminal investigations The radiographs cover a wide range of subject types but there is an unfortunate lack of technical data New photographic apparatus is on view in various parts of the exhibition

Decapod Larvæ of the Great Barrier Reef*

DR GURNEY describes some very interesting larvæ in his latest work The life histories of the Palæmonidæ are little known except for certain members of the Palæmoninæ, and a large series of larvæ from the Great Barrier Reef together with material from Ghardaqa on the Red Sea and from the Discovery Expedition has enabled the author to make a decided increase in our knowledge of the group, which is a difficult one

Among the Palæmonids are specimens belonging to Ortmann s larval genus *Retrocaris*, of very large size and the study of these leads to the conclusion that the larvæ of the *Retrocaris* group belong to the genus *Palaemon* or the closely related *Brachycarpus*, which, although the adults inhabit fresh water, may in certain species migrate to the sea to liberate their larvæ A summary is given of the characters of the last larvæ of *Leander* (excluding *L tenuicornis*, which differs conspicuously and should possibly be placed in a separate genus) and of *Retrocaris* (*Palaemon* or *Brachycarpus*) The larval Pontoniinæ in the collections belong to two groups, one of which, the Periclimenes group, is easily defined and a fair amount is known about them It is exceedingly interesting however, that the larvæ of *Periclimenes diversipes* and *Harpilius gerlachei* indicate quite a different generic grouping of the adults from that which is adopted by Kemp A study of the adults apparently bears this out *P diversipes* differing from *Periclimenes grandis* *P agag* and *P americanus* in almost every appendage and resembling *Harpilius* or *Coralliocaris* Larvæ of the Mesocaris group of the Pontoniinæ are much more difficult to classify The new name *Cryptoleander* has been coined for a third group including three peculiar larvæ *Anchistoides* also has very distinct features, and the late larvæ almost certainly belonging to this genus are most striking It is suggested that it should not be placed in the Pontoniinæ but in a distinct sub family

The Alpheidæ show as a rule great uniformity of structure in the larvæ, several of which are described Their main interest lies in the apparently close relationship with the Palæmonidæ Hitherto there has been a tendency to regard this family as more nearly related to the Hippolytidæ, but the discussion at the end of this paper shows that the Alpheid and Palæmonid larvæ agree in many characters, well shown in the present material The fact that a species of *Coralliocaris* was found which snapped its claws like an Alpheid is significant

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* The Larvæ of the Decapod Crustacea Palæmonidæ and Alpheidæ By Dr Robert Gurney (Great Barrier Reef Expedition 1928 29 Scientific Reports 6 No 1) (London British Museum (Natural History) 1938)

Science News a Century Ago

London and Birmingham Railway

THE most important event in railway history in 1838 was the opening on September 17, 1838, of the whole length of line, 112½ miles long, from London to Birmingham. Parts of the line had been in use for some time, but at 7 a m on that day a train left Euston carrying the directors, the principal engineers and a few friends, Robert Stephenson, the engineer-in-chief, being in charge of the locomotive. The new portion opened on September 17 was that between Denbigh Hall and Rugby, on which is situated the Kilsby Tunnel, 2,400 yards long, which had proved most difficult to construct. Describing the opening, a correspondent of *The Times* said, "Taking this line of road as a whole, it is one of the most stupendous undertakings of modern times, and will ultimately lead to results of which it is difficult to foretell the extent"

J. D. Forbes and His Students

FORBES, when professor of natural philosophy at Edinburgh, had among his students during the session 1836–37, "Batten, Cleghorn, J Anderson, J Rankine, Harrison—the pleasantest I ever had, much occupied with experiments on radiant heat" He kept in touch with some of these and writing on September 17, 1838, to J T Harrison, who became a civil engineer under Brunel, he said . "There has been a considerable break up, of course, among your associates in the Nat Phil Class. Still, however, I have kept my eye pretty well upon those with whom you were more particularly associated and the Physico-Mathematical Society prospered last winter remarkably well . . .

"I shall be glad to hear, though I scarcely expect it, that you have not in the midst of your professional pursuits entirely lost sight of the general scientific principles which form its surest foundation I do not doubt your good-will or the clearness of your views of what befits a liberal and enlightened prosecution of your profession That I am sure you will never do ; but I rather fear that the very success to which your talents and application so well entitle you, may have already forced you to travel upon the narrow railroad of everyday applications. . . ."

The Duke of Sussex and the Royal Society

IN 1830 Prince Frederick Augustus, Duke of Sussex (1773–1843), had accepted the presidency of the Royal Society. He took office just after Babbage had published his "Reflections on the Decline of Science in England" and Sir James South had written his "Charges against the President and Council of the Royal Society" The Duke was elected by 119 votes as against 111 cast for Sir John Herschel. He held office for eight years, and when he decided to resign he wrote a letter to the Council which was published in the *Athenæum* for September 22, 1838 In the course of this letter he said : "I hope and most fervently pray that the Royal Society may long continue to prosper and flourish, but for this purpose, Gentlemen, you must avoid all matters which are of a tendency to create angry feelings, or heart burnings, on questions of a religious or a political nature. They have nothing to do with science but to create difficulties and impede philosophical researches. From these let me conjure you most cautiously to abstain."

Societies and Academies

Paris

Academy of Sciences (*C R*, 207, 197 264, July 18, 1938)

E BOREL The game *pari mutuel*. A study from the point of view of probabilities

L. CAYEUX · Existence of a coarse calcareous sand at the base of the Senonian phosphatic chalk of Picardy.

J DE LAPPARENT and R HOCART Mineralogical nature of the aluminium hydroxides in the bauxite of French West Africa

H DELANGE : Series of polynomials of which the zeros have a regular distribution

F GANTMACHER . Canonical representation of isomorphic substitutions of a semi-simple complex Lie group

A DENJOY · Convergence of trigonometric series

L CHADENSON . A completely relativistic wave mechanics

L AUGER Tuning reed pipes considered as a phenomenon of relaxation

E BADAREU and L CONSTANTINESCO The explosive potential in benzene vapour

MME I MIHUL and C MIHUL Mixed reflection in media with variable optical indexes ; application to the ionosphere

M DÉRIBÉRÉ Highly persistent fluorescence in a group of natural limestones

E CANALS and P. PEYROT . Raman spectra of crystalline powders · hydrates

J THIBAUD and P COMPARAT Distribution of resonance levels during the excitation of nitrogen by fast neutrons

P. AUGER and R. MAZE Large atmospheric cosmic ray showers. Particles with a maximum range of 15 cm of lead were detected

B PONTECORVO . Order of magnitude of the probabilities of radiative transition in the nucleus.

W BRONIEWSKI, S JELNICKI and M SKWARA Solidification diagram of copper-aluminium alloys

G. CHAUDRON, A PORTEVIN and L MOREAU Some consequences of the process of degassing metals at ordinary temperature

A. CHRETIEN and J BISCH : Active aluminium obtained by igneous electrolysis A mixture of aluminium bromide and potassium bromide under pressure at 500°, using aluminium as anode and mercury as cathode, yields an active form of aluminium at the cathode

P GRAMMATICAKIS Action of organomagnesium mixtures on the *N*-acyl-*N'*-phenyl-hydrazines.

R JACQUEMAIN and MLLE. G DEVILLERS : Some propanetriol aminobenzoic ethers

L MARTINEAU and J WIEMANN Isolation of an intermediate product in the catalytic isomerization of dipropenylglycol

P MARIE and A. MILLARDET The microscopic fauna of the sediments of the Cape Breton deep.

T. SOLACOLU, D CONSTANTINESCO and MME M CONSTANTINESCO . Anatomical and cytological study [in *Vicia Faba* L] of the modifications produced and by a mixture of an organo-formative substance and colchicine. While colchicine produces nuclear effects only, a mixture of colchicine and β-indolyl-propionic acid produces tumours showing an upper zone with colchicine effects and a lower zone with exaggerated development of meristem.

Mme L Lavier George Floral anomalies of *Laburnum vulgare* Griseb

R G Werner Bryology and phytogeography

Mme S Belluc, J Chaussin, H Laugier and **Mme T Ranson** Study of the influence of wine on the elimination of urine

J Roche, Mlle A Filippi and **M Mourgue** General reactions of the skeleton following fracture of a bone All bones of the skeleton show a big increase of phosphatasic activity after fracture of any one of them

R Dulsicouet and **R Herlin** Experimental researches on the bacterial membrane which develops on the paints of ships' bottoms its role in corrosion

R Hirsch Therapeutic results obtained by the slow intravenous injection of acidified physiological sera (pH 4 5–5) Such sera are powerfully analgesic and also anti hæmorrhagic

M Langeron Anopheles of the Grand Atlas and of the Moroccan Anti Atlas

Rome

National Academy of the Lincei (*Atti* 27, 37–144, 1938)

E Bompiani Anholonomous varieties Some general theorems (1) The $V_2{}^2$ varieties of the projective element S_2 (2)

F Severi Concerning the theory of equivalent series on reducible curves

O Scarpa and **C Rossi** Volta effect in solid metallic alloys (2)

C P Bogdan Concerning a class of V_2 varieties which admit of an infinity of quasi asymptotic surfaces depending on an arbitrary function

N Cartoviich Effective calculation of the period of perturbed motion in a typical case of first approximation

G Gherardelli An observation on equivalent series on a reducible algebraic curve

I Popa Observations on the parabolic line of a surface

G Colonnetti The second principle of reciprocity and its applications to the calculation of permanent deformations (1)

L Sona Some rigid configurations of vortex filaments perpendicular to one plane (1)

O Zanaboni Relations between internal action and deformations in envelopes with double curvature

P Guareschi (1) Compressibility coefficient of solids (2) Coefficient of thermal conductivity of gases

G Giacomello : Structure of choleic acids determined by means of Patterson's analysis

R Signorini The fold of the Lagoni and Libro Aperto mountains in the Modenese Apennines

P Principi The origin of some white earths from the Valle del Nestore (Umbria)

G Negodi Cariology of the genera *Aposeris* and *Hyoseris* (Compositæ Cichorieæ tribus Cichoriinæ)

A Corradetti Some phases of the schizogonic cycle of *Plasmodium gallinaceum* and of *Plasmodium cathemerium*

E Fulchignoni Reflex experimental epilepsy excited by light stimuli

G Martino and **E Fulchignoni** Phenomenon of facilitation in reflex epilepsy caused by occipital strychninization under the action of conditioned light stimuli

V Zagami Action of the vagi in the metabolism of glycides (1) Behaviour of hepatic, cardiac and muscular glycogen following bilateral vagotomy in pigeons

Forthcoming Events

International Federation for Documentation, September 21–26 —Fourteenth Conference, to be held at Lady Margaret Hall, Oxford (Sept 21–25) and Science Museum, London, S W 7 (Sept 26)

September 21 —Sir William Bragg, F R S The Historical Papers at the Royal Institution (Presidential Address)

Association of Special Libraries and Information Bureaux September 23–26 – Fifteenth Annual Conference to be held at Lady Margaret Hall, Oxford Joint sessions with the International Federation for Documentation on September 24 and 25

Sir William Beveridge The Use of Books in Social Science ' (Presidential Address)

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Junior Scientific Officer (Physicist) at the Fuel Research Station, East Greenwich—The Establishment Officer Department of Scientific and Industrial Research 16 Old Queen Street Westminster London S W 1 by postcard quoting J 38/11 (September 20)

Lecturer in the **Department of Mechanical Engineering** lecturer in **Building and Allied Subjects** and lecturer in **Building Science** in the Central Technical College Suffolk Street Birmingham 1—The Principal (September 20)

Lecturer in Philosophy in the United College St Andrews—The Secretary and Registrar (September 24)

A **Field Officer** and an **Assistant Soil Analyst** under the Advisory Chemist Department of Agriculture University of Cambridge—The Secretary School of Agriculture Cambridge (September 24)

Assistant Engineer in the Punjab Service of Engineers Class II (Irrigation Branch)—The High Commissioner for India General Department India House Aldwych London W C 2 by postcard (September 26)

Lecturer in Chemistry in the Sir John Cass Technical Institute Jewry Street Aldgate London E C 3—The Principal (September 26)

A **Post (Aerial Gunnery)** in the Directorate of Armament Development Air Ministry Headquarters London—The Under Secretary of State Air Ministry (S 2 D) Adastral House Kingsway London W C 2 *quoting ref B* 94 (September 30)

Technical Officers (*B* 59 design development and manufacture of high explosive *B* 92 metals and stresses *B* 91 electrical and hydraulic engineering) at Air Ministry Headquarters London—The Under Secretary of State Air Ministry (S 2 D) Adastral House Kingsway London W C 2 quoting appropriate reference number (September 30)

Technical Officers (Aircraft *B* 70) and **Technical Officers (Engines** *B* 88) and **Assistants II** to these officers (*B* 89 and *B* 90) at Air Ministry Headquarters London—The Under Secretary of State Air Ministry (S 2 D) Adastral House Kingsway London W C 2 quoting appropriate reference (September 30)

Assistant Engineer for the Drainage and Irrigation Department Malaya (M/5765), and **Assistant Engineer** for the Malayan Public Works Service (M/5731)—The Crown Agents for the Colonies 4 Millbank London S W 1 quoting appropriate reference number

Civil Engineer for service with the Sudan Irrigation Department —The Controller Sudan Government London Office Wellington House Buckingham Gate London S W 1 envelope marked Engineer

Reports and other Publications

(*not included in the monthly Books Supplement*)

Other Countries

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No 190 Watermelon Anthracnose By Dr Amin Fikry Pp ii+21+10 plates (Cairo Government Press) P T 4 [298

Indian Forest Records (New Series) Silviculture Vol 3 No 1 An Investigation into the Best Root Length of Stump to use when Stump Planting Teak (*Tectona grandis*) in Areas having a General West Coast Type of Climate By A L Griffith Pp ii+16 (Delhi Manager of Publications) 8 annas 10*d* [298

Imperial College of Tropical Agriculture Seventh Annual Report on Cacao Research 1937 Pp 51 (Trinidad Government Printing Office) 5*s* [308

U S Department of the Interior Office of Education Bulletin, 1937 No 19 CCC Camp Education Guidance and Recreational Phases By Howard W Oxley (Project in Research in Universities) Pp vi+23 (Washington D C Government Printing Office) 10 cents [19

Proceedings of the United States National Museum Vol 85, No 3039 The Cuban Operculate Land Shells of the Subfamily Chondropominae By Carlos de la Torre and Paul Bartsch. Pp 193–423+plates 7–39 (Washington D C Government Printing Office) [19

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Vol. 142 SATURDAY, SEPTEMBER 24, 1938 No. 3595

Progress in the Gas Industry

THE majority of our large industries can claim to-day to be well managed. Two major depressions since the Great War and the need of continuous adjustment to changing world conditions, including the altered views towards labour at home, have provided a stimulus to which even the most conventional and conservative have been forced to react. The more successful industries are those which have favoured research both into new processes and to bettering existing practice. In the steel industry, for example, every time a new plant is erected—and there have been several in recent years—it represents all the most modern views with the addition generally of something new, peculiar to the particular plant. If successful, this novelty is copied in the next plant, though others in the industry can only benefit when the next new plant is built. Such an industry must bear a very high rate of depreciation if it is to replace its plant at reasonable intervals, and it has to solve some very difficult financial problems. In certain industries the amount of capital locked up in a particular type of plant is large, so that a new development which involves the scrapping of this plant whilst it is still in first-class condition is looked at askance.

Whilst it is the prime duty of management to carry on a business as it exists, seeking any and every way of increasing efficiency in all departments, nothing is lost by occasionally reviewing the possibilities in quite other directions than what is normal practice. Whilst competition should be enough to keep industrial firms alert, the great public utilities might conceivably stagnate without the pressure of public opinion.

Probably the most discussed event of the year in the gas industry is a paper by Mr. E. V. Evans, who is chairman of the Research Executive Committee of the Institution of Gas Engineers, in which views are advanced regarding the processing of coal which involve a great departure from existing practice. Inasmuch as coal is both the chief raw material and main source of political and social controversy in Great Britain, whilst each one of us is concerned in the problems of cooking and heating, it is of interest to enlarge a little on this subject.

Two large industries carbonize coal—the gas industry, which makes gas the prime and coke a subsidiary product and also undertakes the supply of gas to every room in every house, and the coke oven industry, which makes coke for the metallurgical industries and sells gas as a by-product when possible.

The Area Gas Supply Committee under the chairmanship of Sir Alexander Walker advocated in 1930 that by means of a system of ring mains this oven gas should be collected from the coke ovens and distributed by the gas companies. The city of Sheffield has adopted this practice with success, though more recently both the Lords and the Commons have given an attentive ear to the opposition of vested interests to a proposed scheme elsewhere in Yorkshire promoted by the gas companies. This incident is both regrettable and short-sighted; it is imperative, to conserve our national resources of coal, that all gas produced at coke ovens or oil refiners should be distributed through the mains of gas companies. In the United States there are many thousands of miles of pipe line serving this purpose.

The purpose of a gas company is to supply gas, and its capital and expenditure is almost entirely devoted to this. The sale of the by-product brought in a casual income which has been supplemented and made more regular since the industry has turned to perfecting at considerable cost the quality of coke both in regard to size moisture and ash content and burning qualities In addition the apparatus in which coke is used has been perfected so that the public is getting to use and to rely on it more and more causing a demand for it in the colder months which roughly balances the production by the gas industry

Mr Evans has drawn up an illuminating balance sheet on *a thermal basis* of the gas industry 300 therms are purchased in the form of coal for 25*s* that is 1 00*d* per therm by a works some distance from the collieries and a further 150*d* is spent on manufacturing costs exclusive of capital charges 72 therms are used during the process so that the cost per therm of the products is 450/228 = 1 97*d* per therm

There are three products namely 75 therms of gas 135 therms of coke 18 therms of tar The coke sells at the works at 1*d* per therm (a working loss of 0 97*d*) and the tar at 1 85*d* per therm a loss of 0 12*d* on each therm If these losses are computed per therm of gas they amount to 1 78*d* making a total manufacturing cost for gas of 3 75*d* per therm into the holder ready to be distributed If gas is to hold its own in the future it should be cheaper particularly if it is to serve—as it should—as a staple fuel and not a luxury commodity The industry in such circumstances will no longer be in a position to afford the continued production of coke the public with cheap gas as a staple fuel will not need coke as a complement Further if gas exclusively is used in a household for which purpose the existing supply mains are adequate the distribution costs will be decreased

This economic survey leads to the consideration of the technical problem of the complete gasification of coal The gas must be low in carbon monoxide and contain enough hydrocarbon gases to give it the calorific value and combustion properties which now characterize it A new process has to be invented and Mr Evans described the experimental work which has led to most hopeful results these are soon to be tested on a large scale in a specially designed plant They are based on the discovery that large yields of methane are obtained by the direct hydrogenation of coal under pressure as it is undergoing decomposition whilst its temperature is being raised from 550° to 800° C The production of the necessary hydrogen at a low cost is based on an earlier discovery by the Lurgi Company that coal gasified under pressure in the presence of steam and oxygen with a high proportion of the former yields a gas rich in hydrogen

The technical details need not concern us The picture is one of coal being charged into a vessel where it will be treated with hydrogen under pressure in such a manner that it will produce rich gas together with primary tar When rather more than half the weight of coal has gone, the rest is fed to a producer operating under pressure and supplied with oxygen and steam where it is gasified to produce hydrogen Such a works would be very much smaller than the modern gasworks purification being done by washing under pressure would be simple and there would be other advantages It would however be entirely different from the gasworks of to day

The gas industry has enterprise and public spirit enough to carry through the experiment it will take time and treasure If it succeeds the day will be nearer when all our heat is on tap the streets free from carts delivering coal and coke the skies free from smoke and our houses cleaner and more convenient

Oxford Essays on Evolution

Evolution
Essays on Aspects of Evolutionary Biology presented to Prof E S Goodrich on his Seventieth Birthday Edited by G R de Beer Pp viii + 352 (Oxford Clarendon Press London Oxford University Press 1938) 15*s* net

FOR close on half a century Prof E S Goodrich has been engaged in zoological research and teaching in the University of Oxford On the recent occasion of his seventieth birthday a congratulatory volume prepared by a number of his colleagues and pupils was presented to him Instead of following the usual method of such *Festschriften* and allowing the contributors to write on any subject they might choose, the editor, Dr G R de Beer, decided to prepare a planned volume on the more important aspects of modern knowledge concerning evolution He secured the collaboration of twenty authors each of whom has dealt with the particular branch of the subject to which he has given special attention The result is a work which has value as a summary of existing knowledge and current opinion quite apart from the circumstances that led to its publication At the same time the very completeness of the survey bears witness to the vitality and catholicity of the Oxford school of zoology while the fact that so many of the authors find occasion to quote from the writings of Prof Goodrich himself is evidence of the many sided inspiration which that school has received from him

It is not possible here to comment on more than one or two of the nineteen essays contained in the volume although all of them merit the attention of every biologist The veteran Sir Edward Poulton contributes in the first essay a vigorous restatement of the Darwinian (or rather Batesian) explanation of insect mimicry a restatement that will perhaps find a more ready hearing than it might have found say twenty five years ago Dr Julian Huxley discusses the present standing of the theory of sexual selection and concludes that the hypothesis of female choice and of selection between rival males is inapplicable to the great majority of display characters

Mr E B Ford and Prof J B S Haldane both write as geneticists the former on the genetic basis of adaptation and the latter on the nature of inter specific differences One gets the impression that the chasm which until a few years ago yawned between genetics and the other branches of biology is being spanned and if the bridge is not yet fit for heavy traffic the foundations of a permanent structure are becoming visible Dr G R de Beer in an essay on embryology and evolution is largely concerned with attempting to redefine the concept of homology in terms furnished by the results of experimental embryology and trying to find what truth may remain in the famous theory of recapitulation The latter theory also comes under consideration by Prof Garstang and Dr R Gurney in discussing the descent of Crustacea from trilobites Mr J Z Young discusses the evolution of the nervous system making some points of importance that will be new to most biologists Dr W K Spencer describes some primitive fossil echinoderms and makes some very interesting suggestions as to their probable habits but perhaps over estimates the capacity of non specialist readers to follow his descriptions Dr H A Baylis s chapter on helminths and evolution provides an excellent example of the way in which the detailed knowledge of the systematist can be brought to bear on some of the fundamental problems of biology

One complaint must be addressed to the editor The deplorable modern innovation of omitting the titles of papers from the lists of references makes these lists of singularly little use W T C

School Physics

(1) A School Physics Revision Notes and Questions
Hydrostatics Heat Light and Sound By S R Humby and F W Goddard Pp viii + 235 (London New York and Toronto Longmans Green and Co Ltd 1937) 3*s*

(2) Concise School Physics
Mechanics By R G Shackel Pp vii + 184 (London New York and Toronto Longmans Green and Co Ltd 1937) 2*s* 9*d*

(3) Electricity and Magnetism
By Dr R G Mitton (Dent s Modern Science Series) Pp x + 272 (London J M Dent and Sons Ltd 1937) 3*s* 6*d*

SCHOOL text books of science sometimes fall between two stools They should either be so fully written and so easily read that the pupil can learn his subject from them with the minimum of help from his teacher or they should be so strictly abridged that the teacher is not embarrassed when he tries to develop the work along his own lines Too often a beginner is only hampered by having a new subject presented to him in two different ways at the start Messrs Humby and Goddard and Mr Shackel have avoided this difficulty in their two books in which there are many points of resemblance for they offer the pupils a clear outline of their subjects supported by a great number of questions taken from examination papers of matriculation standard

(1) The authors of A School Physics state that their book is intended primarily for use as a final revision for students taking the various school certificate and matriculation examinations and for those beginning an advanced course in physics For this purpose it should prove very useful If we must have examinations we may as well use that incentive to the full A School Physics deals with hydrostatics heat light and sound but not with electricity

(2) Mr Shackel, in his book, confines himself to mechanics, but he includes hydrostatics, elasticity, surface tension, viscosity, diffusion and osmosis under this heading The writing is very condensed and the general method of treatment is to define and elucidate a principle, then to provide experimental verification and lastly to proceed to practical application Some of the experimental work which Mr Shackel mentions is novel and many of his applications are modern The frequent historical notes, which add to the attractiveness of the book for the adult, are perhaps too concise to make much appeal to the student, unless—as the author probably intended—they receive amplification from the teacher This book, like the one mentioned above, should prove an effective tool to use in preparing pupils for matriculation and kindred examinations, but—better than that—it provides a sound introduction to more advanced work in physics For students of average ability, it may prove difficult to follow, unless they get considerable help from their teachers The latter should find it very convenient to use with their classes

(3) Though Dr Mitton is concerned with the formal development of one branch of science, his method is to proceed from the practical aspects in order to elucidate principles Thus, in his preface, the author says Most students are interested in the practical applications of electricity, and it must be the aim of a text-book to develop this latent interest, as well as to present the fundamental principles of the subject in an attractive form" "For this reason," he goes on to say, "although the requirements of students preparing for School Certificate Examinations have been a primary consideration, the scope of this book has not been limited by a narrow interpretation of the requirements of any examination syllabus, but has been extended to include a short account of alternating currents, and of modern discoveries in electricity"

A perusal of the book certainly bears out his claims The treatment is sometimes rather didatic, but there is a unity and a coherence much more marked than usual in this type of work, and the numerical examples given in the text are often admirably chosen to help the argument When it is shown, for example, that to transmit electrical energy at 220 volts instead of 132,000 volts without increasing the loss would need a cable of more than 22 feet in diameter, the object of transformers is certainly brought home ! The chapters on static electricity make somewhat heavy reading, but the whole book strikes one as a sound, well planned piece of work, which is both attractive and stimulating

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The Study of Earthquakes

Theoretical and Applied Seismology
By Dr Akitune Imamura Pp xi + 358 (Tokyo Maruzen Co, Ltd, 1937) 7 yen

SINCE the early years of the present century, Prof Imamura has been widely known as one of the most active and capable of Japanese seismologists On the death of Prof Omori in 1923, he succeeded to offices held by him, his first duty being the investigation of the great Kwanto earthquake of that year He has also made valuable studies on the displacements of the crust in connexion with Japanese earthquakes In 1931, he retired from the professorship of seismology in the Imperial University of Tokyo, and the notes that he had collected for many courses of lectures form the foundation of the present volume

A noteworthy feature of the book is the number of references to the work of foreign seismologists Yet there are some curious omissions It is difficult to understand how, in a volume so largely devoted to the earthquakes of Japan, the achievements of Prof Milne in that country should never once be mentioned There are brief references to his catalogue of destructive earthquakes, to his well known seismograph and to the reports of the British Association Committee, but no one would gather from these pages that he was the founder of the Seismological Society of Japan, or the man whose work led up to the present organization of earthquake studies in that country Again, in the chapter on "some great earthquakes", the descriptions of the California earthquake of 1906 and the Messina earthquake of 1908 are both founded on preliminary reports of Prof Omori The detailed accounts of the former earthquake edited by Profs Lawson and Reid and of the latter written by Prof Baratta are not referred to

Serious as these omissions are, Prof Imamura's book is a valuable addition to our list of earthquake manuals Some of the sections dealing with Japanese earthquakes will be found of special interest to European readers, such as those on the displacements of the crust connected with great earthquakes, the Sanriku sea-waves of 1896, the distribution of the earthquakes with the catalogue of severe earthquakes since 1596, and the accounts of the great earthquakes of 1707, 1891, 1923 and 1927

In one important respect the book differs from its predecessors in the special attention devoted to the practical applications of seismology The final chapter on the mitigation of earthquake disasters deals with the selection of the site the construction of earthquake proof buildings and the measures to be taken if fires should break out ending with a section as useful as it is unusual on the behaviour of human beings during earthquakes The chapter on the effects of earthquakes on water closes with similar and equally practical advice on the mitigation of the disasters caused by earthquake sea waves

C D

Aluminium, Potassium and Magnesium

Gmelins Handbuch der anorganischen Chemie Achte vollig neu bearbeitete Auflage Herausgegeben von der deutschen chemischen Gesellschaft (Berlin Verlag Chemie G m b H 1937)
(1) System Nummer 35 Aluminium Teil A Lief 5 Legierungen von Aluminium mit Zink bis Uran Pp 683 886 + xvi 24 75 gold marks
(2) System Nummer 22 Kalium Lief 3 Verbindungen bis Kalium und Tellur Pp 515 804 35 25 gold marks
(3) and (4) System Nummer 27 Magnesium Teil A Lief 1 Vorkommen Darstellung des Metalls Pp 156 18 gold marks Teil A Lief 2 Eigenschaften des Metalls Pp 157 372 25 50 gold marks
(5) Magnesium Legierungen Patentsammlung Von A Grutzner unter Mitarbeit von G Apel und C Gotze Zugleich Anhang zu Magnesium Teil A in Gmelins Handbuch der anorganischen Chemie Pp vii + 192 15 gold marks

(1) THE systematic description of the alloys of aluminium is continued in the part of Gmelins Handbuch under notice A long range of metals including zinc mercury tin lead chromium tungsten and most of the rarer metals is covered and more than a hundred diagrams illustrate the variations in physical properties

Aluminium and zinc mix completely in the liquid condition but at room temperature a maximum solubility of 18 per cent of zinc is indicated by a marked discontinuity in the conductivity curve Solubility in caustic alkalis falls rapidly and in dilute acids rises as the proportion of zinc is increased both curves showing breaks at the concentration corresponding to the composition Al_2Zn_3 Aluminium dissolves very slightly in mercury amalgamation occurs at the boiling point of the latter and also in certain chemical reactions but the products in the latter case are never uniform The amalgam reacts easily with water and provides a convenient neutral reducing agent in organic reactions

Lanthanum and cerium show pronounced maxima at temperatures somewhat above 1400° C Tin and aluminium can be melted together and form an eutectic with 99 5 per cent of tin but in the solid state the mutual solubilities are extremely small and the alloys are readily corroded by water Lead mixes only to a very slight extent even in the liquid condition whilst the data about chromium are contradictory

(2) Compounds of potassium with bromine iodine sulphur selenium and tellurium are described in the second volume under notice Naturally the halides and sulphate receive most attention For exact work on the determination of equivalent weights pure potassium bromide has been prepared from bromine vapour and neutral potassium oxalate which react with liberation of carbon dioxide

The solubility of potassium iodide in different solvents has received much attention The diagram illustrating the solubility of the salt in liquid sulphur dioxide shows the existence of two compounds containing four and fourteen molecules respectively of sulphur dioxide combined with one of potassium iodide Several anhydrous polyhalides of potassium with either three or five halogen atoms per molecule have been isolated but polyiodides are unknown in the unsolvated condition Thus the tri iodide is combined with one molecule of water or two of benzonitrile A poly iodide of the composition $KI_9, 3C_6H_6$ has also been obtained

The complex system between potassium sulphate sulphuric acid and water is described in full detail Potassium sulphate behaves in a remarkable fashion with potassium fluoride since the compound which they form is only stable above 578° C Undoubted evidence of its existence is provided not only by the appearance of two eutectic points on the phase rule diagram but also by the strongly marked depression in the curve of specific conductivity

(3) and (4) In recent years magnesium has sprung into prominence on account of the importance of some of its alloys Although exact production figures are not yet available it has been estimated that the world s output of the metal has risen from about 300 tons in 1926 to many thousands of tons per annum, the demand having

increased suddenly about three years ago. Minerals containing magnesium were used by the ancient Greeks and Romans, but it was Black who first distinguished clearly between lime and magnesia in 1755 In 1808 Sir Humphry Davy obtained an amalgam but failed to isolate the metal. Twenty years later, Bussy reduced the fused chloride to the metallic state with the vapour of potassium, but Davy's original electrolytic method was successfully modified in 1852 by Bunsen In view of the astonishing increase in the industrial applications of the metal in recent years, it is perhaps surprising that this method has not only survived but also has practically eliminated other competitive processes. The chief difficulty to be overcome is the elimination of water from the fused chloride, since even traces of moisture cause hydrolysis and the formation of an insulating layer of oxide Hydrolysis is considerably lessened when potassium chloride is present, and sometimes carnallite is used. The addition of potassium chloride causes the metal to sink to the bottom in spite of its low density

Complete dehydration of magnesium chloride is, however, difficult and other industrial processes have been successfully operated. Thus the oxide can be reduced with carbon in the electric furnace and a modification of the Hall-Héroult electrolytic process for aluminium has been adapted for magnesium Magnesium is the lightest of all metals to withstand atmospheric corrosion, and moreover in the pure state it possesses very valuable mechanical properties. Numerous references are given to technical methods of manufacture and there is a very full description of its physical and chemical properties, including recent work on its atomic structure, isotopes and nuclear transformations under bombardment.

(5) An alphabetical register of all known alloys of magnesium, arranged on the lines of those already published for steels and aluminium alloys, with remarks on their principal uses and references to the patent literature of Germany, Great Britain, France, Austria, Switzerland and the United States from 1909 to the end of 1936, should prove invaluable to those engaged on research work in this technically important and rapidly expanding industry References to journals are excluded, since they are given in abundance in the text

Phenomena of Gaseous Discharges

Elektrische Gasentladungslampen
By Dr W. Uyterhoeven Unter Mitarbeit von Ing K W Hess Pp ix + 364 (Berlin Julius Springer, 1938) 36 40 gold marks

THE scope of this book is wider than its title suggests , this applies especially to the first two parts—the seven chapters dealing with electrons and atoms, and the general theory of discharges in gases

These seven chapters include, in only 140 pages, practically all the fundamental physical ideas from the kinetic theory of gases to the complete discussion of the positive column The literature up to about 1937 is considered In order to cover as much ground as possible in this comparatively small space, the discussion of individual processes has had to be somewhat condensed However, the non-specialized engineer will find the book provides quite a satisfactory account of the various problems, while the student reader who requires detailed solutions will obtain further information from the numerous papers which are cited at the end of the book and co-ordinated with the individual chapters In a future edition this part of the book could, perhaps, be extended, especially as attempts have recently been made to revise the theory of the positive column, which is of prime importance in gas discharge phenomena

Chapters viii and ix deal with light and vision, and contain a survey of colorimetry based on modern concepts, together with a short review of photometry and the efficiency of illuminants

The later half of the book is devoted to discharge lamps—neon and mercury high-pressure (1–10 atm) and super-high pressure (80–100 atm) Some of these chapters will be of permanent value in so far as they discuss the complicated physical *problems* connected with the operation of such discharges and the many practical problems of auxiliary gear The *solutions* may be looked at from a different angle in a few years time, and in addition development of the special lamp types is very rapid The majority of the types discussed are Continental and to a great extent are taken from those of the Company in whose laboratory Uyterhoeven has done important work on the development of the discharge lamp This slight bias is perhaps not unnatural, as the author must have had more information from his own Company than from others

Uyterhoeven's book can be recommended as an interesting survey of a technical field which may prove absorbing to many engineers. Some of the problems also suggest lines for further research.

Our Daily Bread·

a Geography of Production By Sir Daniel Hall Pp xi+169 (London John Murray 1938) 6s net

WE have travelled far since Mrs Mangnall s 'Historical and Miscellaneous Questions , first published in 1800, was widely used for initiating youth into an encyclopædic knowledge that ranged from the architecture of the universe to such lowly things as the nature and sources of hemp and ginger The seeming omniscience of the author no less than the illogical sequence of much of the subject matter, makes amusing reading to day and gives us some justification for pluming ourselves on progress since achieved Sir Daniel Hall s latest book written primarily for use in urban schools marks in a very striking manner the antithesis between the old and the new ways of imparting information In simple language and easy flowing style he relates all those facts about the sources of our daily foodstuffs that a developing adolescent ought to know and a slight discursiveness here and there, as well as many excellent pictures and a few maps adds interest to his narrative

In one respect however the book resembles Mangnall it is purely informative and therefore invites a criticism which the author seems to expect when he says Education consists in something more than handing out information but none the less it is a thin and colourless life that does not start with a basis of facts To the scientific mind a factual basis is a *sine qua non* of every mental discipline never theless for the very young fairy stories have much to commend them, and later on a trained imagination is essential for perceiving relationships between facts for trying to explain differences between related facts, and for drawing conclusions by putting two and two together We may therefore hope that the author will follow up this excellent introduction to the facts of agriculture with a more ambitious book that will not only inform the developing mind but also stimulate it to *think* *Primum pensare deinde vivere*

E H T

Surface and Radiological Anatomy

for Students and General Practitioners By Prof Arthur B Appleton Prof William J Hamilton and Dr Ivan C C Tchaperoff Pp xi+311 (Cambridge W Heffer and Sons, Ltd , 1938) 15s net

THE collaboration of two professors of anatomy with a radiologist has resulted in the production of a work which marks a new departure in the study of surface anatomy, and should be highly appreciated by the medical practitioner and student The work is divided into six parts, devoted respectively to the upper limb, chest and back, abdomen, head and neck, vertebral column and lower limb, preceded by an introduction containing an account of radiological technique There are three appendixes, containing tables of ossification, a summary of ossification and segmental innervation of muscles The radiological methods include œsophagoscopy, gastroscopy, cysto scopy, ventriculography and encephalography

The Subject Index to Periodicals, 1937

Pp xxix+292 (London The Library Association, 1938) 70s

THIS is the twenty second year of publication of the Subject Index to Periodicals prepared by the Library Association The Association and its general editor Mr T Rowland Powel are to be congratulated on the issue of the volume for 1937 only five months after the close of that year

This volume introduces a new and valuable feature in a Location List' which tells the reader where he may consult the periodical mentioned More than 170 libraries in the United Kingdom are mentioned in the list In this list the reader is told in which libraries each of the 584 periodicals indexed may be found There is of course no guarantee that the library in question would be prepared to lend its periodicals to borrowers Of the periodicals indexed 535 are English and American 27 French and Belgian 20 German and 2 Italian

The articles indexed are arranged under subject headings such as hygiene mine accidents microscope, photography The subject headings are arranged in alphabetical order and are chosen from the alpha betical subject headings of the Library of Congress U S A with modifications and additions to suit British practice Verse and fiction are not included

With some important exceptions, periodicals covered by the following publications are not indexed *Agricultural Index Engineering Abstracts Engineering Index Index Medicus Journal of the Society of Dyers and Colorists, Photographic Abstracts Revue de Géologie Royal Meteorological Society Bibliography Science Abstracts A and B Textile Institute Journal* There is no doubt that the Library Association is doing valuable work in preparing this annual index to the contents of periodicals

Diet and Cancer

an Experimental Study By Dr N Waterman Pp v+96 (Amsterdam D B Centen s Uitgevers Maatschappij 1938) 2 50 dollars

AS the result of his investigations at the Leeuwen hoek Cancer Research Institute, Amsterdam, Dr N Waterman while admitting that his results are neither complete nor definitive, maintains that the influence of different foodstuffs on a definite experimental form of cancer is incontestable His experiments, which were carried out on mice develop ing tar cancer, showed that of the classical foodstuffs (proteins carbohydrates and fats) only animal fats appeared to have a definite deleterious effect the malignancy of the process being increased to a marked degree As regards vitamins, increase of vitamin A intake had an undoubted, if not very marked mitigating effect on the course of tar carcinoma administration of vitamin B_1 did not have the un favourable effect in tar cancer which it had in inoculated tumours , and vitamin C delayed the formation of carcinoma and increased the duration of life

A Text-Book of Convergence

By W. L. Ferrar. Pp vii + 192. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 10*s*. 6*d* net.

IN this book, the theory of convergence is developed on two fundamental assumptions. The first of these is concerned with upper bounds, namely, that a certain set of numbers has in it a least number; while the second refers to irrational number as the limit of a sequence of rational numbers, namely, that every irrational number is the limit of a monotonic increasing sequence of rational numbers. With the aid of these assumptions, the theory of convergence is developed without recourse to the properties of Dedekind cuts. The 'real' number appears only in the appendix, where the assumptions used in the body of the work are proved to be consequences of the definition of real number. In the appendix also, the first of the above-mentioned assumptions appears as a theorem, and a proof of the second is given. In fact, the appendix contains as much of the foundations of analysis as is necessary to justify the assumptions made in the initial chapters of the book. A short historical survey prefacing an examination of these 'foundations' shows why such a complex structure as the Dedekind cut is essential to the definition of number.

The notation used throughout the work is one familiar to all analysts; but its use in a text-book is, as the author says, somewhat of an innovation. A great improvement on the majority of text-books is that the proofs do not teem with references to previous theorems. The references are given parenthetically if at all, and the student is advised to use them as sparingly as possible in following the proofs.

Organic Reagents for Metals and for Certain Acid Radicals

By the Staff of the Research Laboratory of Hopkin and Williams, Ltd. Third edition. Pp 156. (London: Hopkin and Williams, Ltd., 1938.) 2*s*.

THE first edition of this small work appeared in January 1933, it was reprinted in July of the same year, a second edition appeared in 1934, and now a third edition has become necessary.

About forty compounds are mentioned in the book; the systematic names (alphabetical order) are followed by trivial names, constitutional formulæ, molecular weight and salient properties. Concise directions are given for use in qualitative and quantitative work. The bibliographies for each compound are full and there is a good index. The book should be used in conjunction with "Modern Methods in Quantitative Chemical Analysis" by A. D. Mitchell and A. M. Ward.

The Conquest of Cholera:

America's Greatest Scourge. By Prof. J. S. Chambers. Pp. xv + 366 + 40 plates. (New York: The Macmillan Company, 1938.) 20*s* net.

THIS book, which is based on the study of contemporary medical literature and old newspaper files, contains a detailed and vivid account of the epidemics of cholera which devastated the United States in 1832, 1833, 1849, 1866 and 1873. In addition to the description of the epidemics, chapters are also devoted to the contributions to medical literature between the epidemics of 1833 and 1849, the work of Pasteur and the substitution of the germ theory for the miasmatic origin of disease. The text is liberally interspersed with portraits, maps and other illustrations, and a bibliography of sixty references is appended.

Weather Rambles

By Dr. W. J. Humphreys. Pp. iv + 265. (London: Baillière, Tindall and Cox, 1937.) 11*s* 6*d*.

IN the form of a series of chatty chapters, the author, whose larger books are well known to all students of meteorology, contrives to give a wealth of information concerning nearly all aspects of the weather in a simple form. The subjects discussed are much too varied to permit of summarizing in a few sentences. Starting with the tornado, or prairie twister, following on with the mysteries of the forms of solid condensation of water vapour and the problem of how the earth got its atmosphere, it ends with the problem of home-made weather, or the control of air conditions in enclosed spaces. This is no systematic text-book of meteorology, but contains a wealth of interesting information, all given in a clear and delightful style.

Climate:

a Treatise on the Principles of Weather and Climate. By W. G. Kendrew. Second edition. Pp. x + 328 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 15*s*. net.

THE new edition of Kendrew's book on climate gives an outline of the physical principles which underlie the variations of weather and climate. The effects of insolation, the relation of the distribution of pressure to wind systems, the formation of precipitation and of fog, the effect of elevation above sea-level on climatic factors, and a fairly detailed description of the weather of the temperate regions, form the most important features of the book.

This book is an interesting and valuable introduction to the study of climatology, and is so clearly written that it requires no special technical knowledge of the reader.

An Introduction to Weather and Climate

By Prof. Glenn T. Trewartha. (McGraw-Hill Series in Geography.) Pp. ix + 373 + 7 plates. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

THE first half of Prof. Trewartha's book is devoted to the physical bases of weather and climate. While this contains a considerable amount of information, it cannot be regarded as free from errors, and so is perhaps not the perfect introduction to the second part of the book, which deals with the classification of climates in accordance with a scheme which is a slight variant of the Köppen classification. The second part of the book is clearly written, and can be recommended as an introduction to the longer treatises on the subject.

The Orient and Europe[*]

By Prof V Gordon Childe

TEN years of excavation throughout the Old World have yielded results startling enough to affect our concrete picture of human history From this vast field I want to gather together some new facts that should mould our total synthesis But my aim in so doing will be not to attempt in an hour an impossible reconstruction of human history I shall rather focus attention on some new data which will permit a concrete answer to a rather abstract question Why is a prehistorian asked to preside over a section in this Association from which historians as such would be *de facto* excluded ? In a word on what grounds can prehistory in general and British prehistory in particular claim to be a science ?

Is prehistory experimental ? Yes but only within very narrow limits and in a restricted sense Normally only one sort of experiment is open to the archæologist an experiment that can never be repeated—I mean excavation Or does prehistory work ? Can it formulate general rules that serve as guides to successful action ? Yes but only as to how to acquire fresh knowledge

The prehistorian s aim is to reduce to an ordered and intelligible system the scattered and isolated splinters of evidence collected through surveys excavations and chance discoveries But only a few regions and short periods have as yet been so thoroughly explored and investigated that the facts of themselves make an intelligible pattern We have to fill up the gaps with guesses and assumptions

The title of my address is intended to recall an assumption which has exercised a profound formative influence on archæological studies which is indeed held by many as an axiom above discussion In 1899 Montelius stated this faith in the book entitled like my address The Orient and Europe At a time when the peoples of Europe were so to speak without any civilization whatsoever the Orient and particularly the Euphrates region and the Nile valley were already in enjoyment of a flourishing culture The civilization which gradually dawned on our continent was for long only a pale reflection of Oriental culture

In 1899 such a statement was very much more an affirmation of faith than a deduction from accumulated data

Restated in simpler but still not altogether unambiguous terms the statement quoted from Montelius resolves itself into the following propositions treated as axioms (1) Civilization in the Orient is extremely ancient (2) civilization can be diffused (3) elements of civilization were in fact diffused from the Orient to Europe (4) the diffusion of historically dated Oriental types provides a basis for bringing prehistoric Europe within the framework of historical chronology (5) prehistoric European cultures are poorer than contemporary Oriental cultures that is civilization is later in Europe than in the East To day none of these propositions except No 2 need be treated as postulates rather than as conclusions from the results of investigations for the excavations published during the last five years have provided abundant data by which to test the axioms validity

Let me first summarize the results of excavations in Hither Asia that tend to establish the first axiom—the antiquity of Oriental culture The beginning of the historical or Dynastic period in Egypt and Sumer now constitutes a fairly accurately dated horizon The coincidence of Egyptian and Mesopotamian sources is now close enough to permit of this horizon being dated with general consent about 3100 ± 100 B C The latest additions to knowledge resulting from Frankfort s masterly operations at Tel Agrab Tel Asmer and Khafaje intensify our appreciation of the high level of Oriental civilization and emphasize the long duration of the Early Dynastic Age The Sin Temple at Khafaje was rebuilt five times In the same period the Temple of Abu at Tel Asmer underwent four reconstructions

The Early Dynastic period itself was far from the beginning of urban life In the Tigris Euphrates delta it is preceded by two periods termed respectively the Jemdet Nasr and Uruk phases during which monumental buildings were already being erected At Erech below the earliest Dynastic temple ruins the German excavators uncovered the wall stumps of a gigantic edifice that had been reconstructed once or twice in the Jemdet Nasr period These walls in turn rested on ruins of a no less imposing building the Red Temple—a veritable cathedral adorned with a mosaic of clay nails and with friezes of stucco beasts The Red Temple itself was twice remodelled and was after all only the successor of a still earlier but no less monumental cathedral termed in view of its unusual stone foundations the Limestone Temple Now you do not build a cathedral every fifty years, even if it be built only of mud brick. This series of three prehistoric temples with their several reconstructions must cover a period of several centuries.

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[*] From the presidential address to Section H (Anthropology) of the British Association delivered at Cambridge on August 22

But even in the Limestone Temple we are dealing with a highly organized urban civilization presupposing centuries of experimentation and development. Some aspects of that development are explicitly revealed in the archæological record. From the floor level of the Limestone Temple the Germans sank a shaft 17 m. or just under 60 ft. deep to virgin soil. It was dug entirely through the debris of prehistoric dwellings. As one winds down the ramp into that dizzy abyss one can distinguish in the pit wall eighteen layers marked by hearths, floors, stumps of walls, and heaps of sherds and artefacts. Admitting that I am now guessing perhaps rashly, I cannot believe that the al'Ubaid culture represented in the lower levels at Erech is later than 4500 B.C.

It has never been suggested that the geologically very recent delta of Lower Mesopotamia was the cradle of food production. It is in fact evident that the al'Ubaid farmers who settled on the freshly emerged land-surface there brought with them from older regions a culture already mature. In the last five years the excavations of Mallowan and Speiser in Assyria and Syria have given us glimpses of what preceded al'Ubaid in the Fertile Crescent. It is true that history does not fully dawn there until relatively late—until the time of the Dynasty of Akkad indeed. But relations with Lower Mesopotamia were so close and so continuous that the archæological record provided by the prehistoric levels of Gawra, Nineveh, and Chagar Bazar can be proved parallel to that from the protohistoric levels of Sumer. So when we find in Gawra XIII pottery and other relics typical of the earliest or al'Ubaid phase of Sumer's prehistory, we have no reason to doubt that al'Ubaid in Assyria is virtually contemporary with al'Ubaid in Sumer. But Gawra XIII already boasted a cluster of three handsome and monumental temples, decorated with painted buttresses and niches, and grouped round a court 20 m. by 14 m. in area.

The al'Ubaid temples at Gawra are perched upon a tell, formed from the ruins of older settlements, and rising already 25 m. to 30 m. above the plain. Below the al'Ubaid foundations come settlements belonging to the Tel Halaf culture. Mallowan found the same culture beneath, and therefore older than, al'Ubaid remains at Arpachiya, 38 ft. below the historical horizon at Nineveh and in deep layers at Chagar Bazar. The Tel Halaf culture is accordingly older than the al'Ubaid—if you want a guess, I would hazard 5000 B.C. as a moderate date—but it is no less sophisticated. Monumental circular buildings, cobbled streets, delicate and beautifully painted vases, ingeniously carved stone beads and stamps already used for sealing property attest already a well-organized society, an advanced economy, highly developed craftsmanship.

The Tel Halaf culture must have flourished for several generations. Mallowan uncovered at least five building levels at Arpachiya and seven at Chagar Bazar; and yet at Gawra, Nineveh and Chagar Bazar the oldest Tel Halaf foundations rest upon the ruins of villages characterized by painted pottery of the Samarra style. Guessing frankly once more, these might take us well back into the sixth millenium B.C.

Yet the culture revealed even in these remote depths resembles the European neolithic only in the most formal sense—in the continued use of polished stone adzes and some other tools. The earliest cultures of the Fertile Crescent, like its Early Dynastic cities, are so unlike anything we know in Cis-alpine Europe before Roman times, are economically so far ahead of Koln-Lindethal or Skara Brae or even Tószeg as to seem almost incommensurable. Yet some comparison is inevitable if Montelius's fifth postulate is to be objectively criticized.

The abruptness of the contrast may to-day be softened by reference to a region that is more than spatially intermediate between Mesopotamia and Europe.

The results of the long campaign conducted at Alişar Huyuk by the Oriental Institute of Chicago, which were published this year, have given the first definite clue to the culture-sequence on the plateau. In particular, they provide the skeleton of a chronology.

Below the Hittite foundations on the acropolis at Alişar (but not on the terrace) came a deposit with Cappadocian painted ware now termed Early Bronze Age or Alişar C. Below that, five building layers, accounting for 11 m. of deposit, represent the Copper Age or Alişar B. This must end by 2000 B.C. A beginning towards 3000 B.C. might be inferred from an imported Mesopotamian cylinder of Jemdet Nasr style, stone figurines like those regarded as Anatolian intruders in the Early Dynastic layers of Gawra and Tel Asmer, and animal pendants of stone remarkably like those from the Early Dynastic temple of Sin at Khafaje. To this same Copper Age belong the ruins and burials at Ahlatlibel near Ankara. It was a period when commerce was sufficiently organized for metal to be common and seals to be useful.

But beneath the lowest Copper Age floors, von der Osten's shaft pierced 8·5 m. of debris, divisible into seven building levels, before reaching virgin soil. The earliest Anatolian culture, represented by Alişar A is already so advanced that it is accurately termed Chalcolithic However sparingly used copper silver and lead were common enough to indicate well established commercial channels of distribution and specialized producers Stamp seals were already employed But certain pot forms and fabrics are already comparable to the Central European two handled tankards like those of the Hungarian Copper Age occur in the topmost layers only (Alişar A2) for the rest lugs take the place of handles but a distinctive shape is a high pedestalled bowl at first with a remarkably Danubian profile The fabric is self coloured black to red but generally muddy and sometimes particoloured—black inside and round the rim but brownish below on the exterior The Anatolian Chalcolithic seems rooted in the fourth millennium B C but how far back remains quite uncertain

Despite conspicuous divergences the Copper Age and Chalcolithic cultures of Central Anatolia are patently related to and continuous with those of north western Anatolia long known from Schliemann s excavations at Troy Re excavation there under Blegen has substantially enhanced the impression of the antiquity of Anatolian culture If the Americans have not yet provided unimpeachable data for determining the absolute age of the earlier cities they have at least filled in and expanded the scheme propounded by Schliemann and Dorpfeld The Troy that the Achaeans might have sacked about 1200 B C did Lord Raglan allow us to believe in a Trojan War was not VI but VIIa Troy VI goes back on the strength of Helladic imports to 1500 B C Cities V IV and III turn out to be quite important settlements divisible into several architectural levels and making up together a formidable accumulation 4 m deep Troy II thus separated from the Mycenaean horizon can no longer be brought down to the Shaft Grave epoch however neat Åberg s typological comparisons may look It is firmly anchored in the third millennium whatever its precise limits may be Troy I below it was already a city girt by an imposing wall Its citizens were executing monumental sculptures that provide a new limiting date on Montelius s assumption for the statue menhirs of Atlantic Europe By this time as Miss Lamb has shown at the contemporary Lesbian township of Thermi copper and even bronze were already being worked celts might have hammered flanges battle axes were used in war while trade brought marble vases from the Ægean Islands Remains of a still earlier phase of culture may be discerned at Kum Tepe Soundings there produced pedestalled bowls like those from the earliest Chalcolithic of Alişar that seem still missing in Troy I and the contemporary Lesbian site

The experiments in Anatolia thus go far to re enforce with objective facts the antiquity and relatively high level of Oriental culture assumed in axiom 1 Moreover taken in conjunction with Heurtley s excavations in Macedonia they concretely demonstrate connexions between Asia and Europe that are the precondition for admitting axiom 3 and provide a crucial instance for testing axiom 5 that is for comparing demonstrably contemporary cultures in Europe and Asia Heurtley has convincingly demonstrated the Anatolian ancestry of the Early Macedonian Bronze Age culture it begins with fully developed horned tubular lugs growing from the bowls rims The evolution of this odd type that appears fully formed in Europe can be traced stratigraphically on the Asiatic side It emerges as a finished product first in phase B at Thermi its earlier stages are illustrated in phase A For once we have fully documented a cultural spread which is irreversible in this concrete instance axiom 3 becomes a conclusion from ascertained facts

Implanted in Europe Anatolian culture appears poorer than its Asiatic parents Even in phase A Thermi was quite a township the contemporary Troy I a fenced city Their economy was so far advanced that copper and even bronze could be used for tools as well as weapons metal was so plentiful that quite a lot was left lying about for Miss Lamb to find The Early Macedonian settlements which are not older than Troy I give the impression of rustic villages For all the metal collected among their ruins they might be neolithic Macedonia was still veiled in mists which the Oriental sun must pierce before an economic system comparable even to the Anatolian could function

But if the Early Bronze Age culture of Macedonia is unambiguously rooted in Asia the later neolithic culture which it supersedes is no less securely linked with that of Vinca and Tordos in the Middle Danube basin beyond the Balkan ranges Comparison of the Macedonian relics with those from the Morava Middle Danube Maros sites shows that we are dealing not with two cultures but with different facies of one and the same culture We may reasonably speak of a Vardar Morava culture extending from the coasts to the Maros

How such a continuum was constituted remains a question for debate elsewhere Its absolute antiquity cannot be defined with precision For our purpose the supreme importance of the Vardar Morava complex is that it establishes at least once a continuity of culture from the Ægean to the Danube basin Whatever be the chronological horizon of that continuity its existence provides a justification for admitting axiom 3—diffusion from Asia to Central Europe is likely

(*To be continued*)

Soil Erosion in India*

By Dr. R. Maclagan Gorrie

CONTRASTS WITH AMERICAN DATA

EROSION losses are less where the rainfall is well distributed, and it is now commonly recognized that erosion has most serious consequences in arid tracts. A heavy monsoon has more effect upon sloping fields than it has on neighbouring grasslands, whereas in arid climates the smaller area of fields is more carefully terraced, but the neighbouring grazing grounds are more vulnerable to infrequent but heavy downpours. This may serve to explain an anomaly that occurs in run-off intensity data. American figures worked out by Ramser and frequently quoted show the following averages in cubic feet per second per square mile, and in contrast I also quote tentative data of the same sort for Indian conditions.

RUN-OFF IN CUBIC FEET PER SECOND PER SQUARE MILE*

AMERICA	Cusecs	PUNJAB	Cusecs
Hilly timber, 10–30% slope	300	Terraced rice fields	60
„ pasture	620	Foothills afforested and with soil catching small dams	120
„ cultivated	1040	Foothills scrub forest closed to grazing	700
		„ open to grazing	1100
		„ disforested and heavily grazed	1600

* Cf. *Current Science*, August 1937, author's review of Q. C. Ayres' "Soil Erosion".

The American farmer using a motor-tractor keeps his fields large, and so the run-off from broad slopes of bare plough land is greater than from his paddocks of comparatively well clothed pastures. This also applies to Canadian and Australian average conditions and to parts of South Africa. On the other hand, the Indian peasant farmers have their fields in tiny and often well-terraced units which catch and hold the rainfall, whereas their grazing grounds are so misused and so badly protected with a mutilated plant cover that the run-off from them is far heavier. In the African dependencies, according to Sir Frank Stockdale's statement at a meeting of colonial officers held in Oxford in June 1937, "agricultural activity was as frequently to blame for erosion as overstocking with live-stock", so probably their run-off figures would be equally heavy for cropped land as for grazed land. Reliable data for run-off and erosion, and also for rainfall intensities and storm behaviour, are lamentably scarce even for our most important catchments, and a great field of work awaits the next generation of colonial research workers.

RAINFALL AND RIVER BEHAVIOUR

Mr. E. G. Bilham's paper on "Weather and Water Supply" read at the Public Works Congress, 1937, directs attention to the fact that even in Great Britain very few attempts have so far been made to correlate the loss of rainfall by evaporation, surface run-off, and seepage with the behaviour of streams. More work is required upon the actual fate of all the rain that falls upon a given type of plant cover and the contribution which this cover makes to the nearest stream in terms of surface and ground-water flow, before we can discuss intelligently the reactions of the larger rivers.

A study of the Ravi River flow records for the last twenty-five years carried out by the staff of the Punjab Irrigation Research Institute shows no significant indication of any gradual increase in number or intensity of floods nor any direct correlation of heavy floods with heavy rain. This is presumably owing to the fact that the heaviest floods arise from heavy snow-melt in the high inner hills, combining with a series of downpours falling on eroded ground in the foothills. The figures of winter flow do, however, indicate a continued deterioration in supplies available for winter irrigation. It is scarcely to be expected that a simple phenomenon such as the run-off of rain can be correlated exactly with the highly complex phenomena which go to make up the stream-flow of a large river. The Ravi River's catchment of nearly 15,000 square miles varies from 2,000 ft. to 20,000 ft. in altitude and contains several recognizable meteorological zones, so instead of looking for any correlation between rainfall and run-off for the whole, it would be better to study small individual sections and find out how each tributary reacts to the rain and snow which fall within its catchment. Unfortunately, the rainfall data in this case are for only one rain gauge for the 15,000 square miles!

NEW INDIAN STATISTICS OF EROSION LOSSES

Reliable run-off figures for forest and grassland are now available for the first time for Indian conditions. A technique of volumetric analysis of water and silt was worked out by the Punjab Irrigation Research staff at Madhopur in 1936 for a type of small isolated plot of undisturbed soil 3¼ sq. ft. in area, and this method has since been followed in forest plots at Nurpur in Kangra district. A battery of six plots gave three pairs, namely, (i) grass, (ii) grass and shrubs, and (iii) bare soil, on a slope of 1 in 4 on an eroded hillside of poor Siwalik sandstone. The grass cover over all is distinctly poor, as it is recovering slowly from previous heavy grazing The bare plots contain a little grass which has been kept clipped back with scissors They thus simulate local grazing conditions to some extent, though we have not reproduced the destructive trampling action of cattle scrambling on a greasy hill-side , and the run-off from grazed areas must therefore be considerably heavier than the figures now reported

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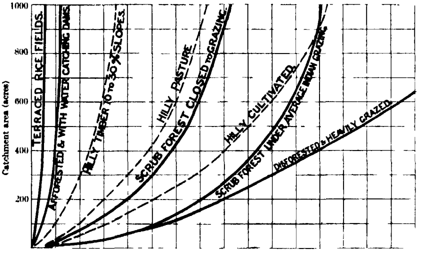
* Substance of a paper read before the Royal Society of Arts on May 4.



Comparative run-off for American and Punjab conditions

American data from C E Ramser's curves (broken lines) Indian data from Pabbi Hills torrent measurements by Irrigation Branch (full lines)

The results of the first monsoon's catch is as follows :

Percentage of rain which ran off.	Grass 80% cover	Grass and shrubs 90% cover	Bare soil, grass clipped every 3 days
Out of total of 46 in on 32 wet days during July–October 1937	7	5	25
Out of total of 5½ in. in 4 hours, the heaviest single storm	2 2	1 7	6
Weight of soil lost per acre			
Carried away on 32 wet days	3,500 lb	3,900 lb	18,500 lb
Carried away by a single storm (5½ in rain)	260 lb	307 lb	3,511 lb

These figures give one food for thought when it is realized that *in a single storm the uncovered plots lost soil at the rate of 1½ tons per acre* This may be taken as a typical figure for all bare fallow fields in the foot-hills of northern India except properly levelled rice land, and they are definitely conservative for the average village grazing lands which suffer from trampling of cattle. The ordinary grazing lands also suffer from the accumulative action of shallow gullies cutting the surface on long slopes, a phase of erosion which is, of course, not reproduced in our small square plots.

Measurements reported from the Bombay Dry Farming Research Station at Sholapur (chief investigator, Mr N V. Kanitkar) show a loss of 115 tons of soil per acre per annum from a field of *jowar*, a *Sorghum* which is the most important combined grain and fodder crop in the Bombay Deccan. This loss was caused in a properly cultivated plot as a result of two very intense storms of 3·5 in and 4 3 in The total rainfall of 28 inches is usually fairly well distributed and no such intense storms occurred during the previous year when measurements were started The silt lost in these intense storms was particularly rich in valuable plant foods such as lime and potash, which were stolen by erosion, leaving the remaining soil much poorer Of the various other kinds of plant cover tested, the amount of water lost in the run-off was not strikingly different where weed or crop cover was dense The amount of soil lost where the weeds had been reserved in fallow was just one two-hundredths of the *jowar* plot, while the clean fallow of bare but uncultivated ground yielded 25 tons of soil per acre or 22 per cent of the *jowar* plot's loss These astonishingly heavy losses of silt were from very gently sloping ground, the average slope being 1¼ per cent or 1 in 80, and the data are entirely reliable, having been collected from thoroughly isolated plots I am indebted to Mr. Kanitkar and Dr W Burns for permission to use these figures

The point which this experiment has brought out is that, under Indian conditions, good cultivation on even a slight slope is no better than bad cultivation for saving soil, unless it is protected by some form of contour ridging The only sure way of reducing soil losses during exceptionally heavy storms is by contour ridging which is sufficiently deep to render each field a more or less self-contained catchment unit, so that cumulative run-off from a series of fields is prevented. The necessity for such protection is brought out by subsequent figures for these same plots in 1937, so far unpublished but furnished in a letter from Mr N. V Kanitkar, who reports that this same *jowar* plot has lost a total in the year of 133 tons per acre. This included one storm in which 2 13 in of rain in half an hour removed the huge amount of 52 tons of silt per acre.

Obituary Notices

Dr. Leo Frobenius

WE regret to record the death, at the age of sixty-five years, of Dr Leo Frobenius, the widely known German anthropologist and explorer, which took place at Biganzolo on Lake Maggiore, Italy, on June 9.

The claim of Frobenius to be remembered in the annals of anthropology will rest on his intrepidity and assiduous devotion to exploration in African lands and among African peoples In the course of his life he made no less than twelve journeys of exploration, all of a more or less arduous character, and it was on the last of those, when in 1934 he penetrated depths of the Sahara scarcely known to the Bedouin, and reached the sources of the River Ouwenat, that he contracted the malady which forced him to abandon the expedition and after some years of illness was the ultimate cause of his death

Frobenius was born on June 29, 1873, in Berlin At an early age he was attracted to the studies which became his life-work After spending some years at the ethnological museums of Bremen, Leipzig and Basle, he determined to devote himself to exploration In 1904 he founded the German Central African Research Expedition and embarked upon a journey to the Congo Basin, which lasted until 1906 In the following year he set out again, and between 1907 and 1915 completed six further journeys in Africa, visiting the Upper Niger, Timbuctoo, Togoland, the northern Sahara, the western Sudan, Khartoum and El-Obeid, Algeria and Tunisia, and finally Turkey and northern Abyssinia

Henceforth for some years Frobenius was busily engaged in working up the anthropological material he had collected in Africa, and he published a number of important books and papers dealing with his observations and conclusions He was a bold, original and independent thinker, but as he had shown in his earliest work as a young man, apt to generalize on insufficient evidence, as well as to give too wide an application to an interpretation which might be valid for a restricted area which had come under his observation. His theory of cultural continuity and cyclical development, in which he maintained that the various phases of civilization had developed in a manner exactly analogous to the growth of a living organism, was the subject of much embittered controversy

In 1924 Frobenius founded the Frankfort Research Institute of Cultural Morphology, and four years later set out with seven assistants on an expedition to Central and South Africa, in the course of which he visited and conducted investigations among the Zimbabwe ruins of Rhodesia, shortly before the excavations by Miss G. Caton-Thompson, conducted under the ægis of the British Association, which was to visit South Africa in the following year Frobenius found himself unable to accept the conclusion that these ruins were Bantu in origin, as suggested by Randall-MacIver in 1905, and as was confirmed by Miss Caton-Thompson's investigations, but arrived at the view that some six thousand years ago this area had been an outpost of Sumerian and Babylonian culture He also concluded that the iron age had begun in Africa a thousand years earlier than in Europe, iron working having entered Africa from India by way of Madagascar In the search of further evidence to support this conclusion, he afterwards visited India Two later expeditions were to Tripoli in 1932, when he studied the prehistoric course of the Nile, and in 1934 to the Sahara, as already mentioned, his last journey In this year he was appointed director of the Racial Museum at Frankfort, and for the rest of his life divided his time between Frankfort and his residence on Lake Maggiore

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Mr. W. R. Barclay, O.B.E.

WE regret to announce that Mr William R Barclay died at his home in Birmingham on September 16, aged sixty-three years He was a leading metallurgist and one of the outstanding authorities on non-ferrous metallurgy

Mr Barclay was educated privately and later attended the Sheffield Technical College (now the University of Sheffield) During 1910–19, he was lecturer in electro-metallurgy in the University of Sheffield During the Great War, he became chief metallurgist and assistant director in the Non-Ferrous Rolled Metal Section and technical director of the Electro-Metallurgical Committee of the Ministry of Munitions. He was made O B E for his services

In 1928, Mr. Barclay became managing director of Henry Wiggin and Co., Ltd , and in 1931 he was appointed consulting metallurgist to the Mond Nickel Co , Ltd. He was largely instrumental in initiating the company research and development organization, as a result of which, in conjunction later with the International Nickel Co , innumerable new uses were discovered for nickel and nickel alloys

In 1936, Mr. Barclay was elected president of the Institute of Metals, and he was re-elected to serve a further term in 1937. It was during his presidency that the Institute decided to award an annual medal for outstanding services to non-ferrous metallurgy.

Mr. Barclay was well-known in metallurgical circles in the United States, and he was invited to deliver the Calvin W. Rice Lecture to the American Society of Mechanical Engineers in June of this year. At the same time, he was to be awarded the degree of doctor of science by the Stevens Institute of Technology. Unfortunately, owing to his illness, he was unable to attend these functions.

News and Views

Albrecht Penck

ON September 25 Albrecht Penck world famed as geologist and geographer will celebrate his eightieth birthday Born at Renditz near Leipzig in 1858 Penck was educated at Leipzig and Munich taking his Ph D in 1878 In 1885 two years after he had published his Die Vorgletscherung der Deutschen Alpen he was appointed to the chair of geography in the University of Vienna where he remained for twenty years until in 1906 he was appointed to take charge of the Museum of Marine Studies in the University of Berlin Under his direction the Museum was much enlarged and he himself made important contributions to the study of hydrography In 1922 he was made director of the Institute of Geography of the University becoming emeritus in 1927 While still at Vienna Penck had established an international reputation for his illuminating treatment of geology and geography as linked studies His Morphology of the Earth s Surface (1894) was speedily accorded recognition as a standard work Notwithstanding his numerous contributions to geography, which his widely extended travels kept in close touch with practical realities Penck s strongest claim to the remembrance of posterity will rest on his epoch making studies of the Ice Age Since the publication of Die Alpen im Eiszeitalter (1909) written in conjunction with his old pupil and friend, Ed Bruckner his classification of the four phases of maximum glaciation has been fundamental in all studies of quaternary geology and the history and chronology of early man In tendering our congratulations on this occasion to Prof Penck we hope that he may live to enjoy the homage due to his labours for some time to come

Mr H C Sampson, C I E

MR H C SAMPSON is retiring from the post of economic botanist at the Royal Botanic Gardens, Kew on September 30 Before going to Kew in 1927, Mr Sampson had gained a wide experience of tropical agriculture in various parts of the Empire Educated at the University of Edinburgh he commenced his career in the Transvaal Department of Agriculture and in 1906 entered the Indian Agricultural Service, retiring in 1923 as director of agriculture Madras In 1920 Mr Sampson made a tour in Cochin China and Cambodia to study coco nut and cotton cultivation, and after his retirement from India he worked for a time in Nyasaland for the Empire Cotton Growing Corporation Mr Sampson s appointment at Kew was made in connexion with the grant from the Empire Marketing Board for the promotion of the economic development of the Empire, and his work at Kew has been devoted to this end In addition to giving advice on crop improvement and on the introduction of plants of economic importance to correspondents from all parts of the Empire Mr Sampson has paid visits, at the request of the Colonial Office to British Guiana, British Honduras the West Indian Colonies and East and West Africa to study their economic resources He has recently published a List of the Cultivated Crop Plants of the British Empire (*Kew Bull* Additional Series 12 1936)

Sir Geoffrey Evans, C I E

MR SAMPSON S successor as economic botanist is Sir Geoffrey Evans who is retiring from the post of principal of the Imperial College of Tropical Agriculture Trinidad Sir Geoffrey was educated at Cambridge and was on the staff of the University Agricultural Department before entering the Indian Agricultural Service in 1906 He retired in 1923 as director of agriculture Bengal Afterwards Sir Geoffrey worked in Australia Fiji and New Guinea as director of cotton culture under the Empire Cotton Growing Corporation and was appointed principal of the College in Trinidad in 1927

Mr O T Faulkner, C M G

THE governing body of the Imperial College of Tropical Agriculture Trinidad has appointed Mr O T Faulkner to the post of principal of that College in succession to Sir Geoffrey Evans It is difficult to suggest the name of anyone better qualified to fill this appointment Mr Faulkner has had a ripe and varied experience of tropical and subtropical agriculture in its many and varied phases He first saw service abroad as mycologist to the Rubber Growers Research Association in Malaya, and after working there for two years was in 1914 appointed to the Indian Agricultural Service as deputy director of agriculture in the Punjab In 1921 he resigned from this Service to take up the appointment of director of agriculture Nigeria For his valuable work in this capacity where he defined the agricultural policy of the country and built up a most efficient Department he was made C M G in 1928 In 1936 he was transferred to Malaya as adviser on agriculture which post he now relinquishes to become principal of the Imperial College of Tropical Agriculture As this College is responsible for the training of all recruits for the Colonial Agricultural Service the post of principal is a most responsible and important one Mr Faulkner was born in 1890 and took his Natural Sciences Tripos at Cambridge in 1911 with first class honours and in the following year took his diploma in agriculture

Scientific Theory and Publicity

THE strictures on the methods of the B B C in relation to certain broadcasts dealing with archæological subjects, with which Prof Gordon Childe prefaced his presidential address to the Anthropological Section at the Cambridge meeting of the

British Association, has once more raised a perennial problem in scientific discussion, which is of no little public interest The methods of the B B C must be above the suspicion of propagating error, especially in relation to the advance of scientific discovery Unfortunately, the field of research to which Prof Childe refers has been in the past the happy hunting ground of the irresponsible theorist In certain branches of archæological investigation the apparent familiarity of the terminology and subject matter—the character and purpose of objects of everyday use in the life of the past, and the inferences as to cultural and racial contact to be drawn from them—not only lend themselves to speculation, but also the more startling and sensational the exposition, the more readily it commends itself as matter likely to be of interest to the public to those who control the machinery of publicity the lay Press and organizations, of which the B B C is the most important, engaged in the unofficial education of the public The obvious remedy that the B B C should be advised by a committee of scientific men, and that other organizations and the lay Press should consult expert opinion in order to eliminate the danger of error, is open to the imputation of stifling progress in favour of orthodoxy The only remedy is full and free discussion without favour, after an impartial statement of controversial points at issue

Jupiter's Satellites

POSITIONS of the newly discovered Satellite X are available from July 6 to August 1, but the interval is too short for the computation of an orbit with any degree of certainty A preliminary investigation, however, suggests that the object is at a distance of about 7 million miles from Jupiter, its motion being direct Whether it is just inside the orbit of VI or outside that of VII is open to doubt, but further observations will enable computers to decide this point Observations of Satellite XI are available from July 30 to August 1, but it is impossible to compute an orbit from such data From the figures it is conjectured that the body cannot be less than 10 million miles from Jupiter, and so it certainly lies outside VII, but there is nothing at present to show that it does not lie outside IX

THESE preliminary investigations were made by Dr M Davidson, who assumed, in the computation of the orbit of Satellite X, that this was practically circular While going to press a Harvard Card announces that two different orbits for Satellite X have been computed the results of which have been communicated by Prof E I Yowell, Cincinnati Observatory The figures in round numbers are as follows The first orbit, which indicates that the motion of the satellite is direct, has a very high eccentricity, 0 6362, the semi major axis being 5,900,000 miles This implies that the satellite makes its closest approach to its primary at a distance of 2,150,000 miles, its greatest distance being 9,650,000 miles The other orbit shows an eccentricity 0 6207, motion retrograde, and the semi major axis 18,310,000 miles If this be correct, the satellite would approach Jupiter to a distance of 6,945,000 miles, and would recede to 29,675,000 miles, the time to complete a revolution being more than 2¾ years The fact that two such diverse orbits can be deduced from the same data shows the great difficulty, as already pointed out, of attaching much importance to the elements which are based upon a short time interval

Inland Ice Field in Alaska

A **BULLETIN** of the National Geographic Society of America announces that an expedition under the auspices of Harvard University and of the National Geographic Society, and under the leadership of Mr Bradford Washburn has made, during the course of aeroplane flights, the important discovery of a vast inland ice field in Alaska The ice is hemmed in by a coastal range of mountains with peaks reaching 10 000–19 000 ft above sea level This range stretches from the Copper River Valley above Cordova to the Alsek River Valley in the Yukon Most of the ice lies athwart and to the west of the Alaska–Canada boundary line where it turns north to the Arctic Ocean The ice thus forms a barrier to land communication between the south panhandle of Alaska and the major part of the territory in the north It is stated that the ice field covers a stretch of territory 235 miles long It is in effect so extensive as to constitute an ice reservoir which provides the source of large outflowing glaciers, including the Bering and Malaspina glaciers the immense size of which—they are 30 and 50 miles wide respectively—is now accounted for This part of Alaska (which possesses the conditions favourable to glacier formation—namely, high altitude, low temperature and high precipitation) thus contains the largest known ice fields outside the polar regions It is a remarkable feat that an expedition of only four men should have succeeded in photographing 1,500 square miles of territory in a country peculiarly difficult of access They have also carried out geological work in the St Elias Range

Solar Activity and Radio Communication

IN the speech made by the Postmaster General, Major Tryon, at a luncheon of the Newcastle-on-Tyne Chamber of Commerce, he announced that the Post Office, after consultations with the American telephone authorities, is constructing a special radio-receiving station to combat the intense sunspot activity which is expected to interfere seriously with world radio communications in 1940 The long distance international radio telephone services are mainly operated on short wave lengths, and are found to be particularly susceptible to serious interference at periods of great sunspot activity This has been proved by the graphs at short wave reception stations, and the connexion between solar flares causing sunspots and fade-outs and magnetic disturbances has been clearly established Approximately, they appear to follow an eleven-year cycle, a disturbance being due in 1940, and owing to the enormous increase in the long distance telephone traffic, engineers are doing their utmost to prevent disorganization of the traffic at that period

THE British Post Office and the American telephone authorities have decided that the best way to obviate the effects of sunspot activity is to adopt a new technique for the reception of short wave transmissions A number of receiving aerials will be suitably spaced in the direction of the incoming signals The Post Office has issued a statement giving an ideal reception station It would accommodate six receivers for twelve circuits and sixteen separate aerials erected so as to face America Very stringent conditions are laid down for an ideal site for the station It must be at least two miles long, a quarter of a mile broad, the length being in the direction of America It must be flat and reasonably damp It should be remote from roads carrying motor traffic and yet be a reasonable distance from London to keep the cost of the land lines low The present Post Office receiving station at Baldock does not even approximately satisfy these conditions The Cooling Marsh at Rochester nearly fulfilled the required conditions and this has been selected It is expected that the new station will be in use early next year, and that even under very bad conditions it will be possible to maintain a satisfactory commercial telephone service

New Metallurgical Laboratories at Sheffield

SIR WILLIAM BRAGG opened the new Sir Robert Hadfield Metallurgical Laboratories at the University of Sheffield on September 15 The laboratories mark the first stage in a scheme of development of the University for which an appeal was issued two years ago Sir Robert Hadfield contributed generously in response to the appeal and as a mark of appreciation of this and his many other benefactions to the University, and particularly the Department of Metallurgy, the laboratories have been named after him, and a commemorative plaque in the main laboratory was unveiled by Sir William Bragg The following telegram was sent to Sir Robert Hadfield 'Members of the University and others assembled at the inauguration of the Sir Robert Hadfield Metallurgical Laboratories send you hearty greetings They remember with gratitude your continuous generosity to the University, and regret your absence from this ceremony They send you best wishes for a speedy recovery to health.' The University of Sheffield is unique among the universities of Great Britain in that it confers degrees in metallurgy as distinct from degrees in science, these were established so long ago as 1907 The new laboratories will be used primarily for teaching, but research work will also be carried out In his address, Sir William Bragg referred to the relation of science to industry, and said that although they may be forced together by circumstances, a metallurgical school, like the restraining constituent in an alloy which prevents separation of the components, holds theory and practice together and gives the industry strength and adaptability

International War on Locusts

THE Fifth International Locust Conference held at Brussels at the end of August was attended by delegates from more than twenty countries The great economic importance of the problem was emphasized by the results of a statistical inquiry organized by the International Centre for Anti Locust Research in London The information collected from the majority of the countries suffering from locusts and grasshoppers showed that the average cost of these pests to the world amounts to not less than 15 million pounds per annum Discussions at the Conference were centred mainly round the necessity of establishing permanent organizations for the supervision of the original centres of locust outbreaks with a view to the prevention of such outbreaks in future An agreement was reached by the various delegations that such organizations should be established without delay and financed on an international basis This decision was made possible by the extensive investigations carried out during recent years by an international team of entomologists surveying some of the most inaccessible parts of Africa and Arabia There is every hope that the recommendations made by the Conference will be adopted and acted upon by the Governments concerned and that the control of locusts by the prevention of the swarm formation will become an accomplished fact

Launch of the *Graf Zeppelin*

A NOTABLE example of the progress of aeronautical science was provided by the launching on September 14 of the new German airship L Z 130, to which Dr Hugo Eckener gave the name *Graf Zeppelin* The launch is described as having been carried out with precision and the great ship took to the air perfectly It will be recalled that, on a similar occasion two years ago, the *Hindenburg* took about half an hour to rise and then twice lurched downwards before her height was brought under control It may therefore be inferred that the designers and constructors have now at their disposal much more complete knowledge as to the factors which influence the stability and behaviour of large airships and that the new vessel is thereby the more assured of a successful career On the first of her acceptance trial flights she cruised for a period of eight hours and made a good landing at the Loewenstadt Military Aerodrome Hydrogen was used as the lifting medium When the *Hindenburg* was wrecked at Lakehurst in the United States, it was stated that hydrogen would not in future be used As, however, helium is practically unobtainable outside America, the engineers have devised a method whereby it is claimed that the main risk is largely eliminated This is associated with the necessity for releasing free hydrogen as the load diminishes due to the consumption of the fuel, but by arranging for the storage of the water formed during combustion, they have provided the necessary ballast so that the ship's height can be controlled with little or no recourse to wastage of hydrogen The motive power is supplied by four Daimler Benz engines, each of more than

700 horse power which give the ship a cruising speed of about 80 m p h In length she is 803 ft — slightly less than the *Hindenburg*—but her hydrogen capacity of 7 062 000 cub ft is fully 25 per cent greater

Iron Age Settlements in Wiltshire

THE investigations by the Prehistoric Society of iron age sites near Salisbury have completed for the time being the examination of the settlement at Odstock which began on June 12 under the direction of Mr C W Phillips honorary secretary of the Society About half of the six acre site has been dug and the remainder will be examined next year The settlement is dated at about 200 B C and as anticipated was found to have been occupied by a small agricultural community growing wheat oats barley peas and beans though traces of wheat only have been discovered Apparently they farmed on an extensive scale As much as fifty tons of grain was stored in a single season Light is thrown on their methods in the report of the recent investigation (*The Times* Sept 6) Many pits for the bulk storage of grain were found within the settlement enclosure but as storage in damp conditions would encourage the grain to sprout it was first toasted in large ovens before being placed in the pits Remains of ovens used for ordinary cookery have also been found as well as quantities of pottery iron knives bone implements etc There is evidence that among the domestic animals were pigs cows and goats and a large number of horses of a small type Some time after the first occupation the settlement was surrounded by an enclosing bank and ditch which were in no sense a fortification Within this enclosure in addition to the pits already mentioned were a large house a timber structure forty five feet in diameter with an external veranda a second which was thirty feet in diameter and a number of other timbered erections

IF the inference as to the character and purpose of the fragments of pottery from the pits is well founded and they are the remains of ovens which had been used for drying corn this is the earliest link in a chain of evidence for a practice which can then be traced in Britain from about 200 B C down to modern times In *Antiquity* of September Dr Cecil Curwen refers to the practice of drying corn in kilns in the island of Lewis comparing the kilns with the corn drying furnaces found in some Romano British settlements in southern Britain Mr O G S Crawford in a note quotes evidence for the practice in the west back to at least the sixth century of our era while Dr Curwen adding that the kilns seem to have been a product of Roman culture in western Europe states that so far as he was then aware they did not occur in Britain before the latter part of the Roman period The evidence from the Wiltshire settlement is thus of considerable interest as a possible instance, considerably earlier in date and not of Roman origin, of a practice with a prolonged history of cultural continuity

Prehistoric Scottish 'Temple'

FURTHER progress is reported in the excavation of the prehistoric temple at Clydebank Dumbartonshire of which Mr Ludovic Mann is in charge The central area of the site in which are a large number of inhumed and cremated interments of the stone and bronze ages is estimated to have a diameter of six hundred feet A recent discovery reported in *The Times* of September 19 is that of the remains of a circular walled enclosure 43 feet in diameter at a distance of 219½ ft from the main centre which is now in course of being uncovered In the walling to the north west has been found a large rectangular stone In contact with this was a fallen pillar stone This seems to have formed part of an altar like structure The pillar stone had been shaped and on cleaning showed traces of what are described as serpentine devices in black and red pigments—a discovery which if confirmed by further examination appears to be unique in British archæology At a distance of 55 ft from the centre of this stone ring and on the same radius as the stone and pillar was another large fallen upright stone Many of the finds on this site which include five different types of pottery are said to be unique in character and technique A large number of socket holes have been discovered which contain decayed and carbonized wood apparently largely of oak The temple seems to have consisted to a great extent of earthworks of which the layout is indicated by the postholes along the margins Traces of a circle of nineteen large equidistantly set monoliths have been detected at a distance of 129 ft radius from the main centre It is evident that this site is of considerable importance and complexity and that careful excavation and planning will be necessary before its true character and purpose can be determined

Economic Use of Water-Power

UNTIL recently engineers considered that when both water and fuel power were available then it was best to develop all the water power first and then use steam as an auxiliary source of power In designing many recent power stations this procedure has almost been reversed The steam station is built first the overhead costs being much cheaper then when the load gets large and it would otherwise be necessary to provide reserve generators and equipment to take the main load a beginning is made with the water power station which is mainly used to help with the peak load and so avoids the necessity of purchasing reserve generators In the preliminary report published in 1934 of the National Resources Board, set up by the United States Government it is stated that the great technical advantage of water power plants is that they can be turned on for a few hours work and then turned off again without much loss In the present technical regime, their function is mainly that of a supplementary source, used to carry peak loads for brief periods During the rest of the time the load is carried by the more economical fuel burners In the August number of the *BEAMA* journal, H E M Kensit points out that quite small water power stations possessing good 'pondage' or moderate storage facilities can be economically developed to several times their continuous capacity in order to take the peak loads of fuel power systems. In Great Britain the Water Power Sources Committee reported in 1921 that there were 250,000 kilowatts of continuous power available. The modern view is that where small water-powers are used, they should be 'over-developed' by providing reservoirs so that they could take both the base loads and the peak loads. There are several electric-power schemes in America which take full advantage of the utility of the storage capacity of water-power in reservoirs when combined with steam stations.

Science and Culture

THE August issue of *Science and Culture*, published in Calcutta under the auspices of the Indian Science News Association as "a monthly journal of natural and cultural sciences", includes several important contributions and is in every way a credit to all who are concerned with its production. In the leading article on social implications of science, support is given for the movement represented by the committee on science and its social relationships of the International Council of Scientific Unions and the new Division of the British Association, and it is suggested that the Indian Science Congress Association should discuss the subject in a plenary session at the forthcoming meeting at Lahore. Sir James Jeans's lecture on the origin of the planets, delivered during the visit of delegates of the British Association to India, is published in the issue; and among the subjects of other interesting articles are: electrical charge distribution in thunderclouds, chemical composition and nutritive value of bananas, and recent advances in the study of plant growth hormones. The speeches made by Sir John Simon and Sir William Bragg at the anniversary dinner of the Royal Society on November 30, 1937, are reprinted in full from the *Notes and Records* of the Society, the first issue of which appeared in April last, together with notes on the foundation and history of the Society from the same publication.

The late Lord Rutherford

THE *Transactions and Proceedings of the Royal Society of New Zealand*, vol. 68, June 1938, contains an obituary notice and photograph of Lord Rutherford, signed "E M.", doubtless the work of his old research student at Manchester, Dr. E. Marsden, who is now head of the N.Z. Department of Scientific and Industrial Research. There are about thirteen pages of biography written by one who well knew and admired Rutherford. Then follow nine pages of bibliography, listing about three hundred publications of books and papers by Lord Rutherford. This has been carefully compiled by Dr. C. M. Focken, Beverly-Mackenzie lecturer in physics at the University of Otago.

Earthquakes in Italy and in New Zealand

THE Central Office of Meteorology and Geophysics at Rome has recently issued its catalogue of *macrosismi*, or sensible earthquakes, for the year 1935 (*Boll. Sismico, anno* 1935). The total number known is 134, or about one third of the average number (412) for the forty years 1891–1930. Their intensity, also, was much less than usual; more than half were so slight that they were not able to shake doors or windows, and only one, with its origin in Etna, approached destructive strength, several houses in Acireale being slightly injured. The seismological section of the Dominion Observatory at Wellington has issued a somewhat less detailed report on the New Zealand earthquakes of 1936 (*Bulletin* No. 125; 1937). From this, we learn that the number of sensible earthquakes was 125, less than half the average (264) for the preceding twelve years, but nearly the same as the average number (122) for the eight years excluding 1929–32, in which many after-shocks of the great earthquakes of 1929 and 1931 occurred. Five of the shocks were of intensity 6 (Rossi-Forel scale), that is, none could be ranked as a destructive earthquake. The epicentral regions (Buller River and Hawkes Bay) of the two earthquakes referred to seem to have resumed their normal activity.

Renewed Seismic Activity in Greece

ATHENS has again been disturbed by strong earth tremors but no damage has been done in that city. The epicentre of the shock is reported to have been to the north-east of the city, and is probably the same as that of July 20 and also July 27. The most recent shock was registered on seismograms in London at about 3 a.m. on September 18, and does not appear to have been any more intense than that of July 20.

Belgian Red Cross Exhibition

THE Belgian Red Cross is organizing a popular scientific exhibition to be held in the Egmont Palace, Brussels, on October 1–30. It will be entitled "L'Homme" and will comprise the following groups: (1) movement (bones, muscles, nerves); (2) blood vessels and circulation; (3) respiration and voice; (4) foods and digestive organs; (5) thought and sensation; (6) special senses; (7) the part played by glands; (8) transparent organs; (9) the man of glass; (10) individual and public health. Further information can be obtained from Croix Rouge de Belgique, 80 rue de Livourne, Brussels.

A Catalogue of Rare Books

IN addition to works on English and European literature, the fine arts and a selection of important new books, a catalogue recently published by Bernard Quaritch, 11 Grafton Street, London, W.1, contains an annotated list of works on natural history including books from the library of Baron Bouck, early medicine and surgery from the library of Sion College, and the exact and applied sciences. Among the numerous works on natural history may be mentioned the German text of J. Hübner's "Collection of Exotic Butterflies" (1806–1841) described as "an extremely fine and complete copy of the greatest entomological work ever produced," "Rippon's monograph on bird-wing butterflies (1898–1906), of which not more than thirty copies were completed, and Dresser and Sharpe's history of the birds of Europe (1871–1896). The most notable works on medicine and surgery in the catalogue are the first quarto edition of Sir Thomas Elyot's "Castel of Helth" (1541), the first edition of Gerard's "Herball or Generall Historie of Plantes" (1597) and the first edition of Harvey's "De Motu Cordis" (1628). Among the old works on the exact and applied sciences figure the first edition of Cocker's "Arithmetik" (1678), Billingsley's translation of Euclid's "Elements of Geometrie" (1570), Watson's translation of Bernard Palissy's "Learned Dialogue Concerning Waters and Fountaines" and Zahn's work on contemporary optics (1702).

Speed Records

ON September 15, the world's speed record on land was raised to 350·2 m p h by Mr. John Cobb at the Bonneville Salt Flats, Utah. The car used was a 2,500 h.p Napier-Railton The previous record was 345·59 m p.h. set up by Captain G E. T Eyston in his car *Thunderbolt* (see NATURE, Sept. 3, p 430). On September 16, Captain Eyston regained the world record from Mr. Cobb with the *Thunderbolt*, attaining an average speed of 357·5 m p.h Sir Malcolm Campbell set up a water speed record of 130·91 m.p h. on September 17 at Lake Hallwil, Switzerland, in his motor-boat *Bluebird*.

North-East Coast Institution Engineering Awards

THE Gold Medals of the North East-Coast Institution of Engineers and Shipbuilders given for papers read during the session have been awarded as follows: Engineering Gold Medal to G J. Lugt, of the Werkspoor Company, Amsterdam, for his paper on "Diesel Varia"; Shipbuilding Gold Medal to Prof. F. Horn, of the Technische Hochschule, Berlin, for his paper on "Measurement of Wake"; M. C. James Gold Medal to Dr. T. Swinden for his paper on "Special Steels and their Application to Engineering and Shipbuilding". The Thomas Fenwick Reed Gold Medal, for the member of the Institution not more than thirty years of age who, among entrants for the medal, shows the greatest evidence of ability to take a share in the control of industry, has been awarded to John Hindmarsh. Mr Hindmarsh was for some time in the employment of Michell Bearings, Ltd., before obtaining his Whitworth Scholarship, when he went to King's College, London; he is now employed by Messrs. Swan, Hunter and Wigham Richardson, Ltd., Neptune Works, Walker, Newcastle-on-Tyne. The Institution is giving two new scholarships this session (each of £100). These have been awarded to Harry Chilton, an apprentice of the North-Eastern Marine Engineering Co. (1938), Ltd., and a student at Sunderland Technical College; and Thomas Corin, an apprentice ship draughtsman in the employment of Messrs. Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, for study at King's College, Newcastle-on-Tyne.

Announcements

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff, will be available for lectures on the Rothamsted experiments to agricultural societies and similar bodies. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

PROF ALFRED KÜHN, director of the Kaiser-Wilhelm Institute of Biology, Berlin, Dr. Hugo Hassingen, professor of geography at the University of Vienna, and Dr Hans Ahlmann, professor of geography at Stockholm, have been elected members of the Prussian Academy of Sciences in the physico-mathematical class

THE Child Welfare Information Centre of the League of Nations has issued a useful analysis of reports received by the Secretariat from thirty-seven countries on the legislative and administrative measures that have been taken or have been under consideration during the year May 1937 to May 1938 with reference to any aspect of child welfare (London: Allen and Unwin, 3s)

THE Child Guidance Council has awarded fellowships in psychiatry of the value of £300 and tenable for a year to Drs. Allen G. Crisp, Kenneth Soddy and Rosalind Vacher for half-time work at the London Child Guidance Clinic, 1 Canonbury Place, Islington, N.1.

THE New York banker, Mr. W. Childs, has left Yale University ten million dollars for cancer research.

THIRTY radio coast stations of the United States are provided with a medical man to give advice to passing ships.

THE London County Council has accepted a tender for £72,135 for building work in connexion with the erection of its new antitoxin establishment at Carshalton, which will afford valuable opportunities for research.

THE Ministry of Health with the collaboration of the Department of Health for Scotland and the National Fitness Council has arranged a permanent Health Exhibition which is being shown at the British Empire Exhibition and will be sent on to towns throughout Great Britain.

THE sixth Argentine Congress of Medicine, which will be held at Cordoba on October 16–21, will consist of three sections devoted respectively to biology, internal medicine and surgery.

THE twenty-fifth French Congress of Social Hygiene will be held at the Bordeaux Faculty of Medicine on September 30–October 2 under the presidency of M. Georges Risler. Further information can be obtained from Alliance d'hygiène sociale, 5 rue des Cases, Paris.

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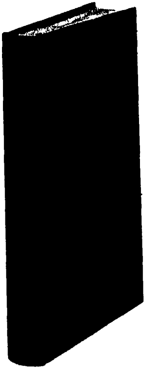

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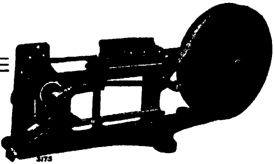

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Letters to the Editor

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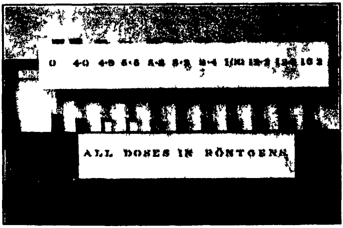
NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 578

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Effect of Increasing Doses of X-Radiation on Colloidal Gold

SOME time ago, in a communication from this Department[1], it was shown that a steadily increasing exposure to X radiation produced alternate increases and decreases in the electrokinetic potential of certain colloid particles The colloid used at the time (a dilution of Aquadag' in water) is peculiarly stable, and at no stage were there any signs of coagulation It was thought possible that with a more sensitive colloid the decrease in potential at the minima of the curve might be sufficient to bring the colloid to its flocculation point, and at my suggestion Dr Liebmann and Mr Jones have been working with certain pure gold sols

After irradiation in a quartz dish by measured doses of X radiation, the specimens of the sol were transferred immediately to well cleaned pyrex test tubes, and allowed to stand for a few hours As will be seen from the attached photograph, specimens of the sol which had been exposed to doses of 4 9 and 5 5 röntgens were completely coagulated, and that exposed to a dose of 5 8 röntgens very largely so On the other hand, specimens of the same sol exposed to larger doses (8 2–12 8 r) show no signs of precipitation The last tube (13 2 r) shows slight sedimentation, indicating the onset of a new coagulation dose



The results are completely reproducible, for the given sol, and measurements with the ultra microscope show that the doses producing coagulation are, in fact, those which produced the greatest decrease in the electrokinetic potential of the particles The photograph illustrates very vividly the interesting fact that, at any rate for certain colloidal solutions, a comparatively small dose of X-radiation may produce complete precipitation, while a dose of twice the amount leaves the sol apparently unaffected A further feature of interest is the very small quantity of radiation required to produce the effect

It is hoped to publish further details of the measurements shortly

J A CROWTHER

Department of Physics
University Reading
Aug 1

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[1] NATURE 140 28 (1937)

Structure of Age-Hardened Aluminium-Copper Alloys

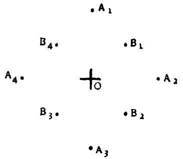
WE have made X ray diagrams of aluminium copper alloys (5 per cent Cu) age hardened at various temperatures (25°–200° C), the samples were composed of large crystals and the radiation was made monochromatic by reflection by a crystal In a previous paper[1], we described a new phenomenon which appeared in these diagrams streaks of various length issuing from the centre, which we attributed to the reflection of X rays by planes We have shown that these planes are parallel with the 100 planes of the crystal of solid solution and, moreover, that they are of small dimensions (100–400 A) We assumed therefore that these planes were composed of groups of copper atoms without making any hypothesis about the disposition of the atoms within those groups

Continuing the study of these alloys (among other things we have made use of molybdenum radiation besides that of copper) two other peculiarities were noticed

(1) From the very intense spots produced by the X ray reflection by the 111 100 110 planes of the solid solution, one or two straight streaks of varying dimensions and of very weak intensity issue As to the spots 100 one is directed towards the centre, the other is perpendicular to it As for the spots 111, 110, on the contrary, they may be inclined to the central radius

(2) A number of distinct spots of extremely weak intensity appear, for which the crystals of the solid solution cannot be responsible By orientating a given crystal so that the primary beam is parallel with an edge of the cube, the diagram which appears on a plate perpendicular to the beam is shown schematically in the figure below The streaks in the centre are due to the groups of atoms included in the planes perpendicular to the plane of the figure, and the distance OA is equal to the distance from one spot 100 of the aluminium crystal to the centre, and the spots B_1, B_2, B_3, B_4 are in the middle of the lines A_1, A_2

We may therefore regard this diagram as the diffraction figure of a two-dimensional lattice, which would be identical with a plane 100 of an aluminium crystal



Likewise, the study of the variation of the streaks described in the previous paragraph with the crystal orientation shows that these traces may be imputed to diffraction by such a two-dimensional lattice

These new experiments enable us to determine more closely the structure of the plane groups which we have described, it seems that the copper atoms should gather in patches in the 100 planes of the solid solution during hardening and should thus produce three rectangular systems of two-dimensional lattice of small extent

ANDRÉ GUINIER

Laboratoire de Physique,
Ecole Normale Superieure,
Paris.
July 21

[1] *C R*, **206**, 1641 (1938) and *C R*, **206**, 1972 (1938)

THE results reported by M Guinier are of interest to us as similar work has been in progress during the past two years in this Laboratory, and we have arrived at virtually the same conclusions as those given by M Guinier A paper describing the results of my experiments was communicated to the Royal Society on May 10, and a brief abstract has already appeared[1]. Pending the publication of the full account, the following summary may be of interest.

The 'two-dimensional' diffraction effect, to which M. Guinier refers, produces a series of elliptical streaks on the Laue photographs of single crystals of an alloy of aluminium with 4 per cent of copper aged at room temperature The accompanying photograph is of a crystal aged for six months at room temperature, orientated with a (110) direction parallel to the X-ray beam. The elliptical streaks make their appearance an hour after quenching the alloy; at first they are broad and faint, and in the course of a week, during which the alloy is hardening spontaneously, they become stronger and narrower, indicating that the area of the regions rich in copper is increasing.

If the alloy, age-hardened at room temperature, is heat-treated at 200° C., the first effect is a rapid reduction of hardness; the Brinell number falls from a figure of about 100 to 60 in ten minutes. At the same time the streaks disappear almost completely. Further heat-treatment leads to a rise in hardness to about 100 in a few hours; during this period the streaks reappear, but they are now quite narrow, showing that the plates of copper-rich metal are of considerable extent, of the order of 10^3 A, but still very thin, less than 10 A If the heat-treatment is continued, the hardness falls slowly and the streaks on the Laue photographs begin to break up into ill-defined spots, which on further heat-treatment become increasingly sharper, and ultimately a new set of Laue spots, indicating the presence of well-developed crystals of a second phase, makes its appearance.

In addition to the metallurgical interest of these observations, the results suggest that application of X-ray methods may throw light on the details of the mechanism of chemical reactions in the solid state.

G D PRESTON

National Physical Laboratory,
Teddington,
Middlesex

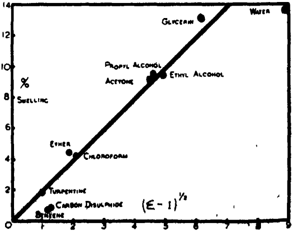
[1] *Proc Roy Soc*, A, **166**, 872 (June 16, 1938)

The Swelling of Birch Wood

M. HASSELBLATT[1] has measured the maximum linear tangential swelling of birch wood in a number of different liquids. An analysis of his results shows that they appear to fit the relation

$$s = a\sqrt{\varepsilon - 1},$$

where s is the swelling measured as an extension per



unit length, a is a constant of proportionality, ε is the dielectric constant (or S I C) of the liquid in which the wood is swollen

The extent of the agreement is shown in the accompanying graph

The above equation is in accord with W Sementschenko s theory of absorption[2] if we assume that the mechanical strain energy per unit volume of swollen wood is proportional to the energy produced on absorption of molecules from the liquid by all the cellulose micelles in a unit volume of wood

The strain energy per unit volume is $\frac{1}{2}Es^2$, where E is a mean value of Young s modulus of the birch the absorption energy is proportional to $(\varepsilon - 1)$ Assuming proportionality between these two quantities, we see that the above equation at once results

N A DE BRUYNE

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Aug 3

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[1] Hasselblatt M *Z anorg allg Chem* **154** 375 (1926)

[2] Sementschenk W *Z physik Chem* **129** 176 (1927)

A Concentration and Measurement of Atmospheric Ozone

Prof F A Paneth and Mr J L Edgar are to be congratulated on having devised a new and ingenious chemical method of measuring both the ozone and nitrogen peroxide in the London atmosphere[1]

It is interesting to note that their measurements agree with those which I obtained as a result of five years continuous measurements at both Plaistow and Upminster by means of an entirely different chemical method[2] My mean figure for the ozone in spring air was given as $1\,2 \times 10^{-6}$ vol per cent whilst that of Prof Paneth and Mr Edgar is given as $1\,1 \times 10^{-6}$

Prof Paneth and Mr Edgar s criticism that the older methods of analysis were not specific and did not distinguish between ozone and nitrogen peroxide does not apply to my own method which was specific I passed half the air through a tower filled with fine crystals of copper sulphate (which completely destroys the ozone but does not affect the nitrogen peroxide) and compared it with the other half containing both the ozone and the nitrogen peroxide The ozone is obtained by difference

There is an interesting point regarding the nitrogen peroxide in the atmosphere which my measurements of both town and country air brought out Nitrogen peroxide is not a normal constituent of country air Like the sulphur dioxide and ammonium chloride in town air (which I also measured) all three are the products of the combustion of coal The percentage of all three increases in the winter In country air near London the percentage of all three is trifling unless the direction of the wind brings them from London The percentage of ozone is independent of the direction of the wind

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[1] NATURE 142 112 (July 16 1938)

[2] *J Soc Chem Ind* 168T (March 28 1930)

IN the note on atmospheric ozone[1] we confined ourselves to a brief outline of our method leaving the discussion of the great number of other chemical attempts at ozone measurements to an intended fuller publication there of course due credit will be given to the very interesting paragraphs dealing with atmospheric ozone determinations in Dr W C Reynolds s paper on London air[2]

It has frequently been assumed that the presence of ozone in air is sufficiently proved by the observation that part of its oxidizing property is quickly destroyed by contact with various reagents Dr Reynolds made use of this effect for a quantitative ozone evaluation by determining the oxidizing power of air before and after this treatment Whether such a method of measurement should be called specific for ozone is a question of terminology but we are sure that Dr Reynolds will agree that it is safer to collect the ozone in a pure state to prove its identity by its absorption spectrum and then to titrate it in a range of concentration in which the potassium iodide method has been found to be satisfactory For highly diluted ozone this method of titration is liable to various errors and the simultaneous titration both of ozone and nitrogen peroxide in such dilutions would have to be investigated very thoroughly before full confidence could be placed in it

It is not obvious from Dr Reynolds s paper whether such preliminary work has been done but apparently he himself does not consider the nitrogen peroxide titration with potassium iodide as very satisfactory since he employs quite a different method when this gas is to be measured Further if anyone intends to apply such a differential method for the ozone determination we should not recommend copper sulphate for the destruction of the ozone content of air according to our experiments even in a slow current of gas this substance is likely to leave part of the ozone unaffected while manganese dioxide which has been used for the same purpose by Usher and Rao[3] or charcoal destroys it completely

Nevertheless it may well be that the figures obtained by Dr Reynolds as well as many of the other figures published by chemists on the ozone content of air were essentially correct, it can scarcely have been a mere coincidence that by crude chemical methods, at least the right order was found long before any spectroscopic measurement was available The trouble was not that these methods necessarily gave wrong results but rather that their reliability could not be checked and that there were not infrequently big discrepancies between results which seemed equally trustworthy It is, in fact, our hope that a much simpler chemical method than the one described by us may be found to be sufficiently exact for meteorological purposes but there is scarcely a better way for deciding this than by comparison with a method which by isolating and identifying the atmospheric ozone is free from the obvious shortcomings of the older ones

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J L EDGAR

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Aug 16

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[1] NATURE 142 112 (1938)

[2] Reynolds W C *J Soc Chem Ind* **49** 168T (1930)

[3] Usher F L and Rao B S *J Chem Soc* **111** 799 (1917)

Neutrons and the Origin of Life

WHEN in early days of the development of the earth its surface was covered with an aseptic solution of various organic compounds, these did not react in the same way as they would have done if certain enzymes, colloids and other complicated substances had already been present[1] The very first impetus to further development had to be given from molecules containing, for example, carbon and nitrogen in certain combinations One possible way of combining nitrogen and carbon not yet discussed in this connexion, may be found in conjunction with certain nuclear reactions, also prevalent in Nature at those early days

By the action of cosmic rays or hard γ rays from radioactive matter present in the ocean, the deuterium of the heavy water, contained in the ocean water, will produce neutrons These neutrons are slowed down in the water and will react with the nuclei of atoms in the molecules dissolved in the water Thus, for example, a heavy carbon atom in an already existent carbon chain compound should be transformable (through a short lived radioactive carbon isotope) into a stable nitrogen atom by expulsion of a β particle

$$^{13}_{6}\mathrm{C} + ^{1}_{0}n \rightarrow ^{14}_{6}\mathrm{C}^{*} \rightarrow ^{14}_{7}\mathrm{N} + {}_{1}\beta$$

If the molecule in which this reaction takes place *is not destroyed by the recoil or by the* β particle the new nitrogen atom may give rise to a new rather unexpected molecule containing a carbon nitrogen link and capable of new reactions In the same way also a phosphorus atom may be generated from a silicon atom and so on

Even the direct action of very hard γ rays on oxygen[2] is capable of producing a stable nitrogen atom (with mass number 15) through a short lived radioactive oxygen isotope

$$^{16}_{8}\mathrm{O} + \gamma \rightarrow ^{15}_{8}\mathrm{O}^{*} + ^{1}_{0}n$$
$$^{15}_{8}\mathrm{O}^{*} \rightarrow ^{15}_{7}\mathrm{N} + ^{0}_{+1}e$$

Thus various complicated organic molecules containing, for example, carbon nitrogen may have originated in a way rather different from ordinary chemical reactions and will perhaps have influenced the evolution of organic matter, eventually leading to the first primitive forms of living matter, no longer present on earth

JOHN TANDBERG

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Aug 15

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[1] Compare Oparin A J The Origin of Life (New York 1938)

[2] Chang Goldhaber and Sagane NATURE 139 962 (1937)

Condensation Coefficients of Mercury Halides

USING the method of Alty[1], we have measured the coefficients of condensation (f) of the compounds mercuric chloride, bromide and iodide A hemispherical cap of these salts was deposited by sublimation on the end of a glass tube which could be heated internally by boiling turpentine The temperature of the cap surface was measured by a fine thermocouple while the salt evaporated in a high vacuum The quantity of salt evaporated per unit time and area (M_1) was determined by weighing the deposit on a surrounding glass tube immersed in liquid air By calculating the maximum rate of evaporation (M_2) from the formula of the kinetic theory of gases

$$M_2 \quad \frac{0\ 0584\ \sqrt{M}}{t}\int^{t}\frac{P}{\sqrt{T}}\,dt \text{ gm /cm}^{2}\text{ sec ,}$$

where P is saturated vapour pressure (mm mercury), M is molecular weight, t is time of evaporation, T is absolute temperature, one finds $f = M_1/M_2$

The mean of the results of three or four runs for each substance is as follows

$HgCl_2$	$HgBr_2$	HgI_2
0 76 ± 0 1	0 64 ± 0 1	0 53 ± 0 1

For calculating M_2 the saturated vapour pressures P were extrapolated from the formulæ given in the Critical Tables The extrapolated values seem to be a little too small as compared with single direct measurements[2], and for this reason the coefficients f may be close to unity This means that each molecule striking the solid surface condenses at once The mercury halide molecules being linear have no dipole moment, and so this result is not inconsistent with Alty s empirical rule that the coefficients f for non polar molecules are near unity

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[1] Alty *Proc Roy Soc* A 161 68 (1937)

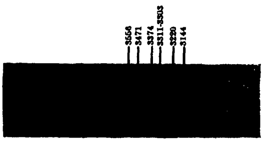
[2] Kelley *Bull* 383 U S Dep of the Interior Bureau of Mines Washington (1935)

Probable Dissociation of Nitrogen Molecules in the High Atmosphere

KAPLAN[1] recently succeeded in exciting, in the after glow of nitrogen, a line, λ 3471 A, that probably corresponds to the forbidden transition $^2P \rightarrow {}^4S$ of NI Theoretically it is very interesting and curious to see that this line is emitted under relatively high pressure, at the same time as the Vegard Kaplan bands, which are themselves forbidden

Here, however, I wish chiefly to direct attention on the application of this beautiful experiment to the knowledge of physical conditions of the upper atmosphere Indeed, as Kaplan points out, Dufay[2] and Gauzit[3] mentioned the presence of an intense radiation at a wave length λ 3471 A in the spectrum of the night sky, new observations, made by me, confirm very clearly the existence of this radiation and its intensity, as it is easy to see on the accompanying spectrum Probably we have here the line of NI, as Kaplan suggested two years ago[4]

The two arguments which prevented acceptance of this attribution have now disappeared First, the



ULTRA-VIOLET SPECTRUM OF THE NIGHT SKY

line λ 3471 A has been produced in the laboratory Further, while the dissociation during the day by absorption of ultra violet light from the sun is certainly very slight any other process seemed impossible , we thought that the energy for excitation of the light of the night sky—which does not exceed 7 electron volts—is not sufficient to dissociate the nitrogen molecule But this energy of dissociation was not accurately known , the value (9 0 volts) accepted a few years ago is now recognized as too high , the value adopted to day[5] is 7 34 volts We can consequently accept the dissociation of nitrogen molecules

In a recent paper Bernard[6] shows that a radiation at λ 3471 A is also present in the spectrum of diffuse auroras where the Vegard Kaplan bands are particularly intense This is an interesting confirmation of the probable presence of metastable *N*I atoms in the high atmosphere But Bernard s paper requires two comments

(1) Vegard and his collaborators probably observed the line λ 3471 A in the aurora they did not separate it from the second positive band near 3469 A the intensity attributed to this band is evidently too high

(2) The line λ 5206 A which corresponds to the $^2D - ^4S$ transition of NI, has not yet been recognized in the night sky , but its existence in the spectrum of the aurora was pointed out by V M Slipher and L A Sommer[7], who suggested its origin and mentioned that the line had been observed[8]

In conclusion, I propose seeking the λ 5206 A line in the spectrum of the night sky by a right choice of photographic plates and studying the λ 3471 A radiation of the night sky by the interferometer method, in order to ascertain for certain the existence of nitrogen atoms in the high atmosphere

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Aug 2

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[1] Kaplan NATURE **141** 845 and 1139 (1938)
[2] Dufay *J Phys* vii **5** 523 (1934)
[3] Gauzit *J Phys* vii **5** 527 (1934)
[4] Kaplan Quatrième rapport de la Commission pour l étud d s relations entre les phénomènes solaires et terrestres p 140 (1936)
[5] See for example Mathur L S and Sen Gupta P K *Proc Acad Sci U P* **5** Part 2 187 226 (1938)
[6] Bernard NATURE **141** 1141 (1938)
[7] Slipher and Sommer *Naturwiss* **171** 802 (1929)
[8] See Kayser Handbuch der Spektroscopie **5** 57

Angular Distribution of Electron Pairs

A NUMBER of experiments have been made on the angular distribution of electron positron pairs liberated by a beam of γ rays, but the results, where it is possible to compare them, do not seem to be in agreement It is therefore of interest to see what the theory predicts, and in the following a short account is given of the results obtained by a rigorous treatment of the problem The method used is an extension of that given by us[1] to find the total number of pairs created So far, the calculations have been made for Z (atomic number) = 84, $h\nu = 5\ mc^2$, and $Z = 50$, $h\nu = 3\ mc^2$ and $5\ mc^2$, where $h\nu$ is the energy of the γ ray

Denoting the *average* angles made by the direction of the electron and positron with the direction of the γ ray by θ_e and θ_p respectively, and the *average* angle between the pair by γ, the following results were obtained.

(1) θ_e, θ_p and γ decrease with increasing energy of the γ ray For particles of definite energy, the formula given by Bethe and Heitler[2] for the number of electrons of energy E_e emitted at an angle θ_e

$$\Phi(\theta_e)d\theta_e - \frac{\theta_e\, d\theta_e}{(\Theta^2 + \theta_e^2)^2} \qquad \Theta \qquad \frac{mc^2}{E_e},$$

is not valid for such low energies The values found for θ_e θ_p and γ when $Z = 84$ are about twice those given by the above formula ($h\nu - 5\ mc^2$)

(2) θ_e is slightly greater than θ_p This is to be expected since the average energy of the positron is greater than that of the electron This is in qualitative agreement with Grosev and Frank[3], who find for krypton $\theta_e - 33°$, θ_p 30°

(3) θ_e, θ_p and γ increase slowly with Z It is easy to show that the angular distribution is independent of Z to the first order (Born approximation), but for large Z the electrostatic forces on the particles become important and these must be responsible for the increased values of θ_e, θ_p and γ noted in (1) The strongest evidence in support of this would seem to be Alichanian s experiments[4] on lead, with $h\nu$ 14 mc^2 He found γ to be about 65°, as compared with 48° in krypton[3] for a considerably lower energy ($h\nu$ 5 mc^2) Similar results have been obtained by Jelepov (ref 3 p 52 footnote)

The calculations involved in the use of the accurate wave functions are extremely laborious particularly the evaluation of γ the angle between the pair For purposes of comparison with the theory it is therefore advantageous to have experimental results for θ_e and θ_p It is hoped to publish fuller details and results shortly

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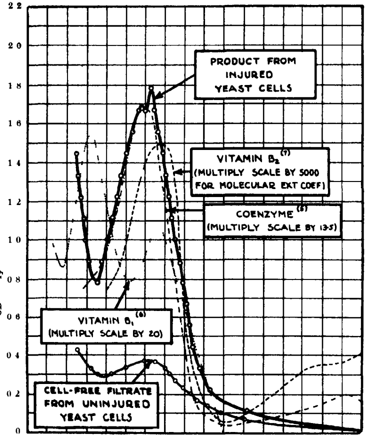
[1] Jaeger and Hulme *Proc Roy Soc* A **153** 443 (1936)
[2] Bethe and Heitler *Proc Roy Soc* A **146** 83 (1934)
[3] Grosev and Frank *Comptes rendus* (*Doklady*) **19** 52 (1938)
[4] Alichanian, Dzelepov and Spivac *Comptes rendus* (*Doklady*) **19** 379 (1938)

Chemical Nature of Proliferation-Promoting Factors from Injured Cells

WE have published investigations indicating that yeast[1] and animal cells[2] injured by ultra violet light and other means produce factors (intercellular wound hormones')[3] which are apparently released by injured, but living, cells into the intercellular fluid and stimulate the proliferation of normal cells Spectrographic and chemical studies indicate that the active materials from yeast contain nucleic acid derivatives, as previously suggested[4]

The 'wound hormones' were produced by prolonged, low intensity, full ultra violet irradiation of yeast in isotonic salt solution or distilled water Cell-free Berkefeld filtrates from irradiated and non-irradiated suspensions were assayed in yeast growth experiments The biological potency and extinction at 2600 A were much more marked in the filtrates from irradiated suspensions, and the potency and 2600 A extinction in various samples were closely parallel

As shown on the accompanying graphs, the spectrum of the 'wound hormone', or factor from injured cells (obtained by photographing the spectrum of the filtrate from irradiated yeast with filtrate from non irradiated yeast in the comparison cell) is characterized by a marked maximum at 2600 *A* and a minimum at 2360 A similar to the spectra of nucleic acids and their derivatives[5] On irradiation of the filtrate from injured cells, the extinction at 2600 A decreases and that at 2360 A and on the long wave leg of the curve increases as in adenine, guanine etc[6] Of absorbing components of nucleic acids, the spectrum least resembles that of uracil or cytosine Guanine is suggested by the broadness of the curve and adenine by the 2600 A maximum The spectrum is markedly different from that of vitamin B_1 [7] It lacks the long wave maximum of vitamin B_2 [8] It is similar to that of coenzyme[9]



Filtrates from both irradiated and non irradiated suspensions contained nitrogen and phosphorus but not halogens or sulphur (negative lead acetate nitroprusside and Sullivan reactions before and after sodium fusion) Both contained pentose (Bial test) but apparently not desoxypentoses (Kiliani test[10]) The Thomas[11] β napthol test gave a blue ring with both materials and a non uniform brownish colour with the Thomas[11] tryptophane reagent Negligible reducing activity was shown with Benedict s solution, and substantial freedom from protein by the biuret test Both materials gave positive murexide[12], Kossel[13], and diazo[14], and negative Weidel[12] and Wheeler Johnson[15] tests The positive reactions were more marked with the filtrates from irradiated suspensions Slight turbidity or opalescence was obtained from phosphotungstic, picric, and meta phosphoric acids No precipitate formed with $HgCl_2$ Contrary to previous indications[4], no positive colour reactions[16] could be obtained for pyridine even after boiling The active materials gave *p*H values of about 5 5 (glass electrode) in concentrations of 0 5 to 1 5 mgm per c c They were soluble in water and 50 per cent alcohol slightly soluble in 95 per cent and absolute alcohol and insoluble in ether and petroleum ether Their activity was not reduced by autoclaving at 20 lb for 15 minutes

A correlation of the spectrographic and chemical data shows the presence of phosphorus pentoses guanine and adenine Uracil cytosine pyridine and vitamins B_1 and B_2 are not indicated and yeast nucleic and adenylic acids seem to be ruled out by the Thomas[11] tests Of related substances resemblance is closest to cozymase[17] or coenzyme[9] The presence of guanine and the apparent absence of pyridine suggest that though similar to it the wound hormone is not identical with coenzyme or cozymase

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[1] Fardon Norris Loofbourow and Ruddy NATURE 139 589 (1937) Sperti Loofbourow and Dwyer, NATURE 140 643 (1937) *Studies Inst Divi Thomæ* 1 163 (1937) Loofbourow Dwyer and Morgan *Studies Inst Divi Thomæ* in the press Loofbourow and Morgan *Science* in the press

[2] Sperti, Loofbourow and Lane *Science* 86 611 (1937) Loofbourow Cueto and Lane *Studies Inst Divi Thomæ* in the press

[3] Loofbourow and Morgan *Studies Inst Divi Thomæ* in the press

[4] Loofbourow Schmieder Stimson and Dwyer *Studies Inst Divi Thomæ* 1 79 (1937) Cook Loofbourow and Stimson Xth Int Congress of Chem Rome May 1938

[5] Holiday *Biochem J* 24 619 (1930) Heyroth and Loofbourow *J Amer Chem Soc* 56 1728 (1934)

[6] Heyroth and Loofbourow *J Amer Chem Soc* 53 3441 (1931) *Bull Bas Sci Res* 3 237 (1931)

[7] Wintersteiner Williams and Ruehle *J Amer Chem Soc* 57 517 (1935)

[8] Kuhn Rudy and Weygand *Ber* 68 625 (1935)

[9] Warburg Christian and Griese, *Biochem Z* 282 157 (1935) Warburg and Christian *ibid* 287 291 (1936)

[10] Kiliani *Arch Pharm* 234 273 (1896) 251 562 (1913)

[11] Thomas *Z physiol Chem* 199 10 (1931)

[12] Winterstein and Samló Handbuch der Pflanzenanalyze Berlin 1933 vol 4 Pt 3

[13] Kossel *Z physiol Chem* 12 241 (1888)

[14] Burian *Ber* 37 703 (1904) Levene and Bass Nucleic Acids New York 1931 p 112

[15] Wheeler and Johnson *J Biol Chem* 3 183 (1907)

[16] Kulikow and Krestowosdwigenskaja *Z anal Chem*, 79, 452 (1930), Barta and Marschek *Biochem Z* 293, 118 (1937) Vilter Spies, and Mathews *J Amer Chem Soc* 60 731 (1938) and personal communication of Dr Mathews

[17] Myrbäck *Ergeb Enzymforsch* 2 139 (1933)

Mutation of the Blood-Group Genes

THE current theory of the mutation of the blood group genes postulates the appearance of gene *A* by mutation in one or more sites in the Europe-Asia land mass, and a similar appearance of gene *B* in India and in Africa.

There is little doubt that the mutation giving rise to gene *A* and *ipso facto* to group *A*, must have been a replacement of, or a change in, gene *R*, but the same certainty does not hold for the mutation of gene *B*. Gene *B* may have been a replacement, in one form or another, of gene *R* or of gene *A* or of both genes. Each of these three possibilities implies a different pre-mutation distribution of the genes in the races concerned.

If gene *R* alone was susceptible to *B* mutation, then the pre-mutation frequency of *R* in a race undergoing this change must have been equal to the sum of the post-mutation frequencies of *R* and *B*, and the frequency of gene *A* would be unaltered by the phenomenon.

If gene *A* alone was susceptible, then the frequency of gene *R* would be unaffected by the change, and the pre-mutation frequency of *A* would be equal to the sum of the post-mutation frequencies of genes *A* and *B*.

If both genes were liable to change, then, had the mutation affected all the susceptible genes, the present frequency of gene *B* would be 100 per cent, and for less complete changes the effect of the mutation is given by the equation

$$A = \frac{a}{1 - b}$$

where A is pre-mutation frequency of gene *A*, *a* is post-mutation frequency of gene *A*, *b* is post-mutation frequency of gene *B*.

This means that in the Hindu, if *R* alone were susceptible, the pre-mutation frequency of *A* must have been 0·149, if *A* alone were susceptible, this frequency must have been 0·440, and if both were susceptible, the frequency of *A* prior to mutation must have been 0·210.

The fact that there are no races showing gene *B* without some gene *A* suggests that the presence of *A* is a *sine qua non* to the appearance or mutation of *B*. It follows from this that *B* mutation was a change in gene *A* alone.

If this be the case, then the pre-*B* mutation frequency of *A* will show a maximum in the centre of the Europe-Asia land mass, as opposed to the minimum in the same place shown by the post-*B* mutation frequency of *A*. This is an attractive idea as it would imply a single mutation of gene *A*.

In what races other than the Hindu is there direct evidence of *B* mutation? It is generally accepted that there must have been such a change in Africa, but the site of this change is generally considered to have been West Africa, mainly because the Yoruba and the Senegalese show a biochemical index of less than unity. However, these peoples could have obtained their present distribution as a result of the mixing of other races in Africa. The only races having *B* in Africa about which this cannot be said are the pygmies and the Egyptians. These peoples each show a high proportion of both *A* and *B*, and could have given rise one to the other, but this seems unlikely on other grounds. They could not have received their gene distributions by the crossings of any other known races, even including the Hindu.

If we accept the conception that *B* mutation was a change in gene *A* and not in gene *R*, then the distributions of these races could not have arisen from any extant race or races by mutation, but their pre-*B* mutation frequency of gene *A* must have been considerably higher than that shown by any modern races, and in fact, higher than that shown by the pre-*B* mutation phases of any other people.

This implies one of two possibilities: either there was a mutation of *A* in Africa, or Africa was invaded by peoples having a very high proportion of *A*. When one bears in mind the extreme bastardization of the modern Bush people, it seems likely that they too, in their purer forms, must have had a similar proportion of *A*. Now did these various peoples, Bush, Pygmy and Egyptian, receive their *A* from the same source, and was this source an African *A* mutation, or was it the main mass of mankind?

Finally, there is a third, and very interesting possibility, namely, that Africa was the site of the main *A* mutation, and that peoples outside Africa have obtained their *A* from that continent.

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Aug. 9.

Pleistocene Site in the Malay Peninsula

IT was to be regretted that until recently no artefacts of Pleistocene age had been found in the Malay Peninsula, and particularly so because of the relationship of the peninsula to the now sunken Sundaland which formerly joined Sumatra, Java and Borneo to the mainland of Asia.

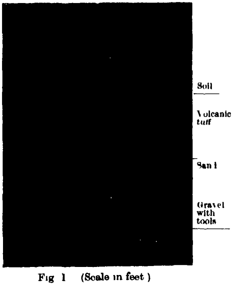

Fig. 1. (Scale in feet.)

Acting on a suggestion of Mr. E. S. Willbourn, director of the Geological Survey, F.M.S., I visited the Kota Tampan Rubber Estate which lies on the west side of the Perak River about three and a half miles south of Lenggong, Upper Perak. On this estate is a deposit of volcanic tuff overlying a bed of sand and gravel which itself rests on laterite. The site lies just below the 250 ft. contour and is probably an old terrace of the Perak River. Since there have been no recent volcanoes in Malaya, a foreign origin had to be supposed for the tuff, specimens of which were kindly examined by the Netherlands Indies Vulcanological Survey in Bandoeng, who reported that it probably came from "the big Toba eruption', which was the origin of Lake Toba in Sumatra Fig 1 shows a stream cut section of the deposits, but the underlying laterite cannot be seen

In this and two other nearby gravel beds were found stone tools, typical specimens of which are shown in Fig 2 The majority are made from pebbles of quartzite and most of them are unrolled or only slightly rolled They comprise (*A*) Chopper with just enough flaking to make an edge This is the commonest type (*B*) Chopper, of very fine grained rock, the exact find spot is shown by the cross in Fig 1 (*C*) Hand axe, triangular section, rolled the only specimen found (*D*) Hand axe, the butt has been flaked to reduce the size of the tool

The characteristics of these tools are that they are made from pebbles with the minimum flaking on one side only, and the cutting edge is always made by the meeting of a flaked surface with the unworked natural pebble skin

The other types consist of flakes worked up into end scrapers, hollow scrapers and points, together with a large number of pebbles used as hammer stones The latter tools would seem to show that the place was a workshop and perhaps even a dwelling site

As yet not enough specimens have been found to warrant detailed comparison with other cultures, and dating is not possible on palæontological grounds since no fossils were found There does, however, seem to be an undoubted kinship with the Pajitan culture described by von Koenigswald from central Java[1], but it differs from it in the complete absence of bilateral flaking and in the greater amount of original pebble surface which is preserved It may therefore be an earlier phase of the Pajitan culture The commonest type (Fig 2A) is very much like a Pre-Stellenbosch tool from South Africa illustrated by van Riet Lowe[2]

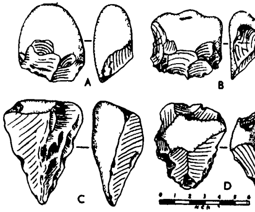

Fig 2

It is hoped to carry out further excavations in the near future, and in the meanwhile I propose the name *Tampan Culture* to describe the tools from this, the first Pleistocene archæological site to be found in the Malay Peninsula

Raffles Museum, H D COLLINGS
Singapore, S S July 29

Dry Crossing of the Nile

THROUGH the co operation of Dr Alexander Cruickshank, senior medical inspector of the Equatorial Province of the Sudan, and of my son, Lieut Colonel F O Cave, I am able to give some recent particulars of Wayland s crossing, or the dry crossing of the Nile Dr Cruickshank visited it last Easter and took photographs of it, one of which is reproduced herewith The width of the river is about 80 yards, and the width of the crossing from its upstream to its downstream edge is approximately 250 yards

WAYLAND S CROSSING EASTER 1938 LOOKING DOWN STREAM WIDTH OF RIVER APPROXIMATELY 80 YARDS DEPTH OF CROSSING APPROXIMATELY 250 YARDS

In places the accumulated vegetation exceeded 10 feet in thickness but at the edges it was loose and thin in places, and one of Dr Cruickshank s porters fell through But away from the edges and presumably in some parts at the edges it was thick enough for elephants to cross, for recent elephant spoor was found On the surface there was a thick ash deposit left after grass and papyrus had been burnt It would appear from Dr Cruickshank s account that there are no signs of the crossing breaking up at present

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Aug 24

Distribution of the Polychæte *Ophelia cluthensis* McGuire

Ophelia cluthensis was described in 1935 by McGuire[1], who obtained her specimens from Millport in the Clyde, and more fully in 1938 by Brown[2] It occurs in a narrow zone of sandy beaches just below high water mark neaps, frequently to the extent of several hundred to the square metre Besides being recorded from the Firths of Clyde and Forth, Wohlenberg[3] records its presence at Sylt, Germany Specimens obtained by Fauvel[4] at Saint Vaast, France, were described by him as young *O limacina* but are considered by Brown to be probably *O cluthensis*

As a result of recent shore collecting I have now to record the species from South Wales and Ireland The Welsh specimens were obtained from a small area of the beach at Lavernock in the Bristol Channel, about four miles along the down channel coast from Cardiff The salinity at high water at this point varies from 20 per mille in winter to 28 per mille in summer The Irish specimens were obtained from a sheltered bay at Falcarragh, Co. Donegal, about six miles east of Bloody Foreland The salinity of the water here is affected, particularly at low water, by a stream of freshwater. At one station 1,100 specimens per square metre were counted At both places the sand was of fine grade with a small quantity of silt

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[1] Early Palæolithic Stone Implements from Java *Bull Raffles Mus* Ser B 1 No 1 1936

[2] The Geology and Archæology of the Vaal River Basin Geological Survey Union of S Africa *Mem* 35 Pl VIII No 1

I am obliged to Dr A C. Stephen for confirming my identification, and for the information that the Welsh animals are quite typical, but that the Irish specimens show a certain amount of variation In both cases the animals are small, the largest being only 8 mm in length, so that these variations are probably due to immaturity.

The addition of these two records lends support to Dr. Stephen's opinion that *O. cluthensis* is considerably more common than the previous records suggest It seems certain that this species has been frequently overlooked or dismissed as a juvenile form

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[1] McGuire, *Scot Naturalist*, 45 (1935)

[2] Brown, *Proc Roy Soc Edin*, **58** (2), 135 (1938)

[3] Wohlenberg, *Helgol Wiss Meeresuntersuch*, **1** (1), 1–92 (1937)

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Connexions of the Pterygoquadrate in the Tadpole of *Philautus variabilis* (Anura)

WHILE examining the chondrocranium of Ranid and Rhacorphorid (Polypedatid) genera of frogs, the connexions of the pterygoquadrate with the cranium were found to vary considerably. It is well known since the time of Parker[1] and Gaupp[2] that in the anuran larvæ, the pterygoquadrate gains attachment with the cranium normally in three regions, namely, an anterior ligamentary or, in the majority of cases, a cartilaginous quadrato-ethmoidal connexion, the second connexion is in the posterior orbitotemporal region, called the processus ascendens, which bears definite relationship with the three branches of the Vth cranial nerve. When the tadpole undergoes metamorphosis, this larval connexion is lost (say in the case of *R. fusca* larva (*S temporaria*) 29 mm, de Beer[3]) and the adult is without one There is no anuran larval form described where, in the larval stages prior to metamorphosis, the absence of a processus ascendens is described. The last connexion is the oticus one; the posterior portion of the pterygoquadrate unites with the dorsal wall of the otic capsule over the cranioquadrate passage. This connexion, however, may be absent from some tadpoles.

Now, with regard to the genera which I have examined, *Philautus variabilis* Günth (tadpoles kindly identified by Prof. C. R. Narayan Rao) needs special mention. I have examined the sectional views of at least two tadpoles of each of the stages measuring 22 mm. and 24 mm. (head and trunk 10 mm.) and 31 mm. (head and trunk 11 mm.) in all of which the posterior limbs have not appeared. All these tadpoles belong to premetamorphic stages. While the anterior connexions of the pterygoquadrate with the cranium are normal, the sections of the posterior orbitotemporal region do not show the presence of the connexion of a processus ascendens palatoquadrati with the pila antotica or an oticus connexion with the otic capsule, there being a little connective tissue between the posterior portion of the pterygoquadrate and the cranium, and so far as is known to me the absence of both these connexions in the larval anura is not recorded This is a remarkable feature in *P. variabilis*, and if the processus ascendens connexion has broken down as early as the stage studied, then it is an excellent example of developmental acceleration or heterochrony If, on the other hand, the connexion is not established at all, which I think is more probable, then *P. variabilis* is the first anuran larval form where both the processus ascendens and oticus connexions are wanting

Further study of the development of the cranium in this and allied forms is engaging my attention, and the result will be published elsewhere

My thanks are due to Prof A Subba Rau for helpful criticisms

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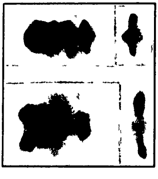
[3] de Beer, G R, "The Development of the Vertebrate Skull" (Clarendon Press, Oxford, 1937)

[4] Okutomi, K, *Z Anat u Entwick*, **107** (1937)

[5] Goodrich, E S, "The Structure and Development of Vertebrates" (Macmillan and Co, Ltd, London, 1930)

Differentiation of Heterochromatic Regions during Meiosis

HETEROCHROMATIC regions have been revealed in the somatic cells of a large number of plants and in certain animals during the metaphase by many investigators They are usually situated around the centromeres and at the distal ends One of the characteristic properties of the heterochromatic regions is the intensive absorption of hæmatoxylin and other stains Genetically, they are poor in genes in *Drosophila* and are usually called 'inert regions'.



The chromosomes have usually a spiral structure during the meiotic metaphase This is characteristic for both heterochromatic and euchromatic regions Differentiation of heterochromatic and euchromatic regions in pure species during the meiotic metaphase is technically more difficult than in some species hybrids, where one of the parents has longer chromosomes, obviously with a larger amount of heterochromatic substance than the other The accompanying illustration shows two meiotic metaphases in side view and two single bivalents from two other meiotic plates of the amphidiploid *Nicotiana glauca* × *N Langsdorffii* Both single bivalents have darker regions at the portions turned towards the poles, where the centromeres are obviously situated The bivalents at the left side of both metaphase plates are darker than the right (lighter) pairs of each plate The former have probably more heterochromatic substances than the latter Each of the lighter bivalents of these two plates has two chiasmata, their centromeres, directed towards the poles, are surrounded with small heterochromatic (darker) portions

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Points from Foregoing Letters

A PHOTOGRAPH is submitted by Prof J A Crowther showing the effect of increasing doses of X radiation on colloidal gold The photograph shows that, whereas the sol is completely precipitated by doses of 4 9–5 5 röntgens, larger doses of 8–12 8 röntgens leave the sol completely stable

In X ray diagrams of age hardened aluminium copper alloys, A Guinier finds diffraction spots produced by two dimensional lattices, suggesting that the copper atoms form small plane groups, where they maintain a regular disposition G D Preston reports a similar effect, observed in Laue and oscillating crystal photographs during the process of age hardening of an alloy of aluminium with 4 per cent copper He ascribes it to the segregation of copper atoms of relatively high scattering power on widely separated (100) planes of the aluminium lattice

Dr N A de Bruyne finds that the maximum linear swelling of birch wood is related to the dielectric constant of the swelling liquid by an equation which has a simple theoretical interpretation

Dr W C Reynolds points out that the percentage of ozone in London air found by Prof F A Paneth and J L Edgar, namely, 1 1 × 10^{-6} vol per cent, agrees with that which he obtained during five years measurements by an entirely different specific chemical method Prof Paneth and Mr Edgar comment on a few essential differences between their method and those previously employed for the determination of atmospheric ozone

Dr J Tandberg suggests that nuclear reactions may have influenced the development of organic matter in the ocean in primeval times Organic molecules may on rare occasions have had a carbon or oxygen atom transformed into nitrogen as an impetus to new and rather unexpected reactions, resulting in organized systems with colloids, leading to primitive forms of living matter

The coefficients of condensation of mercury chloride, bromide and iodide are calculated by F Metzger and Dr E Miescher to be 0 76, 0 64 and 0 53 respectively, using the formula of the kinetic theory of gases Owing to uncertainty in the extrapolated values of the saturated vapour pressure the authors infer, however, that the condensation coefficients may be close to unity, which would mean that each molecule striking the cold solid surface condenses at once

Prof J Gauzit states that his new observations of the spectrum of the night sky confirm the presence of an intense λ 3471 A radiation, which probably coincides with the line recently excited by Kaplan in the high pressure nitrogen afterglow Recent determinations reduce to 7 34 volts the energy of dissociation of nitrogen molecules, and thus dissociation in the high atmosphere is probable The line λ 5206 A, which corresponds to the transition $^2D - {}^4S$ of NI, has already been observed in the auroral spectrum

By calculations involving the use of accurate wave functions, J C Jaeger and Dr H R Hulme estimate that the average angles made by the electron and the positron with the beam of gamma rays by which they are liberated, and also the average angle between the electron and positron, decrease with increase in energy of the gamma rays and increase slowly with the atomic number of the atom involved The average angle for the electron would be slightly greater than for the positron

The chemical nature of the factor producing cell proliferation, formed by the action of ultra violet light upon yeast cells, and generally when cells are injured (wound hormones) has been investigated by Prof J R Loofbourow, E S Cook, and Sister M M Stimson Its absorption spectrum is similar to that of cozymase or coenzyme but the presence of guanine and the apparent absence of pyridine suggest that it is a different substance

Assuming that the gene responsible for the *B* blood group reaction arose from a mutation of a gene responsible for the *A* blood group reaction (or admitting, at any rate, the presence of *A* before the presence of *B*), Dr R Elsdon Dew discusses the probable place of origin of the genes in the light of the present geographical distribution of the various blood groups among African peoples

The discovery of artefacts of Pleistocene age in gravel underlying volcanic tuff at Tampan, Malay Peninsula, is reported by H D Collings

Records of the distribution of *Ophelia cluthensis* McGuire in Wales and Ireland are added by C B Rees to previous records from Scotland, Germany and France

Dr L S Ramaswami reports that in the cranium of two tadpoles of *Philautus variabilis* he has been unable to find either the processus ascendens or the oticus connexions and, unless the connexions had broken down at an unusually early stage, this would be the first case of anuran larvæ in which those connexions are absent.

Research Items

Stone Age Cultural Succession in Southern Rhodesia

A ROCK-SHELTER on the Nyazongo Mountain, twenty miles to the north of Penhalonga and ten miles from the eastern border of Southern Rhodesia, has been excavated by Mrs C. Martin with the view of ascertaining whether a sequence comparable to that established by A. L. Armstrong for the Bambata Cave also occurs throughout Mashonaland, and, if possible, of determining the predecessor of the Wilton culture on the eastern border. A trial trench dug in October 1936 was extended in 1937 to a total measurement of nine feet by ten. Mrs Martin's report is supplemented by technical reports by the late Father P. Stapleton, dealing with the implements, and by Mr L. H. Wells, dealing with the pottery (Queen Victoria Memorial Library, Salisbury, *Occasional Paper* No. 1, 1938. Pp. 18. 5*s*. net). The existence of two stone age industries was established, Bambata and Wilton. The lower is characterized by broad flakes of both greenstone and quartz and 'points' in both materials. This occupies the third and fourth foot of the excavation. It predominates in the fourth foot, and in the third is mixed with Wilton. It does not appear in the higher levels, but is found below the fourth foot level and under the ledge in front of the cave. This confirms the conclusion that this is the earliest industry of the shelter. The points show that it is a Bambata industry, though it is not the latest phase of that industry. The upper culture is Wilton. It occurs first in the fourth foot, more than fifty specimens being counted from that horizon; but from the third foot some one hundred and fifty were recovered, and from the first two feet more than three hundred. There is no break between the industries. Though they were not contemporaneous, the interval between them cannot be long. Ground axes belong to the Wilton horizon, though not to the earliest part. The custom seems to have come in during the Wilton occupation. The fragments of pottery found in abundance in the uppermost foot and occasionally in the second foot fall into four or rather three groups, which may be resolved into two types, belonging either to the previously known 'pit-circle' people, or the later Manyika inhabitants.

Recent Botanical Exploration of China

PROF. H. H. HU has recently reported upon his botanical collections in China since 1920 (*J. Roy. Hort. Soc.*, 63, Pt. 8, August 1938). Although many garden plants of proved excellence are of Chinese origin, that country must hold many more botanical or horticultural treasures. A beautiful new species, *Sinojackia xylocarpa*, was, for example, found in a suburb of Nanking. A rich harvest of new species is cited in the paper, and several of them are figured upon very clear lithographs. Prof. Hu's collections have been mainly from south-western Yunnan, and three distinct elements have been recognized in the flora, namely, the Burmese, the Indo-Chinese and the endemic. The Indo-Chinese elements link the Yunnan flora with that of Kwangtung, Kwangsi, Hainan and Formosa. Species of the genera *Camellia*, *Adinandra* and *Eurya* are the chief endemic plants, but a number of new rare genera are also represented. Many Burmese genera are found in Yunnan but not elsewhere in China.

History of Rhubarb Cultivation

THE use of rhubarb for medicinal purposes is of considerable antiquity, for the Chinese herbal of Pen-King mentioned its corrective properties as early as 2700 B.C. Miss D. M. Turner has made a study of the economic significance of various kinds of rhubarb from that date until the present time (*J. Roy. Hort. Soc.*, 63, 8, August 1938). Though known in classical times, it was not until the thirteenth century that roots of the 'rhapontic' rhubarb were brought to Europe by Marco Polo. Herbals of the seventeenth and eighteenth centuries mentioned several kinds, and the plant attained culinary popularity about 1750. Miss Turner's paper considers the history, taxonomy, hybridization and varieties of *Rheum rhaponticum*, *R. palmatum*, *R. undulatum*, and other species. Forcing of the plant during winter was apparently discovered by accident at Chelsea in 1817, and the history of rhubarb forcing in the south West Riding of Yorkshire makes interesting reading. The climate of this region, though unsalubrious for man and many other organisms, is completely adjusted to the needs of rhubarb grown for forcing.

Compounds of Divalent Europium

PRESENT knowledge of the compounds of divalent europium makes it probable that in this state the metal behaves like an alkaline earth metal, intermediate in properties between strontium and barium. G. Beck and W. Nowacki (*Naturwiss.*, 26, 496, 1938) report experiments on the preparation and crystal structure of the sulphide and fluoride of divalent europium which support this view. To prepare europium fluoride, EuF_2, the trivalent fluoride, EuF_3, was reduced in a stream of hydrogen at a red heat. An impure europium sulphide, EuS, was obtained by heating the oxide Eu_2O_3 in a current of hydrogen sulphide. It was pure violet in colour, but contained some oxysulphide. The pure sulphide was obtained by heating europium sulphate, $Eu_2(SO_4)_3$, in a current of hydrogen sulphide. It was brownish-violet in colour and was pyrophoric when gently warmed. Efforts to make the oxide EuO were unsuccessful. The crystal structures of the sulphide and fluoride were determined by the usual methods. The sulphide EuS has a lattice of the sodium chloride type with $a = 5.957 \pm 0.002$ A. The ionic radius of Eu^{++} obtained from this is 1.24 A. Europium fluoride, EuF_2, has the fluorite structure. Comparison of the lattice constants with those of strontium and barium fluorides shows that in this respect europium compounds approximate more closely to strontium than to barium compounds.

Study of Atmospheric Dust

P. L. FAYETTE (*Thèse de Paris*, No. 487; 1938) states that although the first work on pulmonary diseases due to inhalation of dust dates from the eighteenth century, the first scientific work on the subject did not appear until the beginning of the nineteenth century and was due to the researches of Laennec, Parent Duchatelet and Virchow. Fayette describes the following groups of dust inhalation of which may be injurious. (1) Microbial dust in which the number of germs varies according to the site, season and atmospheric conditions. (2) Dust with a local chemical action giving rise to silicosis. (3) Dust containing particles of coal or tobacco which merely causes a change in the colour of the lung without producing disease. (4) Dust containing substances such as wool, cotton, silk, pollen and drugs which give rise to a number of allergic diseases. The campaign against dust which is more advanced in Great Britain and the United States than in France is of special importance in industrial hygiene, in which medical selection and supervision of workmen exposed to the inhalation of dangerous dust are very desirable.

Atmospheric Pollution at Wellington, N.Z.

METEOROLOGICAL OFFICE NOTE NO. 19 of the Department of Scientific and Industrial Research, New Zealand, is an extract from the *New Zealand Journal of Science and Technology* in which an analysis is given by C. E. Palmer of observations of atmospheric pollution at Wellington, N.Z. They were made with the aid of a dust counter of the type designed by Owens and extend at irregular intervals over a period of four years. They are not numerous enough to give a comprehensive survey even for the limited area of Wellington in which they were made, but nevertheless afford some interesting comparisons with similar data in other towns that are less fortunate than Wellington in the matter of pollution. The apparatus provides for the sudden cooling by expansion of air already saturated with water vapour, which leads to supersaturation and the condensation of the excess on ions, hygroscopic nuclei and dust particles present in the sample of air under examination. The resulting droplets adhere to a slip of glass and can then be examined under the microscope. A table is given showing the relative numbers of different types of particle and also the accompanying meteorological conditions, the particles being classified under four main headings: (a) separate black smoke spheres large and small, the small being at or near the limit of visibility with a 1/12 in. oil immersion objective, while those distinctly visible were classified as large, (b) aggregates of smoke spheres, (c) hygroscopic crystals, and (d) glassy particles. The separate smoke spheres are much the most numerous and the glassy particles the least numerous although of relatively large size (generally 10–20 μ in diameter). The average number of particles of all kinds per cubic centimetre was 184 whereas Kidson found about 500 in Melbourne, and in London the figure is more like 10,000.

Accuracy of Meteor Data

IN a recent paper, Mr. J. G. Porter has dealt with 102 meteors doubly observed by Mr. J. P. M. Prentice and Mr. G. E. D. Alcock (*J. Brit. Astro. Assoc.*, **48**, 9, July 1938). The paths of these have been computed, and Mr. Porter has made a brilliant analysis of the data with the object of discovering possible sources of observational errors. It is well known to meteor observers, and more so to computers of their real paths, that one or more observers will frequently miss a portion of the path, either beginning or ending or both. British observers have generally aimed at recording *directions* of flight with great accuracy, and their object has usually been attained. Admittedly they often miss a portion of the beginning or ending, but this does not prevent a computer from determining the radiant, which depends upon direction and not on length of flight. Mr. Porter's paper shows conclusively that there are also small errors in direction—*errors in altitude*'—and that the end of the path is more accurately observed than the beginning, a conclusion that one would expect from the fact that when a meteor is seen its path and end can be followed with considerable accuracy, whereas its exact beginning can be recorded only when the observer is looking towards that particular portion of the heavens. As the errors are distributed at random according to the analysis, the arithmetic mean of the computed heights is the best value to adopt, and the mean deviation can then be taken as a criterion of the weight of the path. It is pointed out that the harmonic mean of the computed velocities should be used to obtain the greatest accuracy—a method adopted by Öpik some years ago—and an elementary proof is supplied for the reader. Estimates of magnitudes should, it is suggested, be given as mean zenithal magnitudes, the reduction being effected by the formula, $m = 5 \log \sec z$, where z is the zenith distance of the meteor when observed, and m is the magnitude reduction.

Origin of Binary Stars

DR. RAYMOND A. LYTTLETON has recently published a paper (*Mon. Not. Roy. Astro. Soc.*, **98**, 8, June 1938) in which he casts serious doubts on the theory of the origin of binaries by fission. A brief discussion of the fission problem is given, with reference to the work of Poincaré, Darwin, Liapounoff and Jeans, who investigated the configurations of equilibrium of a rotating mass of gravitating liquid of uniform density, especially that part of the problem which dealt with the secular stability of the pear-shaped figure. Jeans showed that this pear-shaped figure is secularly unstable, and within recent years Cartan has shown that it is also ordinarily unstable, so that once the pear-shaped series is reached, the relative motion of the parts is no longer slow and oscillatory. From this point the motion cannot be traced by a series of definitely equilibrium configurations, the system departs in an exponential manner from the critical configuration and it is possible to advance a number of general considerations indicating the result of this instability, though the motion cannot be followed rigorously. Dr. Lyttleton discusses the matter and deals with the two cases which arise for consideration. (1) The smaller body may be endowed with insufficient velocity to escape from the larger body. If, however, the smaller comes within the Roche limit, as it would do, disruption would occur. The assumption of nearly equal masses made by Jeans is inadmissible because there is insufficient angular momentum in the critical ellipsoidal form. (2) The smaller body may escape altogether from the larger—a view which is shown to be much more likely. The fission theory is unable to explain systems in which the mass-ratio is less than 3:1, and as similarity of mass is the rule rather than the exception in spectroscopic binaries, it seems that the origin of binary stars by fission must be discarded, as well as deductions from it relating to the time-scale.

Vector Maps and Crystal Analysis

By Dr. Irving Langmuir and Dr. Dorothy Wrinch

IN a series of communications, Patterson[1] and Harker[2] have introduced a new method of exhibiting the data contained in X ray photographs of a crystal with the view of facilitating the use of such data for the determination of the atomic arrangement in the crystal The essential feature of this type of analysis lies in the use of special Fourier series by means of which it is theoretically possible to construct a three dimensional 'vector' map of a crystal, regarded as a distribution in space of positive and negative point intensities, superposed upon a continuously varying volume distribution of electrons These maps represent, not the distribution of the point intensities in space, which is of course the objective of crystal analysis, but vector distances between them taken two at a time The question then arises as to how far it is possible to derive from point intensity distributions in 'vector space, S_2, corresponding point intensity distributions in 'atomic' space, S_1

Vector diagrams, that is, sections and projections of vector maps, have been constructed in a few cases including proustite[3], pyrargyrite[3], and pentaery thritol[3] Supplemented by data relating to the chemical composition, density, etc , of the crystal, they have been used in the determination of these structures Some vector diagrams have also been constructed for an insulin crystal[4]

Previous to the construction of these diagrams, a structure, namely, the cyclol cage C_2, was proposed for the insulin molecule[5] Investigations were consequently undertaken[6,7] to ascertain whether these diagrams confirm this structure or (as has been stated[4,8]) fail to confirm it, in the course of which it became clear that simple geometric arguments make it possible to go a long way towards interpreting these diagrams, and presumably other vector diagrams also, even when nothing whatever is known about the chemical composition, size, shape or density of the insulin molecule In this communication a preliminary sketch is given of the geometrical method developed in these investigations, since it appears to have a wide field of applicability in the interpretation of vector maps, whether they are derived from molecular or megamolecular lattices

We consider first vector maps which result from various simple distributions of point intensities Suppose in atomic space S_1 there are two points A, B with intensities $\pm r$, $\mp s$ respectively To construct the vector map in space S_2 of this distribution in S_1, we select any point O as origin in S_2 and erect at O vectors corresponding to the vector distances from A to A, from B to A, from A to B, and from B to B, associating with AA, BA, AB and BB, the end points of these vectors, intensities r^2, $-sr(=-rs)$, $-rs$ and s^2 respectively. We may write this result in the form

$$V(\pm rA \mp sB) \equiv (\pm rA \mp sB, \ \pm rA \mp sB) = r^2AA - srBA - rsAB + s^2B^2 \qquad (1)$$

Here the points AA and BB lie at the origin O, and since the steps from B to A and A to B in S_1 are equal and opposite, the points BA and AB in S_2 are symmetrically placed with respect to the origin We notice that points in S_2 obtained from pairs of points in S_1 with intensities of the same sign have positive intensities, those obtained from pairs of points in S_1 with intensities of opposite signs, negative intensities , also that the magnitude of the intensity at O is the sum of the squares of the intensities of the points in S_1

Now the expression on the right of (1) is the formal expansion of the expression $(rA - sB)^2$ and the generalized expression

$$V\Big(\sum_n r_nA_n\Big) \equiv \sum_n r_n^2A_nA_n + \sum_{m \neq n} r_nr_mA_nA_m \qquad (2)$$

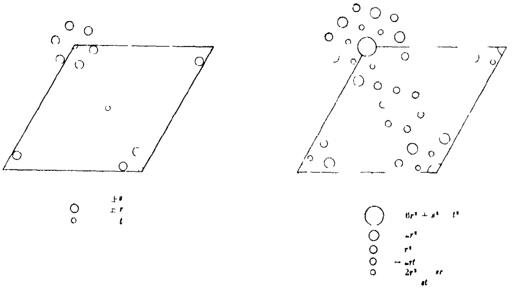
similarly gives the method of constructing vector maps for any set of point intensities in any dimensions This binomial formulation of the structure of the vector map of a set of points not only makes it simple and easy to be sure that all the requisite terms have been considered it also indicates the type of mathematical problem upon the solution of which the interpretation of vector maps depends It is essentially akin to the problem of finding a square root , indeed *interpretation of vector maps is the art of deducing the positions of n points in space S_1, from the positions of n^2 points in S_2*

To apply these ideas to crystals, we consider distributions of point intensities which are periodic Thus if in S_1 there is a one dimensional distribution, consisting of points of intensity $\pm r$ alternating with points of intensity $\mp s$ at even distances, the vector map in S_2 has the same unit cell and comprises at cell boundaries an intensity of $r^2 + s^2$ and at mid points intensities of $-2rs$

A second illustration—a two dimensional crystal in which the unit cell is rhombic—is shown in Fig 1*a* The repeating unit consists of a hexagon of points of intensity $\pm r$ at the centre of the hexagon a point of intensity $\mp s$, in addition a point of intensity $\pm t$, arranged as shown The vector map, periodic in the same unit cell, is shown in Fig 1*b* It contains points with intensities $2r^2$, r^2, $2r^2 - 2rs$, $2rt$, $-2st$ (In the figures, relative intensities are indicated by the areas of the circles They have been drawn for the particular case in which in S_1 r $-s$ t = 8 -6 3, so that the intensities in S_2 are in the ratio $2r^2$ r^2 $2r^2-2rs$ $2rt$ $-2st$ 32 16 8 12 -9)

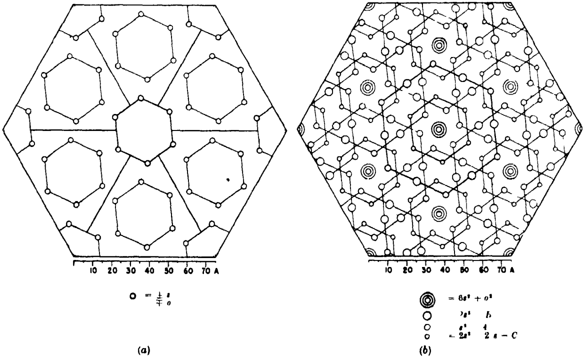
A third example relates to a three dimensional crystal in which the rhombohedral cell contains one molecule consisting of points of intensity $\pm s$ at the corners of an octahedron and a point of intensity $\mp o$ at its centre The molecules are arranged with one trigonal axis along the trigonal axis of the crystal Fig 2*a* shows the *c* plane projection of the crystal in S_1 Fig 2*b* shows the corresponding projection of its vector map in S_2, in which there are points the intensities of which are $2s^2$, s^2 and $2s^2 - 2os$

The S_2 projection shows that the molecules in S_1 are trigonal and that the molecular and crystal hexagonal axes are not coincident but make an angle with one another (say 6° in the figure) The dimensions of the molecule are obtained when it is realized that the distribution around the cell corners in S_2 implies a distribution around the cell corners in S_1 of half the dimensions The relative intensities of the points A B (s^2 and $2s^2$ respectively) make it possible to interpret the intensities on an absolute scale Finally, the lower intensity of the point C which contains a term $2s^2$, demonstrates the presence of an intensity at the centre of the molecule the sign of which is opposite to that of s, which, contributing, with the s points, a negative intensity $-2os$ to C, reduces the total intensity there to $2s^2 - 2os$



(a) (b)

Fig 1



(a) (b)

Fig 2

The illustrations given above have been selected, not only because they indicate the essentials of the geometrical method of approach to the problem of interpreting vector maps, but also because they are directly relevant to the case of insulin Thus, in Fig 2b the positions of the maxima A, B, C found in the c plane projection of the vector map of an insulin crystal calculated from X ray photographs are reproduced[9] The points associated with the hexagons obtained from the C_2 cages are also shown The superposability of these two sets of points represented the first stage in the proof of the correctness *of the C_2 structure proposed for insulin*[6] Fig 2*a* indicates the size and orientation of the molecules in the insulin lattice, deduced from the vector diagram, Fig 2*b*

Again, Figs 1*a* and *b* show how it proved possible[7] to deduce from the vector section, $z = \frac{1}{6}$[10] the presence and position of three 'foreign' high intensity points per molecule in the lattice, nothing whatever being assumed about the chemical composition of the crystal The images in Fig 1*b* around the cell corners and around the middle point of the cell of the original distribution around the corners of the cell in Fig 1*a* show how the existence and size of the negative intensity region at the centre of the insulin molecule was also deduced from this section[7] These investigations showing that it is possible to deduce that the insulin molecule is a polyhedral cage structure of the shape and size predicted, give some indication of the powerful weapon which the geometrical method puts at our disposal

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Patterson *Phys Rev* **46** 372 (1934) *Z Krist* **90** 517 (1935)

[2] Harker *J Chem Phys* **4** 381 (1936)

[3] Llewellyn Cox and Goodwin *J Chem Soc* 883 (193)

Crowfoot *Proc Roy Soc* A **164** 580 (1938)

[5] Wrinch *Science* **85** 566 (1937) *Trans Faraday Soc* **33** 1309 (1937)

[6] Wrinch *Science* **88** 148 (1938)

[7] Wrinch and Langmuir *J Amer Chem Soc* in the Press

[8] Bernal *Réunion Internationale de Physique Chimie et Biologie* Paris 40 193

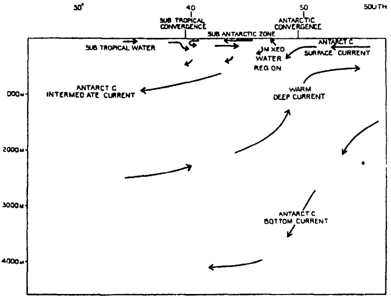
[9] Crowfoot *loc cit* Fig 1

[10] Crowfoot *loc cit* Fig 3

Marine Research in the Antarctic

THE wide scope of the investigations undertaken by the Discovery Committee in the Antarctic is well shown by the contents of their most recent reports[1] First comes an account of the hydrology of the Southern Ocean by G E R Deacon which includes two results fundamental to an understanding of world water movements

Of recent years the origin of the ubiquitous Antarctic bottom water, which in the Atlantic reaches as far as 40° N has stimulated oceanographers



VERTICAL CIRCULATION OF WATER IN THE SOUTH ATLANTIC OCEAN FROM DISCOVERY REPORTS VOL 15

As a result of the 1932–33 circumpolar cruise of *Discovery II*, we can no longer suppose that this bottom water is formed by the sinking of shelf water all round the Antarctic Continent Deacon now believes it to arise in, and only in, the south western and western parts of the Weddell Sea While moving eastwards, it incorporates water from the warm deep layer—now shown to exist throughout the whole of the Antarctic Zone—and the resultant highly saline bottom water flows northwards in the Atlantic Indian and Pacific Oceans It is the heaviest water in the sea

On all sides of the Pole Antarctic surface water also spreads northwards in a shallow surface layer until it reaches the Antarctic convergence There it plunges abruptly to a deeper level to continue its course as the Antarctic intermediate current The sharpness and constancy of position of the convergence is now shown to be governed by the movements of the warm deep water and the Antarctic bottom water The northward movement of the latter depends on the configuration of the bottom The sections at the end of the report suggest that near the convergence the bottom water is flowing steeply down hill to the ocean abyss As to whether this is always so the text is not very clear At any rate where the southward moving deep water is opposed by a large volume of Antarctic bottom water the former is forced up from below 2 000 metres to within 200 metres of the surface Over this ascending warm deep water the northward moving Antarctic surface water flows like a cascade to become the Antarctic intermediate current Room is then left above for the warmer and lighter sub Antarctic surface water This picture appears to apply not only to the South Atlantic but also to the Indian and South Pacific Oceans as well

There follows an account by A W B Powell on marine mollusca from New Zealand waters, describing six new genera, 128 new species and thirteen genera previously unknown there

Of the problems in the Antarctic requiring scientific study, perhaps the most urgent is the effect on the stock of Blue whales of modern intensive whaling methods. A H Laurie finds that Blue whales reach physical maturity at ten or eleven years of age and that they breed only once in two years at most and often only every third year The length of female Blue whales has decreased so much that on an average they are caught before they have had time to reproduce at all Continued fishing on the present scale must have a disastrous effect on the stock As Laurie points out, when killing has reached the point at which recruitment shall virtually have ceased, the future of Blue whales and whaling will be limited to the lifetime of those whales now living Shall it be said of whaling as may now be said of other branches of the fishing industry *inopem me copia fecit ?*

Discovery Reports vol 15 Title page and Contents Pp vi 9d net The Hydrology of the Southern Ocean By G E R Deacon Pp 124+44 plates 30s net Notes on the Dynamics of the Southern Ocean By G E R Deacon Pp 125 152 4s net New Species of Marine Mollusca from New Zealand By A W B Powell Pp 153 222+plates 45–56 15s net The Age of Female Blue Whales and the Effect of Whaling on the Stock By A H Laurie Pp 223-284 9s net (Cambridge University Press 1937)

Progress in Building Research

A MATTER of considerable importance dealt with in the report for the year 1937 of the Building Research Board, by Dr R E Stradling director, is the account of the work done in connexion with "Soil Mechanics This is a new and rapidly developing branch of engineering science which, it is felt, has not received from practising engineers in Great Britain the measure of recognition accorded to it elsewhere The report therefore lays especial stress on the importance of recent developments in this direction In the past, it is pointed out, such civil engineering problems as those associated with foundations and the stability of cuttings and embankments, have had to be dealt with on an empirical basis As the necessary scientific knowledge did not exist this was inevitable , but a new school of thought has arisen and, following the lines explored by Terzaghi and others, the Station has been engaged in a programme of research In this it has been actively assisted by the Earth Pressures Committee of the British Association, and by an Earth Pressures Sub Committee set up by the Institution of Civil Engineers Abroad, the results of research have had a large measure of application and there are reported to be signs of increasing attention here, the inquiries received at the Building Research Station being taken to show that engineers are becoming more fully aware of the assistance which this new science can give in promoting accurate and economical design This increased interest has had the result that the soil mechanics section at the Station has been strengthened and it is hoped, with the support of outside bodies interested in its aims, to extend its operations and so to hasten the work of fundamental research and the solution of problems of immediate practical interest

The two avenues of soil research which have been mainly followed at the Station are in connexion with the settlement of structures and the stability of earth slopes In its method of dealing with the former the development of this science has led to a complete change in the mode of approach to this type of problem In the past, it was held that the type of soil alone governed the pressure which could be imposed upon it From the accumulation of practical experience, certain broad rules were evolved and, as a result, the so called 'bearing values' of different soil types were embodied in tables which formed the basis of design In difficult or doubtful cases loading tests might be carried out, usually on comparatively small areas, in an endeavour to assess the bearing value in these cases

The new mode of approach is through an understanding of the mechanism by which settlements take place and, considering the structure itself, the relative amount of settlement permissible as between one part of the structure and another is regarded as the determining factor in the design of the foundations It is to the work of Terzaghi and his followers that an appreciation of the broad aspects of the problem is due Although, as the report states, the mechanism by which settlements occur has not as yet been fully explained, it is understood that settlement depends not only on the type of soil immediately below the footings but also on the nature of the soil strata to a considerable depth A deep seated stratum of soft clay may be, and indeed has often been, the cause of serious settlement Apart from the influence of the pressure on a footing, settlement depends on the *size of the footing the depth at which it is placed* and the presence of other footings in the immediate proximity In the case of clay soils, time is also an important element, for settlement continues at a diminishing rate for a period determined by the conditions, and failure may occur some time after the completion of the structure With so many factors entering into the problem, the difficulty in interpreting the results of loading tests and in appraising the limitations associated with them becomes obvious

In the second part of the report, which contains the more detailed account of the Station's activities during the year, an outline is given of the methods employed in estimating and analysing the settlement of a structure It is based on the laboratory examination of soil samples taken in an undisturbed' condition from several strata beneath the structure From the results of tests made with the Terzaghi oedometer together with calculation of the distribution of pressure from the building, it is possible to estimate the amount of settlement to be expected It may be objected that the conditions of the test do not actually reproduce those existing in practice, and this is acknowledged, but if, from actual measurements, agreement can be shown between the actual and the estimated movements, then a very great step forward can be recorded This represents the present stage of development of the subject , every effort is being made to get information about such comparisons and, the more the work progresses, the more impressive does the closeness of the correlation appear The results of work done in connexion with a new building for the Fire Testing Station, Elstree, will shortly be published and it is claimed that the agreement in this case is as near as one can hope to get. Further cases are under observation and, as the data from these become available, this method of testing and analysis will be more firmly established It certainly provides a much more accurate design technique than any other known method

On the cognate subject of the stability of earth slopes, the report states that special opportunities have arisen during the year for the study of earth bank failures on a practical scale, and the various engineers concerned have given facilities for samples and measurements to be taken on the sites It is now held that the stability of an earth slope depends upon the shear characteristics of the soil in the slope and in the foundation layers The shear resistance of clay has been shown to depend on its cohesion, with the result that the maximum angle at which a clay slope can stand without support decreases rapidly with increasing height This puts a new complexion on the problem, and the report shows how progress is being made to determine the properties of soils and how these and other aspects of it are being investigated

These notes treat of but one of the many interests being dealt with by the Station, ranging from the homely problem of the smoky chimney through the whole gamut of building problems to research on the constitution and properties of materials Both in its routine work and in special investigations the fact is clearly recognizable that the services of the Station are of great value to the building trade and to the nation, as well as to the promotion and development of applied science in a wide field

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Australian Echinoderms

DR H L CLARK'S first papers on Australian echinoderms appeared in 1909 when he described the Australian forms in the Museum of Comparative Zoology, and the *Thetis* collection made off New South Wales and at Lord Howe Island They proved to be the forerunners of a series, continued to the present day*, in which he has made known far more about Australian echinoderms than any other man He has described the collection of the Western Australian Museum (1914), the many echinoderms, excepting the holothurians, taken by the *Endeavour* off the coasts of Queensland, New South Wales, Tasmania, Victoria, South and Western Australia (1916), a small collection from Western Australia (1923) and another from the Barrier Reef (1926), the very large collection, other than the holothurians, of the South Australian Museum (1928), mostly southern forms, and the echinoderms, other than asteroids, of the Barrier Reef Expedition (1932)

All but the first of these papers were on collections submitted to Dr Clark, as an expert in another country, by Australian and other authorities The collections comprised nearly 6,000 specimens among which were representatives of 113 new species In the meantime, in 1913, Dr Clark had been to Australia himself and had made a large collection in the Torres Strait It was described in two papers in 1915 and 1921

These notes on earlier papers are given as a background against which to see Dr Clark's most recent work They show that he had described a great deal of material from all coasts of Australia except the north western, which remained a *terra incognita* in marine zoology His most recent paper describes the very rich echinoderm fauna he found in the north west and much additional material from all other coasts as well

It is based on specimens which for the most part he himself collected, alongshore and by dredging, on his visits to Australia in 1929 and 1932 Treating the two visits as one, he spent six weeks at Darwin, visited two points on the coast between Darwin and Broome and spent three months at Broome, small collections were made, where echinoderms occurred, at five points between Broome and Perth, and three weeks collecting was done from Fremantle There followed short visits to study the material at the Museums of Adelaide, Melbourne, Hobart, Sydney and Brisbane and collecting excursions from some of them Finally, three weeks were spent at Lord Howe Island in the Tasman Sea

Dr Clark returned to America with more than 11,000 specimens of echinoderms of which he and his immediate helpers, including Mrs Clark, collected nearly 10,000, the remainder being loans and gifts from museums and other sources in Australia They represented 422 species of which 128 were new The descriptions of the species are as in Dr Clark's papers on the Torres Straits collections, richer because the author saw them alive and observed their abundance and habits and colours His descriptions of these things will be invaluable to those who may seek the animals in life They are of great interest to students who cannot, for them Dr Clark has described too the colours the species have when dried or kept in spirit—though it is often the dingy brown called museum colour There are eighteen beautiful coloured plates based on sketches made from life by Mrs Clark, they and the coloured plates of the Torres Straits report must make the Australian echinoderm fauna one of the best illustrated in colour in the world

The report falls into five sections corresponding to the five echinoderm classes Before each, Dr Clark tells us, among other things where the members of this class are most abundant in Australian waters, in what sites they should be sought and how they may best be fixed and preserved Because the species of the starfish genus *Anthenea* are mostly Australian and Dr Clark had a large series before him, he has discussed or described all the known species and given a key to them In the ophiuroid section he has made a beginning with—what has long been overdue—a sub division of the large genus *Ophiothrix* starting with the long armed species of the Indo Pacific region At the end of the volume are local lists of echinoderms for ten localities

Dr Clark has in earlier papers discussed the geographical distribution of the Australian echinoderm fauna and its relationships to that of other regions Now that he has collected and described so much new material, a great deal of it from the hitherto unknown north west, it is good to know that in a subsequent report he hopes to give a full account of the fauna as at present known, and to discuss its apparent history and relationships D D J

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* "Echinoderms from Australia, an account of Collections made in 1929 and 1932" by Dr Hubert Lyman Clark *Mem Mus of Comparative Zool*, 55. Pp 596 + 28 pls

Science News a Century Ago

Engineering Education

THE *Athenæum* on September 29, 1838, in a review of some recently printed pamphlets, gave its views on engineering education At the head of the review it mentioned the "Program des Cours de l'Ecole Centrale des Arts et Manufactures", regulations for students in civil engineering in the University of Durham, arrangements for conducting the various departments of King's College, and the prospectus of the class of civil engineering and mining, University College, London In the course of the review, the *Athenæum* remarked But no man pursues his trade or art successfully or well, who does not, beside the practice, possess the science of it, and the great distinction between artificers, for the most part practically equal, is this, that some have and some have not the knowledge of the science of their art Science is everywhere aiding man in his contest with the physical difficulties of his position, and ministering to him new powers and capabilities of thought and action "

Treatment of Wounds by Heat

"THE rapid cicatrization of wounds by heat has been the object of several experiments made by Drs Breschet and Jules Guyot To severe wounds and amputations they apply a heat of 36° of the centigrade thermometer The apparatus consisted of a box, carefully constructed, in which is a glass, through which the progress of the wound may be watched, and communicating with a tin tube, adapted to a lamp, precautions are taken to prevent the contact of the wound with the wood of the box, and a piece of linen or other material surrounds the orifice, and ties above the wound, when once adjusted, the apparatus is left on without any other application till the wound is healed M Larrey has remarked on this, that the heat of Egypt seemed to him to be highly favourable to the cure of wounds, inasmuch as they were healed in half the ordinary time, but he doubts whether the application of local and artificial heat will have the same effect as that of atmospheric air ' (*Athenæum*, September 29, 1838)

Whitby and Pickering Railway

IN its early days, the Whitby and Pickering Railway, opened in 1836, was worked by horses, the carriages consisting of stage coaches with flanged wheels It had heavy gradients and at one of these a tank was provided, mounted on railway wheels, at the top of the incline To assist in drawing a coach up the incline, the tank was allowed to descend the reverse slope and at the bottom the tank would be emptied Airy, the Astronomer Royal, who was visiting Yorkshire at the time, wrote from Brampton, near Chesterfield, on September 30 "On Wednesday morning at 8 we started by the railroad (from Pickering) for Whitby in a huge carriage denominated the Lady Hilda capable of containing 40 persons or more drawn by one horse, or in the steep parts of the railway by two horses The road goes through a set of defiles descending in one part by a long crooked inclined plane, the carriage drawing up another load by its weight . The rate of travelling was about 10 miles an hour Betsy declares that it was the most agreeable travelling that she ever had "

Societies and Academies

Paris

Academy of Sciences (*C R*, 207, 265–312, July 25, 1938)

E JOUGUET Secular stability when positional forces do not admit of potential

A COTTON Remarks on a note of M Brylinski entitled On the symmetries of the magnetic field"

R GARNIER Extension of the Euler Savary formula to the most general movement of a solid

E BAUMGARDT A method for the determination of the adiabatic moduli of elasticity Measurement of the speeds of ultra sonic waves in three different directions through a cubic crystal would give data for calculating the three moduli of elasticity

R GRANDMONTAGNE Colour of the night sky New observations emphasize the importance of the red radiations

D G DERVICHIAN and C CLARK Use of the ring method for the measurement of surface tension A simple empirical relation is found

E BADAREU Remarks on the explosive potential in benzene vapour

R FORRER Cause of the anomaly of magnetite at low temperatures There are two kinds of magnetite, distinguished chemically by the power of adding on chlorine That which does not add on chlorine shows in a thermomagnetic apparatus, a sudden increase of magnetization at − 138° to − 118° C The anomaly is thus attributed to a bond between two iron atoms generally considered divalent but actually trivalent

R SERVANT Rotatory power of quartz in the far ultra violet and in the Schumann region

G COSTEANU Raman spectrum of ammonia and of the ammonium ion

M DODE and B PONTECORVO A radio element produced in cadmium under the action of rapid neutrons

MME T GUILMART Study by reflection of the absorption spectra of organic substances in the solid state

J J TRILLAT and P NARDIN Influence of temperature on the interfacial tension of the system castor oil water Rise of temperature opposes orientation

H GAULT and A CHABLAY Kinetic study of the phenomena of acidolysis

H VINCIENNE Alteration of cretaceous flints in the Upper Sands of the Perte du Rhône, at Bellegarde

C SAUVAGE Germination of *Lepidium sativum* L in presence of salt

P RIOU and G DELORME Distribution of iron and manganese in the maples of the Province of Quebec

L RAPKINE Role of sulphydryl groups in the activity of triosephosphate oxidoreductase

RAYMOND HAMET Secondary vasodilatory action of adrenalin

M LAFON The qualitative requirement of nitrogen in *Drosophila melanogaster* Meig

M POLONOVSKI and P BOULANGER Influence of the structure of amino acids on ammonia in the renal blood vessels

J Caminopetros, D Comninos and Mlle Dervou Experimental study of a virus isolated from the cephalorachidian fluid of a case of post vaccinal meningo encephalitis

Brussels

Royal Academy (*Bull Classe Sci* **24** No 4 1938)

G Cesàro and J Mélon The crystalline form of acmite A form $\overline{72}$ 75 10 or $\overline{43}$ 45 6 preponderant in all the crystals studied a prism to which the writers have erroneously assigned a symbol of the form $\overline{h}h1$ Simplification of Brögger s notation taking the face $\overline{2}01$ as base

L Godeaux A configuration formed by two Laplacian sequences

E de Wildeman Sterility senescence and dis appearance of species in plants

O Rozet Non cyclic involutions of order twenty seven belonging to an algebraic surface

Calcutta

National Institute of Sciences of India (Aug 20 1938)

Sir Lewis Fermor Notes on vredenburgite (with devadite) and on sitaparite

N N Chopra The role of nitrogen compounds in the fermentation of fruit juices

S C Pillai A biochemical investigation of the tuberculation of water pipes

M N Saha and R N Rai Ionization of the upper atmosphere

S M Sulaiman Levi Civita s formulæ for two bodies

Rome

National Academy of the Lincei (*Atti*, **27** 189–266 1938)

G A Blanc Geochemical interpretation of the quaternary formations of Grotta Romanelli (Terra d Otranto) (1) Data of the problem and method of investigation

S Faedo Rational surfaces with canonical hyper plane sections and a paradox relative to their singularities (1)

B Segre (1) Families of isoparametric hyper surfaces in Euclidean spaces in any number of dimensions (2) Systems of linear equations with constant coefficients having partial derivatives of any order with only one unknown function

C Tolotti Cauchy s problem in the non analytical case

M Villa A class of V_k varieties situated on the Veronese cones

G Colonetti The second principle of reciprocity and its applications to the calculation of permanent deformations (3)

L Venturelli Einstein's statics in a gravitating fluid mass

G Boaga: Gravimetric campaign in Sardinia

A Baroni Telluro mercaptans

A. Salvatori Chlorine content of the organs and tissues of the rat in relation to their age

V Zagami Action of vagi on the metabolism of glycides (2) Behaviour of the cardiac, hepatic and muscular glycogen after administering insulin in vagotomized pigeons

Atti **27** 267 316 1938

G A Crocco Factors of the static kinetic stability of aircraft

S Faedo Rational surfaces with canonical hyper plane sections and a paradox relative to their singularities (2)

M Haimovici ds^2 binaries with given total curvature

F Sbrana Some questions relating to plane and oblique curves

T Franzini Method of working of a proton tube

C Guareschi The nucleus of the salivary glands of the larvæ of *Chironomus plumosus* studied in a dark field in polarized light and by means of the Feulgen reaction

G Moruzzi and G Borgatti Action of bromine on the development of the organism

R Rubini Behaviour of the *p*H of human urine during the daytime

D Gigante Percentage loss of weight in death through inanition and through hypo alimentation

Washington, D C

National Academy of Sciences (*Proc* **24** 303 364 August 15 1938)

P C Mangelsdorf and R G Reeves Origin of maize A genetical investigation supported by archæological evidence suggests that cultivated maize originated in South America as a single gene mutation from a wild form of pod corn *Euchlæna* formerly considered a progenitor of maize is probably a recent natural hybrid of *Zea* and *Tripsacum* (another American genus) which arose in Central America the majority of North American varieties arose from this cross

S E Hill and W J V Osterhout Calculations of bio electric potentials (3) Variation in partition coefficients and ion mobilities

H Bateman (1) Rayleigh waves A theoretical discussion leading to the view that when the ground rises after an underground explosion the air imme diately above it either moves away laterally and produces a reaction on the ground elsewhere, or will tend to compress the great body of air above it This has a bearing on earthquake noises (2) Coulomb s function

M Morse Functional topology and abstract variational theory

H S Vandiver Criteria concerning singular integers in cyclotomic fields

G A Miller Groups of degree *n* involving only substitutions of lower degrees

J L Walsh and W Seidel Derivatives of functions analytic in the unit circle

A D Michal Differential calculus in linear topological spaces

J Douglas (1) Minimal surfaces of higher topo logical structure (2) Green's function and the problem of Plateau (3) The most general form of the problem of Plateau

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

DEMONSTRATOR IN BACTERIOLOGY at King's College Newcastle upon Tyne (University of Durham)—The Registrar (October 1)

POULTRY PATHOLOGIST in the Agricultural Advisory Centre University of Bristol The Registrar (October 6)

CHEMIST IN CHARGE and CHEMISTS at the Royal Ordnance Factory Irvine Ayrshire—The Under Secretary of State (C 5) The War Office London S W 1 (October 7)

DIRECTOR of the Imperial Veterinary Research Institute, at Muktesar United Provinces India The High Commissioner for India General Department India House Aldwych London W C 2 (October 7)

LECTURER IN PHYSIOLOGY AND HYGIENE in the University of Leeds The Registrar (October 8)

ASSISTANT LECTURER IN PHYSICS in the University of Sheffield The Registrar (October 10)

DIRECTOR OF DAIRY RESEARCH in India—The High Commissioner for India General Department India House Aldwych London W C 2 (October 10)

Two appointments in the MECHANICAL ENGINEERING AND TRANSPORTATION (LOWER) DEPARTMENT of the Indian State Railways—The High Commissioner for India General Department India House Aldwych London W C 2 (October 14)

A PROFESSOR OF MALARIOLOGY AND RURAL HYGIENE and a PROFESSOR OF VITAL STATISTICS AND EPIDEMIOLOGY in the All India Institute of Hygiene and Public Health Calcutta—The High Commissioner for India General Department India House Aldwych London W C 2 (October 21)

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research Report of the Food Investigation Board for the Year 1937 Pp v + 266 (London H M Stationery Office) 4*s* net [29

Mines Department Sixteenth Annual Report of the Safety in Mines Research Board including a Report of Matters dealt with by the Health Advisory Committee 1937 Pp 136 + 15 plates (London H M Stationery Office) 2*s* net [59

Milk and Nutrition New Experiments reported to the Milk Nutrition Committee Part 3 The Effect of Commercial Pasteurisation on the Nutritive Value of Milk as determined by Experiments on Calves Pp 27 (Reading National Institute for Research in Dairying) 2*s* [79

Ministry of Health Memorandum on Smallpox (Memo 215 Med) Pp 8 (London H M Stationery Office) 2*d* net [89

Proceedings of the Royal Society of Edinburgh Session 1937 1938 Vol 58 Part 2 No 12 Green's Function for an Ellipse and its Application to the Motion of a Point Vortex By Dr D Mekryn Pp 176 180 6*d* Vol 58 Part 2 No 13 The Brackish water Lochs of Orkney By Dr Edith A T Nicol Pp 181 191 1*s* Transactions of the Royal Society of Edinburgh Vol 59 Part 2 No 13 Differential Fertility in Scotland 1911 1931 Part 1 By Dr Enid Charles Pp 371 383 1*s* 6*d* (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) [99

Ministry of Agriculture and Fisheries Agricultural Statistics 1937 Vol 72 Part 1 Acreage and Production of Crops Number of Live Stock and of Agricultural Workers and Output and Prices of Agricultural Produce in England and Wales Pp 109 (London H M Stationery Office) 1*s* 6*d* net [129

Department of Scientific and Industrial Research Deterioration of Structures in Sea Water Seventeenth (Interim) Report of the Committee of the Institution of Civil Engineers Pp iv + 83 (London H M Stationery Office) 9*d* net [129

Other Countries

Cornell University Agricultural Experiment Station Bulletin 686 An Economic Study of the Costs of Selling and Delivering Milk in the New York Market By Charles Blanford Pp 60 Bulletin 687 Study of Artificial Incubation of Game Birds 3 Effect of Air Movement on the Incubation of Pheasant and Quail Eggs 4 Interrelation of Temperature Humidity and Air Movement in the Incubation of Pheasant and Quail Eggs By Alexis L Romanoff Pp 30 Bulletin 688 Effect of Changes in Milk and Feed Prices and in other Factors upon Milk Production in New York By Merton S Parsons Pp 68 Bulletin 689 An Economic Study of Land Utilization in Clinton County, New York By O H White Pp 52 Bulletin 691 Experiments in the Fattening of Lambs By John P Willman and F B Morrison Pp 28 Bulletin 693 Agricultural Production in New York 1866 to 1937 By T E La Mont Pp 34 Bulletin 694 Early cut Nitrogen fertilized Timothy Hay as compared with Alfalfa Hay for Feeding Dairy Cows By G W Salisbury and F B Morrison Pp 30 Bulletin 695 The Membership of Farmers in New York Organizations By W A Anderson Pp 28 (Ithaca N Y Cornell University) [19

New Zealand State Forest Service Annual Report of the Director of Forestry for the Year ended 31st March 1938 Pp 28 Bulletin No 9 A Synopsis of Forest Fungi of Significance in New Zealand, By T T C Birch Pp 17 (Wellington Government Printer) [29

Canada Department of Mines and Resources Mines and Geology Branch, Bureau of Mines Comparative Pulverized Fuel Boiler Tests on British Columbia and Alberta Coals and on Ontario Lignite By C E Baltzer and E S Malloch (No 790) Pp ii + 54 (Ottawa King's Printer) 25 cents [29

Mémoires du Musée Royal d'Histoire Naturelle de Belgique No 82 Hydrobiologie piscicole du Bassin Moyen de la Lesse (Ardennes Belges) Par Marcel Huet Pp 128 + 4 plates No 83 Le Couvinien de l'Ardenne et ses faunes Par Eug Maillieux Pp 58 + 2 plates No 84 La faune des Couches de passage du Dinantien au Namurien dans le synclinorium de Dinant Par Prof F Demanet Pp 201 + 14 plates Deuxième Série Fasc 13 The Atlantic and Gulf Coast Tertiary Pectinidæ of the United States Section 3 Systematic Descriptions By Dr H I Tucker Rowland Pp 76 + 6 plates Hors Série Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL AA RR le Prince et la Princesse Léopold de Belgique Publiés par V Van Straelen Vol 2 Fasc 19 Prosobranchia et Opisthobranchia Par W Adam et E Leloup Pp 209 + 8 plates Vol 3 Fasc 18 Astéries et Ophiures Par H Engel Pp 31 + 4 plates (Bruxelles Musée Royal d'Histoire Naturelle) [59

Imperial Council of Agricultural Research Miscellaneous Bulletin No 19 A Preliminary Annotated List of Fruit Pests of the North West Frontier Province By Dr Hem Singh Pruthi and H N Batra Pp 18 1 rupee 1*s* 9*d* Miscellaneous Publication No 20 Report on an Enquiry into the Cultivation of Cloves in India By A K Yegna Narayan Aiyer Pp ix + 75 + 3 plates 2 4 rupees 3*s* 9*d* (Delhi Manager of Publications) [59

Government of India Industrial Research Bureau Report for the Year 1937 38 Pp iv + 38 + 3 plates (Delhi Manager of Publications) [59

Department of Agriculture of South Australia Bulletin No 333 Vegetation Types associated with Plague Grasshoppers in South Australia By H G Andrewartha Dr J Davidson and D C Swan Pp 47 (Adelaide Government Printer) [59

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 118 A Soil Survey of the Horticultural Soils in the Murrumbidgee Irrigation Areas New South Wales By J K Taylor and P D Hooper Pp 108 (Melbourne Government Printer) [59

Crohamhurst Observatory Eighth Observatory Paper The Climate of Australia during the Hypothetical Jovian Sunspot Period 1901 1913 together with the Monthly and Annual Rainfall Observations at Selected Stations during that Period and some Comments on the Evidences of Cyclical Reproduction of the Weather and the Immediate and other Effects of Sunspot Changes Pp 94 Report of the Crohamhurst Observatory for the Year ending 30th June 1938 Pp 5 (Crohamhurst Qd Crohamhurst Observatory) [59

Smithsonian Miscellaneous Collections Vol 97, No 6 Evolution of the Annelida Onychophora and Arthropoda By R E Snodgrass (Publication 3483) Pp 159 (Washington D C Smithsonian Institution) [69

Det Kgl Danske Videnskabernes Selskab The Eyak Indians of the Copper River Delta Alaska By Kaj Birket Smith and Frederica de Laguna Pp 592 + 18 plates (København Levin and Munksgaard) [79

Geological Survey of British Guiana Bulletin No 7 Report on a Geological Reconnaissance Survey of part of the North West District By S Bracewell With an Appendix containing a Report on the Geology of the Aruka District by W F Ford Pp iv + 37 24 cents Report No 9 Report of an Area between Quartzstone Head Aremu Mine and the Puruni River near Peters Mine By D W Bishopp Pp ii + 20 12 cents (Georgetown Geological Survey) [79

League of Nations Economic Committee Preliminary Investigation into Measures of a National or International Character for Raising the Standard of Living Memorandum by N F Hall (Official No A 18 1938 II B) Pp 91 (Geneva League of Nations, London George Allen and Unwin Ltd) 2*s* [79

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 90 The Phloxes of Oregon By Edgar T Wherry Pp 133 140 (Philadelphia Academy of Natural Sciences) [99

Royal Observatory, Hong Kong Magnetic Results 1937 Prepared under the direction of C W Jeffries Pp 51 + 2 plates (Hong Kong Royal Observatory) 1 dollar [129

League of Nations International Committee on Intellectual Co operation Report by Prof G de Reynold on the Work of the Twentieth Plenary Session of the Committee (Official No C 253 M 150 1938 XII) Pp 53 (Geneva League of Nations London George Allen and Unwin Ltd) 2*s* [129

League of Nations Advisory Committee on Traffic in Opium and other Dangerous Drugs Report to the Council on the Work of the Twenty third Session, held at Geneva from June 7th to 24th 1938 (Official No C 237 M 136 1938 XI) Pp 41 (Geneva League of Nations London George Allen and Unwin Ltd) 1*s* 6*d* [129

Summary Proceedings of the Thirty sixth Meeting of the Indian Central Cotton Committee Bombay held on the 25th and 26th January 1938 Pp 99 (Bombay Indian Central Cotton Committee) 1 rupee [129

Ceylon Part 4 Education, Science and Art (G) Administration Report of the Acting Marine Biologist for the Year 1937 By P E P Deraniyagala Pp G 16 (Colombo Government Record Office) 20 cents [129

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès verbaux des réunions Vol 108 Part 1 Contributions to Special Scientific Meetings 1938 Pp xv + 114 5 00 kr Vol 108 Part 2 Light Measurements Pp 21 1 00 kr Vol, 108 Part 3 Salmon Migrations Pp 35 1 50 kr (Copenhague Andr Fred Høst et fils) [129

Lucknow University Studies No 2 Recent Advances in Indian Palæobotany By Prof B Sahni Pp viii + 102 (Lucknow Lucknow University) [129

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The Changing Outlook for Engineering Science

WHAT policy should govern the content of university training in engineering science? What policy should govern research? What policy should govern relations with the community? These were the three main questions dealt with by Prof. R. V. Southwell in his presidential address delivered at Cambridge to Section G (Engineering) of the British Association. No one, we believe, would disagree with Prof. Southwell that the time for a general stocktaking, such as is implied by the questions, has arrived.

> "It is a commonplace," he said, "that the boundaries of natural science have so extended that no man can hope to comprehend the whole of physics or chemistry or any other field. But engineering science embraces all these fields; its boundaries extend not only continuously, as knowledge grows in tracts already surveyed, but at times by a sudden accretion of new territory—as when recently the new technology of plastics came to replace, for many purposes, older methods of fabrication in wood and metal . . . What is to be our policy in the face of this continuous accretion of knowledge, seeing there is no corresponding increase in the capacity of undergraduates to absorb?"

It will be generally agreed that mere lengthening or intensification of academic courses will not solve the problem, and that the planning of time-tables, in Prof. Southwell's words, "must be conditioned first and foremost by ineluctable limits to the instruction we can give with confidence that it will really be assimilated". No intensification or lengthening of courses can guarantee the production of men of personality, educated to take wide views, which Prof. Southwell tells us are what industrialists demand. The filling of every hour of the working day by lecture or laboratory courses, which leave little or no time for "undergraduate activities", may well cut out just that part of a university training most likely to develop the very qualities that should be produced.

Clearly, in shaping courses, the purpose which they are to serve must be decided, and here Prof. Southwell's view is clear: "their purpose is to train recruits for industry, and the taking of honours in a final examination should indicate an assimilation of engineering principles adequate in a man who is starting a professional or industrial career—*but not more than this*". With that end in mind he sees that "the real and difficult duty of a professor is to decide, not what subjects of instruction should be included because of value, but what can be omitted on the ground that, pushed into a mind already taxed, it will push out something still more valuable".

But how decide what can be omitted? Prof. Southwell would call industrialists into council; and in this connexion he puts his finger on a vital spot. Very rightly, he insists that the time is past when a student's three years at the university and his two years' apprenticeship can be regarded as distinct phases in training. The five years should be an integrated whole devoted to a single objective. He would therefore, with the industrialists, work out a plan to secure the recruits which are wanted. He would not neglect the importance of leisure in the formation of personality, and he would ask that industrialists scrutinize syllabuses, so that they may say whether items can be omitted either as never likely to be applied in practice or as being easily and more appropriately learned in works.

He displays a proper educational care He would not engage to drop a subject simply because an industrialist has not found it useful—that may be an accident of particular interests—but he would examine suggestions and find out, perhaps, "much that has crept into our courses more by accident than design"

There will be general agreement with all this but there are difficulties which must not be overlooked Who are the industrialists to be called in ? Is there a body of industrialists who can be asked to do what is required ? The idea has been used, of course, in certain technical colleges : but when the need is for the re-shaping of university syllabuses, something more is required of the details of how industrialists are to be secured who can and will help in this work

With Prof Southwell's views on research we are in entire agreement He has given the answer to the pessimistic view that engineering research at universities is doomed because, as it makes even fuller use of mathematics and physics and chemistry, its problems will be such as must more and more be referred to specialists in those subjects, and because of the vastly increased provision for *ad hoc* experimentation which has been made since the Great War in Government departments and in industrial concerns As he points out, the engineer's problems are inexorable and he must so recognize them The physicist, for example, is free to choose his "shapes" they "are not dictated by constructional or manufacturing requirements, nor his materials by considerations of strength and cost" There are still countless problems of engineering, too difficult for routine investigation, which will provide vast scope for academic engineers

When Prof. Southwell comes to the question of engineering as it concerns the life of the community, he reminds us that, because man has not learned to use his mastery of Nature wisely, he now often questions its value "Because engineering includes guns, battleships, aeroplanes, tanks, therefore engineers are regarded as a class more than others responsible for the horrors of modern war." So runs the argument (with variations, of course ; sometimes it is the chemist or some other specialist, but practically always it is "the scientist") we hear so often in these days of international trouble and crises. Prof. Southwell answers that the engineer is as much responsible as any man, *but no more* We ought to be grateful for his succinct summing up of the matter when he says. "When men talk of 'beneficent' and 'destructive' science as though we were free to pick and choose, then I say they have not even begun to understand what science is " Obviously, we cannot have the benefits of science without its risks and temptations

When the impact of science on life produces grave problems, hard and clear thinking is required ; but here Prof Southwell's view is that "we only confuse the issue when we intervene *as specialists* in discussions which concern us really not as specialists, but as members of a community" He thinks, therefore, that the scientific worker must come to political discussions unlabelled, in hours of leisure rather than give support to a notion that political problems will yield to something known as "the scientific attack" "Talk to me of the scientific approach in physics and I shall have some idea what you mean talk to me of a 'scientific approach' to problems of real life, I shall suspect you of indulgence in mere jargon " He goes on to say that, instead of defending himself against the charges of dreadful responsibility for horrors, the man of science should devote himself to instilling into the public mind a clearer notion of the aims with which real scientific work is done The popular notion of the "wonders of science" performed by workers aloof and remote from the world might be cleared up by giving a picture of these people doing their jobs and "seeking truth like artists because they must"—a picture not of the treasure found, but of the quest in search of it.

Such popular misconceptions must certainly be cleared up , but that is not enough It may be argued that the search for abstract truth is not sufficient Truth is relative, and the search for it must have some relation to the life of the community. For that reason a "scientific approach to problems of real life" cannot be regarded as mere jargon · and while it is not necessary to believe that a specialist in a particular subject will necessarily think clearly on matters of ethics and politics, nevertheless a scientific approach to modern problems can be formulated with enormous benefit to the modern world.

Prof Southwell is to be congratulated on his stocktaking—the more so because he urges the obvious need for planning as the outlook for engineering science changes, and because, if that planning is to be done efficiently, we must strive to find agreement on problems which will not lightly tax both courage and skill.

A Pioneer of Long-Distance Telephony

The Collected Papers of George Ashley Campbell, Research Engineer of the American Telephone and Telegraph Company
Pp xii + 581 + 1 plate (New York and London American Telephone and Telegraph Company 1937) n p

DR G A Campbell who has recently retired from active service with the American Telephone and Telegraph Company is well known to telephone engineers for his many contributions to the theory and practice of telephony One of his best known inventions is the wave filter which bears his name by means of which the harmonics in the electromotive waves produced by a generator are effectively suppressed by means of a multiple system of condensers and inductances To commemorate his retirement the American Telephone and Telegraph Company has issued this handsome volume of his collected papers The representative of this company in Great Britain has written stating that requests for copies of the book will be entertained so long as the somewhat limited number of volumes printed lasts Requests should be addressed to Dr L F Morehouse American Telephone and Telegraph Company Bush House London W C 2

A few years after the invention of the telephone by Bell the present plan of organizing the Bell System had been evolved The unusual requirements of the telephone industry were met by an organization having licensee telephone units and a manufacturing unit grouped around a parent company In 1897 the American Bell Company the functions of which as the parent company were taken over later by the American Telegraph and Telephone Company had by gradual steps built up a research organization of physicists chemists and engineers It was then located in Boston under the direction of Dr Hammond V Hayes In 1937 this department appears a small group but so late as 1897 organized industrial research was scarcely known outside the Bell System In those days the Bell System had 325 000 stations compare this with the 14 million stations of to day

Forty years ago long distance telephony had begun to come to the front but line costs were high and a practically commercial range did not exceed a thousand miles Hence the two main objectives were to secure better and more economical circuits and to explore the possibilities of reaching greater distances The rapidly expanding telephone business about large cities soon made it necessary to place telephone circuits in cables The study of these circuits presented many problems to the engineer and called for considerable mathematical knowledge Dr Hayes was faced with the problem of adding to his staff one who had a good working knowledge of advanced electrical theory—work recently developed by Kelvin Maxwell Weber Heaviside and others of the great mathematical physicists of the nineteenth century He appointed Dr George A Campbell a graduate of the Massachusetts Institute of Technology who had also had five years study at Harvard Paris Vienna and Gottingen This appointment was fortunate and timely for the communication industry

In an introductory chapter Mr Colpitts says that soon after Campbell's appointment he was engaged in developing cable circuits At the same time and independently Prof M I Pupin was engaged on the same problem and his patent slightly anticipated Campbell's The Associated Companies immediately acquired Pupin's patents Campbell's analysis was more thorough and led him to formulæ more convenient than his rival's The latter alone were employed for the building of loaded lines in the United States When engaged in this work he invented his famous wave filter

It was found that all the questions relative to loading coil design depended on the quality of the iron used in the core The best results were obtained using iron of normal permeability and very high resistivity In 1900 a successful experiment was carried out between Bedford N Y and Brushton Pa a distance of 670 miles over a loaded cable Campbell was the inventor of the single transformer anti sidetone circuit which is now almost universally used

Perhaps Campbell's best known paper is that On Loaded Lines in Telephonic Transmission published in the *Phil Mag* in 1903 Even at that early date he had begun to consider the problem of the high pass and the low pass wave filters As an early investigator of antenna arrays to secure directional transmission Campbell did excellent work and holds certain fundamental patents in this field He is at present taking a leading part in the struggle to get the adoption of a rational system of physical units

Although the volume extends to nearly 550 pages, all Campbell's researches are not included in it We hope that he will continue his researches for a long time to come

A R

Aspects of Nuclear Physics

(1) The Newer Alchemy

based on the Henry Sidgwick Memorial Lecture delivered at Newnham College Cambridge November 1936 By Lord Rutherford Pp viii + 68 + 13 plates (Cambridge At the University Press 1937) 3*s* 6*d* net

(2) Elements of Nuclear Physics

By Prof Franco Rasetti Pp xiv + 327 (London Glasgow and Bombay Blackie and Son Ltd 1937) 18*s* 6*d* net

(3) Die Atomkerne

Grundlagen und Anwendungen ihrer Theorie (Physik und Chemie und ihre Anwendungen in Einzeldarstellungen Band 2 Von Dr C F von Weizsäcker Pp viii +214 (Leipzig Akademische Verlagsgesellschaft m b H 1937) 16 gold marks

(4) Einführung in die Kernphysik

Von Dr H Kallmann Pp vi + 216 (Leipzig und Wien Franz Deuticke 1938) 12 gold marks

(5) An Outline of Atomic Physics

By members of the Physics Staff of the University of Pittsburg Second edition Pp ix + 414 (New York J Wiley and Sons Inc London Chapman and Hall Ltd 1937) 18*s* 6*d* net

A COMPARISON of Dr Gamow s well known book Constitution of Atomic Nuclei published in 1931 with say Dr von Weizsacker s book in the list above almost persuades one that they deal with different subjects The discovery of the neutron and of the positive electron the disintegration of elements by accelerated protons and deuterons and the discovery of artificial radio elements have all taken place since the publication of Dr Gamow s book In 1931 only a few examples of nuclear processes were known those of the natural radioactive elements at one end of the periodic table and those cases of artificial disintegration produced by α particles amongst the lighter elements At the present time some hundreds of nuclear reactions have been reported and new series of transformations have been caused by neutron bombardment to start in uranium and thorium

The rapid developments which took place in these few years led to many changes in outlook and to a wide extension of the field of inquiry When this exciting period was followed by comparative calm it was natural that many writers should seize the opportunity to assimilate the new knowledge and to give a connected account of nuclear physics in a form suitable for students and for research workers It will be immediately obvious to readers of these books that much of our knowledge in nuclear physics is still unsatisfactory and our understanding vague and incomplete The subject could not remain long in the state depicted here Nor has it The discovery of a new particle the Yukawa particle or heavy electron has given a new orientation to many of our ideas This may indeed prove to be a most significant advance towards a satisfactory theory of nuclear problems but its full bearing has yet to be appreciated and worked out In the meantime however the books reviewed here give in their different ways excellent surveys of the subject

(1) The late Lord Rutherford s lecture gives a refreshing account of the development of nuclear physics Small as is its compass it contains the essence of the subject From a brief account of the natural radioactive transformations it leads to a discussion of the elementary particles of matter the experiments on artificial transformations by α particles and the discovery of the neutron and the production of radioactive bodies There follows a description of methods of producing high voltage ions for use in artificial transmutations and an account of some simple cases of transmutation In its clarity and directness and above all in its stimulating enthusiasm and vitality this book is characteristic of its author All interested in physics should enjoy it

(2) This book contains exactly what its title implies—a survey of the facts and theories on which nuclear physics is based Prof Rasetti gives a general account of radioactivity the properties of the radiations and their interaction with matter He then discusses the properties of atomic nuclei and the theory of nuclear structure leading to a description of the artificial transmutations The book concludes with a short chapter on cosmic rays

The important facts are brought out clearly and so far as possible explained in general terms In certain cases for example internal conversion of γ rays the α decay the general problem of collisions a more detailed theoretical analysis is given Throughout the treatment is clear concise and easy to follow Many illustrations and tables are given and the printing is good This is an excellent introduction to the subject and it can be strongly recommended

(3) Dr von Weizsäcker assumes a knowledge of the experimental facts and builds upon them the general theory of nuclear physics so far as it

has been developed and generally accepted His book will appeal both to the experimental worker who wishes to know how far his results can be explained and to the theoretical worker who inquires what particular problems require further examination and in what respects the present explanations are unsatisfactory

As a rule important questions are first discussed from a general physical point of view and then the mathematical theory is developed in detail This procedure is especially useful to the experimental worker The subjects dealt with are the foundations of nuclear theory the structure of the nucleus natural and artificial transmutations and the problem of the β disintegration The treatment is extremely thorough and complete There are many diagrams and tables and the printing is good This is a valuable book for those specially interested in nuclear physics

(4) In many respects Dr Kallmann s book is intermediate between those of Prof Rasetti and Dr von Weizsacker It is broadly speaking an account of the present state of the subject in which the object seems to be not so much to build up a general theory of nuclear physics but rather to describe the experimental results in terms of fairly simple concepts The formulæ of quantum mechanics are usually quoted and not established This is not to say that the description is qualitative rather than quantitative The book is clearly written and the arguments are easy to follow It will fill a useful place in the literature of the subject It should perhaps be mentioned that the date on the title page is 1938 although the book appeared in 1937

(5) This is the second edition of a most useful and interesting book for the general student of physics It deals mainly with atomic structure and the nature of radiation but two chapters are given to radioactivity and nuclear structure The theory of relativity is discussed and there is a long and interesting chapter on astrophysics For a general text book on atomic physics the scope is very wide

It is inevitable that some minor inaccuracies and loose statements should occur Thus we read on p 44 in the nuclei of the heavier atoms electrons and protons are closely packed together On p 260 the mass of the proton is given as 1 00815 this is the mass of the hydrogen atom The illustrations and diagrams are on the whole very good but here again are some which are not up to the high standard of the book For example the reproductions on p 230 might be better the photograph of p 258 is not what the legend says it is These however are small defects in what is an admirable and stimulating book for the inquiring student

Reproductive Rhythm in Man

Season of Birth

its Relation to Human Abilities By Dr Ellsworth Huntington Pp viii + 473 (New York John Wiley and Sons Inc London Chapman and Hall Ltd 1938) 17*s* 6*d* net

THIS volume is designed to throw light on some of the interesting problems connected with the seasonal variations in the birth rate The author has managed to collect a great deal of material on the month of birth in different parts of the world It seems that accurate information on the month of birth is not too easy to obtain In Italy it is common practice to postpone the registration of those born in November and December until January since this delays military service for a whole year In pre War Russia many births which took place in December were not registered until the following January owing to the fact that the central Government insisted that end of year reports should be sent in even though they were incomplete This end of year error is common to a great deal of data on the month of birth

The author s main thesis is that man has acquired an innate reproductive rhythm which is set in motion by the weather and such related conditions as sunlight and diet and which is so adjusted that the young are born at the season when their chances of survival are greatest A little later in the book after a discussion of the seasonal distribution of births he concludes that the basic reproductive rhythm depends primarily on temperature factors such as diet being of secondary importance and that the optimum mean diurnal atmospheric temperature for conception to take place is 62° F The author maintains that the chief advantage of an infant being born in the late winter or early spring lies in the fact that at that time there will be an increasing supply of milk for the following months and that the infant will have developed sufficient control of body temperature before the onset of the heat of summer

The effects of fasts, feasts and religious ceremonies seem to have a considerable influence on the incidence of conceptions, especially among highly superstitious peoples such as existed in pre-War Russia Unfortunately, no post-Revolution figures are available for comparative purposes A great deal more information is needed on the season of marriage, and the month after marriage when the first child is born, together with the economic circumstances underlying such seasonal variations as do occur, before the hypotheses in this book can be established

The discussion of the season of birth of abnormal types such as psychotics and mental defectives is intermingled with much unusual and unconventional theory We read on p 396 that "the most important cause of mental deficiency is environmental conditions which act upon the child during pregnancy, at birth, and onward throughout life" There may, of course, be some truth in this statement, but if it is untrue, then this section of the work is largely invalidated

As the book proceeds, more weight is placed on the effect of atmospheric temperature on the seasonal distribution of births and less on other factors such as diet On p 417 we read that "Temperature appears to be the main factor" Most of the work done on the relationship between diet and fertility has been entirely neglected There may possibly be some powerful and direct relationship between atmospheric temperature and fertility, but on the other hand there may not

It is always a difficult task to make a critical estimate of the value of a book of this size The author tells us that the work has taken two years, but in view of the immensity of the problems studied, which are biological, psychological and sociological, it would be unfair to expect more than a general survey of the field and a set of likely hypotheses worthy of investigation The spirit of enthusiasm which pervades this work should do much towards stimulating further research into this interesting and unexplored field

R M W T

Study of the Bantu

Bantu Beliefs and Magic:

with particular reference to the Kikuyu and Kamba Tribes of Kenya Colony, together with some Reflections on East Africa after the War. By C W Hobley Pp iii + 368 + 11 plates (London H F and G Witherby, Ltd, 1938) 15s net

Mr HOBLEY'S study of Bantu beliefs and magic, dealing more specifically with the Kikuyu and Kamba peoples of Kenya, was first published in 1922. It was at once recognized as work of the first order, both as a study of these African peoples, and as a contribution to the general stock of anthropological material, most notably perhaps in its observation and interpretation of the place of the concept of *thahu*, the 'curse', as an element in their life and thought The importance of this concept was duly stressed by Sir James Frazer in his preface to the original edition. The book has long been out of print. A new edition is welcome, not only because it makes accessible once more a book essential for the student, but also because much water has passed under the bridge since its original appearance Mr. Hobley can now compare present-day conditions with his diagnosis of the native situation in the immediate post-War years.

The comparison redounds to the credit of Mr. Hobley's understanding of the people and the sanity of his judgment He is no doctrinaire, he gauges the needs of the moment with the eye of an administrator Although it is now many years since he retired, he has kept closely in touch with the trend of events, while his detachment from controversial strife is obvious

Mr Hobley shows a ready appreciation of the value of the work of the native councils, but in his view the crux of future development is education, with finance as a stumbling block Missionary education, though economical, is deprecated as for the most part in the hands of those who are untrained. At the same time he does not agree with the views of Lord De La Warr's Commission on the necessity for developing a system of higher education Mr Hobley would rather see efforts concentrate on secondary education. He holds that the young African is not so intelligent as the average European, though malnutrition may be in part responsible. The best solution of Africa's problem he can find is co-operation. It may be that his wisest advice is "Trust the settler", but by 'Young Africa' he is not as yet greatly impressed

However much any reader may disagree with Mr Hobley on specific points, he will have to admit that, as a whole, his survey is judicial in its attitude and in its outlook sane

La notion de temps

temps physique et relativité, la dynamique du point matériel Par Ernest Esclangon Pp iv + 77 (Paris Gauthier Villars, 1938) 20 francs

THERE is nothing very new in this little essay by the Director of the Paris Observatory, but it is a lucidly written contribution to that subject which is now almost universally known as the philosophy of science M Esclangon introduces his discussion by a consideration of metaphysical time which he decides can be reduced to a sensation that is individual in every one of us and owes its existence to a kind of biological clock to which we refer our sensory perceptions The extension of this idea to a Being who although infinite and therefore beyond our powers of conception yet dominates the universe and is equipped with a form of consciousness akin to our own, has given birth to the illusion of a real and absolutely independent time This illusion has only been dispelled—with considerable difficulty —from human minds by the concept of relativity M Esclangon concludes that apart from the various times defined by a series of conventions which are the creation of science and form the subject of discussion of the rest of the book there is only this subjective, individual time of which the true nature must for ever remain mysterious and impenetrable

For the rest M Esclangon discusses these various scientific times—of which one example is the time of the special theory of relativity—examines the principle of reciprocity with a description of Fizeau s experiment the invariance of natural laws in uniform translation and the equations of dynamics which are deduced from the principle of reciprocity He does not minimize the difficulties involved in all physical theory, and is of the opinion that at present no firm territory is to be found in those regions which lie at the frontiers of present day science A V Z

Bird Flocks and the Breeding Cycle

a Contribution to the Study of Avian Sociality By Dr F Fraser Darling Pp x + 124 + 1 plate (Cambridge At the University Press, 1938) 6s net

THE author spent about two years on uninhabited Priest Island, off the north west coast of Scotland There he observed the breeding behaviour of the sea birds, particularly of the lesser black backed and herring gulls He reports on his observations in this book, and presents a shrewd conclusion which one feels may lead to the solution of many problems, such as the lack of elasticity or recuperative power in the population of a species when its numbers fall below a certain level It is understood by the majority of naturalists that the breeding behaviour of individual pairs is a sufficient stimulus to bring mating to its successful conclusion Now Dr Darling finds in certain birds which have social habits that the proper pitch of emotion can only be reached by the combined behaviour of a certain minimum population

This is an important contribution to the study of animal behaviour, and a book which brings to the layman from the authority himself the result of his scientific observation J D M

The Hypothalamus

Morphological, Functional Clinical and Surgical Aspects By Dr W Le Gros Clark Dr John Beattie Dr George Riddoch and Norman M Dott (The Henderson Trust Lectures, Nos 13 16) Pp xii + 212 (Edinburgh and London Oliver and Boyd 1938) 12s 6d net

THE importance of the region of the brain near the pituitary gland has been recognized with increasing clearness in recent years and a review of modern knowledge of the hypothalamus is therefore welcome The book consists of an amplification of the Henderson Trust Lectures which were delivered in Edinburgh in October 1936 by the four authors Prof Le Gros Clark s section gives a detailed account of the development and anatomy of the hypothalamus in mammals with a special section on man and smaller sections on reptiles amphibians and fishes Dr Beattie discusses the physiological evidence which has led to the conclusions that the hypothalamus controls sleep the pituitary and the reactions of the body to heat and cold and that the anterior portion controls the parasympathetic system and the posterior portion the sympathetic system Dr George Riddoch discusses the pathology of the region and Mr Norman Dott describes four cases in which he removed tumours Both of them independently describe the clinical symptoms and signs associated with hypothalamic disease—the hunger and the thirst, the obesity and the cachexia and the disturbances of sleep, sex temperature and the stomach

The book is attractively produced with more than a hundred figures and diagrams and an adequate bibliography

About Petroleum

By J G Crowther Pp xiv + 181 (London Oxford University Press 1938) 7s 6d net

THERE are a great many people who use petroleum in some form or other every day of their lives without really knowing anything about it Some of them from time to time are actuated by the desire to find out what it is and where it comes from Unfortunately however petroleum is such a complicated substance both chemically and physically that the normal run of text books is comprehensible only to those who have specialized knowledge of the subject Mr J G Crowther in his book anticipates questions that must arise in the minds of motor drivers, business men housewives and others in the course of their daily duties, and endeavours to give simple answers to these The result is that within the confines of a slim volume information is given in a form palatable to the non scientific mind on all major aspects of petroleum technology The text is amplified by means of carefully selected photographs and easily interpreted diagrams Moreover there is an exhaustive index which facilitates easy reference to the vast number of facts which have been used as a basis of this work There is little doubt that the author s aim will be achieved and that this book will serve as an excellent primer to more comprehensive treatises on petroleum

German Forestry

By Prof Franz Heske Pp xxv + 342 + 16 plates (New Haven Yale University Press, London Oxford University Press, 1938) 14*s* net

THIS is a large book of 342 pages, and has been chiefly written for the American forester Dr Heske deals chiefly with forest economics and policy The character, extent and ownership of forests in Germany, the growth, production and utilization of wood materials and the general public services of the forests in the protection of watersheds, in the conservation of wild life, affording recreation and in maintaining industries, employment and stabilizing communities An interesting fact is stressed Until recently the management of the forests was under the different German States with a consequent difference in policy A greater measure of control of policy by the central Government is now being introduced, a factor which is all to the interests of the country as a whole

The new departure in such well established forestry countries as Germany and the former Austria would appear to merit close attention in India, where the devolutionary pendulum has swung so strongly in the contrary direction

A Bibliography of Eastern Asiatic Botany

By Elmer D Merrill and Egbert H Walker Pp xlii + 719 (Jamaica Plain Mass Arnold Arboretum of Harvard University 1938) 12 50 dollars

THIS magnificent volume, which in truth deserves the hackneyed adjective monumental, places all workers on the botany of the Far East in a deep debt of gratitude to the indefatigable authors The area covered comprises China, Japan, Formosa, Korea, Manchuria, Mongolia, Tibet, eastern and southern Siberia, and neighbouring regions The main body of the work consists of an alphabetical index of authors under whose names the references are arranged chronologically The scope of each reference is briefly summarized In addition there are separate general geographical and systematic indexes, and three appendixes on Oriental bibliography

The volume contains references up to and including 1936, and appears to be remarkably complete The authors and sponsors are to be congratulated on the production of a work which will greatly lighten the labour of future research in the flora of eastern Asia

The Dragonflies of the British Isles

By Cynthia Longfield (The Wayside and Woodland Series) Pp 220 + 260 illustrations (London and New York Frederick Warne and Co , Ltd , 1937) 7*s* 6*d* net

THIS handy manual should prove of material help in popularizing the study of British dragonflies It is the first to appear on the subject since Lucas's handbook of 1900, which is expensive and now out of print Miss Longfield has achieved a judicious blend of scientific accuracy with an absence of all except a very few technicalities, which is what is needed in a work of its kind It will serve as a guide to the identification of native British species and an introduction to their habits and distribution Methods of collecting and preserving specimens are described, while a scientific classification of these insects is appended at the end for those who need it It is up to date, fully illustrated and, in every way, a reliable little volume We hope that it will arouse more interest in these insects than prevails at present, for there is much spade work, such as their range of distribution in the British Isles, which the amateur might study to advantage

Mechanics, Molecular Physics, Heat and Sound

By Robert Andrews Millikan, Prof Duane Roller and Prof Earnest Charles Watson Pp xiv + 498 + 54 plates (Boston, New York Chicago and London Ginn and Co 1937) 4 dollars

THIS text book by American authors, seems to be nearly an ideal one for the intermediate science examination of British universities The style is excellent and it contains many beautiful plates illustrating the history of physics It is perhaps particularly valuable for the presentation of mechanics as a branch of physics with its mathematical side, although not shirked, put in its proper perspective , but the other sections are almost equally good A student who has used this book will not have to relearn what he already knows in any essentially new way on proceeding to more advanced work

Höhenstrahlung (Ultrastrahlung)

Von Dr Erwin Miehlnickel (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr Raphael Ed Liesegang Band 44) Pp xvi + 316 (Dresden und Leipzig Theodor Steinkopff 1938) 23 50 gold marks

STUDY of the cosmic radiation has entered on a new phase with the recognition of the probable existence of a heavy electron Dr Miehlnickel's account of the subject deals with the ground covered prior to this discovery It is written in the style of Meyer and Schweidler's handbook of radioactivity, and although primarily categorical is nevertheless full of interest For a book of this type the illustrations are good, but it would have been improved by more Wilson cloud pictures The most valuable feature of the book is the classified bibliography interspersed throughout the text

Bombyliidæ of Palestine

By E E Austen Pp ix + 188 + 4 plates (London British Museum (Natural History), 1937) 15*s*

THIS monograph is concerned with the rich fauna of Bombyliidæ found in the relatively small country of Palestine The bulk of the collection upon which it is based was formed by the author during the Palestine campaigns of 1917–18 in the Great War Out of 128 species or varieties dealt with in its pages no fewer than 46 are described as new The work is a model of its kind—admirably clear descriptions, first rate text figures and excellent printing It does credit to all concerned in its production

Ley-Farming and a Long-Term Agricultural Policy*

By Prof R G Stapledon, C B E

IN view of the immense amount that has been published during the present century it is not without significance that the leading agricultural journals contain but few articles dealing primarily or even remotely with the rotation and next to nothing relative to the basal philosophy of the rotation The truth is that agricultural thought in recent decades has turned ever more exclusively towards the narrow too narrow as I think path of commodities each considered as such Excessive concentration on commodities leads inevitably towards monoculture and to what we too lightly please to call specialization and leads away from the rotation and ultimately to disaster Greatly daring then I have set myself to combat this modern fetish of over concentration on commodities

Such is the precarious state of the world to day and of Great Britain in particular that there can be only one approach to the problems of agriculture and that is the national approach It so happens at least it appears to me that the present needs of the State and also the more menacing of the foreseeable contingencies unite to demand one and the same essential contribution from our agriculture It is not for me to attempt to decide whether war danger or the danger of our about rapidly to dwindle population is the greater peril little less disconcerting are the effects of soil erosion and soil depletion in those countries from which we are wont to obtain abundant and cheap supplies of food I am concerned with a long term agricultural policy the kind of policy that would take at least ten years to put into full operation and consequently we have to consider not so much immediate war danger as such a danger that owing to our island position would seem to be something from which it is now difficult to see how we shall ever escape I believe the extent of the influences of soil erosion and depletion are not even yet fully realized All methods of countering this must in the last resort react against the British housewife and must tend to increase the cost of overseas production while taking soil erosion soil depletion and land deterioration together a vaster area of the globe is undoubtedly affected than is generally supposed

The immediate and on all hands generally admitted need of our peoples is an abundance of fresh food An abundance of fresh food is not compatible with a superabundance of permanent grass Since permanent grass flows like the sea right up to the very doors of some of our largest centres of population such centres of population are automatically denied an abundance of really fresh vegetables

To sum up so far and on the strength of the various considerations I have brought forward I would say this What is demanded of our agriculture is first to maintain as large a rural population as possible for probably on a large and contented rural population depends to a marked degree the increase of our population as a whole secondly to maintain as large an acreage as possible in a highly fertile and always ploughable condition and thirdly so to conduct our farming as to allow at all times and in all places for the absolute maximum of flexibility in commodity production

Four systems of farming namely arable ley farming nondescript and permanent grass account for most of the farms of Great Britain Unless we know the number of farms and the gross acreage of such farms operating on each of these systems we know next to nothing as to how Great Britain stands relative to potential food production Furthermore schemes for helping the farmer via commodity subsidization and by planned marketing cannot be assessed in their influence on the maintenance and enhancement of soil fertility—and that is what matters above all things—unless we know the systems of farming under which the assisted commodities are being predominantly produced How much quota wheat for example is being produced respectively on arable farms nondescript farms or on ley farms ? Where is most of the milk being produced—and this is a matter of fundamental national importance in the interest alike of the health of the cattle and of the children of this country on nondescript farms permanent grass farms or on ley farms ? Where is most of the permanent grass of the country and where is the best and where the worst—on nondescript farms or on permanent grass farms ? These are all essential facts to be known in the formulation of a long term national policy for agriculture The facts are only on the land the agricultural statistics cannot give anything approaching a full answer to any one of these questions

The answer to these questions and to equally important questions connected with facilities at the farmstead and over the fields (watering drainage and the condition of fences) can only be given by a properly conducted survey carried out over the whole country and on a uniform plan Map also the type or class of all the rough grazings and permanent grass (in a manner broadly similar to the survey of Wales recently undertaken by my department) and map the ploughability of the several fields then and only then should we know where we stand To conduct such a survey would be a relatively simple matter To my mind until such a survey is put in hand and the lessons of the same—cruel and bitter the lessons will be—duly digested there is little hope that the country at large will realize either the deplorable condition of our acres or their immense potentialities The first necessity from all points of view—that of the statesman the townsman farmer and countryman in short that of the nation—is literally and in fact to put rural Britain on the map

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* From the presidential address to Section M Agriculture) of the British Association delivered at Cambridge on August 19

Only when rural Britain is on the map shall we be able amongst other matters to decide where in the national interest it is desirable to extend arable farming and where ley farming and where it may be necessary or permissible to tolerate nondescript and permanent grass farming

In my view no problems so much as those of grass land demand prolonged and large scale agronomical investigation I would wish to distinguish between on one hand agronomical research and on the other scientific research as normally understood and conducted The major aim of agronomical research which is essentially field research is to study all the factors which are operative at once and together and in their natural interplay for nature is a theatre for the inter relations of activities Such a procedure it may be said is impossible or at least unscientific It is certainly not impossible and if it is unscientific it will yet remain agronomical and many of the problems of agriculture are more likely to be solved shall I say by agronomical investigation than by scientific research while nearly all the results of scientific research have to pass through the sieve of an immense amount of agronomical investigation before they can be made useful and in some cases perhaps before they can be other than positively dangerous to the practitioner

The technique of agronomical research entails a great deal more than blindly following all the elaborate rules and regulations laid down by the statisticians indeed such rules and regulations are of no fundamental significance in the proper planning of an elaborate series of field experiments They are sometimes but by no means always useful in the actual placing of plots on the ground and they are sometimes essential but are by no means always necessary in the examination of quantitative data One effect of the modern glorification of statistical methods has undoubtedly been a tendency to obscure the wood by the trees to concentrate on the part often an isolated part (yield for example) instead of the whole and worse still to fill the agronomist with a medley of complexes and inhibitions which have reacted adversely on the development of a technique adequate to solve a large number of the problems that can only be solved by highly complicated field experiments Many agronomists are almost too frightened to set up the sort of experiments their experiences teach should be set up because they are timorous lest the data could be made amenable to statistical analyses

Agriculture would have been the gainer if the agronomist had never been taught to be timorous and if he had plodded away undeterred and undismayed at the details of his own technique when by now perhaps he would have been able to justify his claim that what is primarily wanted to day is enormously increased facilities for the conduct of field experiments in contradistinction to field trials and demonstrations That at least is my claim for I claim to be an agronomist and in that capacity one who has been responsible for the setting up of hundreds of weird little field experiments involving in all literally thousands of plots

As always however the greatest and the final hope is the farmer himself for he at least is untrammelled by the technique of science and is not a slave to the fashions current in science while his major training is not in collecting data but in the gentle art of unadulterated observation Just because therefore of the immense accumulation of scientific knowledge so much of it but half digested in the practical sphere there has never been so urgent a necessity as at present for an abundance of well informed originally minded and affluent pioneers men willing and eager to transgress against every canon of good husbandry and to explore and almost *de novo* the whole field of rotation of crops and the whole idea of rotation of pastures of different types and of stock over the surface of the farm

I have adopted an unusual course in my approach to my subject instead of reviewing the data and evidence available I have in effect reviewed my own reactions to the implications of the work with which I have been connected for the past twenty five years and more Perhaps I need not apologize for this for after all facts and data are of no practical use until people grapple with the practical implications Instead of my facts —and scientific facts are not always correct—I have put my grapplings before you that is all and if justification is necessary I think sufficient justification is the admittedly deplorable conditions of a huge acreage of Great Britain the dilapidated condition of many of our farms and farmsteads and the therefore necessarily backward state of much of our farming Two needs seem to me to be crystal clear first the conduct of a survey on the land—and I believe every agricultural scientist though perhaps not every farmer and every economist would agree to on the land somewhat on the lines I have suggested—and then the ways and means of getting the plough into the grasslands that the survey conclusively proves ought to be ripped up Working capital and the correct expenditure of that working capital is in the last resort the only solution for our derelict and quasi derelict acres

I like the American idea of loans with a working plan of loans with advice I do not believe that the history of the years since about 1894 shows that the spasmodic periods of agricultural prosperity that have on occasion intervened have been responsible for a great deal of land improvement or for a proportionate improvement in the equipment necessary for productive farming Prosperity as such in agriculture as in industry is to a large degree a function of equipment for without the necessary equipment it is impossible to farm economically just as it is impossible to manufacture economically

Again it is unreasonable to expect that a man devoid of working capital and probably the son of a man similarly devoid should have all the knowledge of how best to farm and particularly of how best to improve land (in which art he will necessarily have had no sort of experience) in sympathy with adequate working capital suddenly provided for the purpose Advice and some measure of control must necessarily go with credit facilities and in so far as breaking up grassland is concerned I like still better the American idea of group loans and of a master borrower The master borrower in this case would be set up as a contractor with tractor and necessary equipment to break up the grasslands for it is important to remember that ploughing up of this sort is essentially tractor work that it interferes with the normal routine of an ill equipped farm while tractors are to all intents and purposes non existent in many of the districts where wholesale ploughing up is most necessary My own experiences are interesting in this connexion We tested the desire for contracting last year and had three times as many applications as we could fit into the acreage we could do while now and because of the demand our work has created locally a lorry contractor in the neighbouring village has acquired a tractor and is fully engaged on contract ploughing

I like also the American idea of being boldly eclectic and scheduling particular districts as being eligible for their rehabilitation loans There are innumerable districts that should be similarly scheduled and similarly helped in Great Britain, but always through financial help cum technical advice terminating in an agreed working plan and here again my own experience comes to support my contention for in those cases where we contracted we only did so when the farmer agreed to follow all our advice as to subsequent operations manures and seeds to the letter and in all cases the farmer has done so and demonstrably to his own advantage

The breaking up of derelict grassland is to be helped forward not only by loans but by a reorientation of such working capital as the farming community possesses and also I think by a reorientation of the monetary and other arrangements existing between landlord and tenant

Ley farming in my view affords great scope for such re orientation for it would make possible and on a general scale a variety of methods of share farming For example one might conceive of a mechanized wheat grower operating over a large number of neighbouring ley farms on a share basis another man on a share basis might be running the poultry the proprietors themselves being primarily interested in the adequacy of the rotation and farming operations and possibly in one major product—milk shall we say ? By this means farmers should achieve a better return on such working capital as is available and also the nation should achieve a more balanced specialization between farming *qua* farming and commodity production and disposal Landlords themselves could often think out with advantage methods of sharing in with their tenants and ley farming opens many avenues of approach to such sharing in but in any event it behoves the landlords of many districts to be alive to changing times and to be ready for the day—not I think far distant—when better tenants will be found for farms which are going concerns on the ley farming basis than for those which are nondescript or permanent grass It may thus prove to be a wise policy to adjust leases and even financially to assist purposeful tenants towards that system of farming which will accord best with the trend of national and international events

Let me insist in conclusion that the affairs of agriculture slowly moving as they necessarily must be are ill adapted to respond to the dictates of any immediate expediency for expediency is ever shifting and at the best is the mere shadow of what is right and true To be ever prepared for change in a world that is ever changing can be the only possible basis for a sound agricultural policy for Great Britain since we are so peculiarly liable to be crucially affected by happenings beyond our own control beyond our own jurisdiction and beyond our own borders

The Orient and Europe*

By Prof V Gordon Childe

FORTIFIED by the conclusion that diffusion from Asia to Central Europe is likely let us turn to axiom 4—the prehistoric chronology of Central Europe There the cultural sequence is reasonably clear at least north of the Bakony and the Little Carpathians The divisions which I tentatively suggested ten years ago have on the whole been fully justified by recent research But to what Oriental cultures shall these several phases be compared ? Encouraged by the newly revealed proofs of intercourse let us apply Montelius s fourth axiom to dating the Danubian sequence

The earliest bronze objects found in Central Europe (in graves and hoards of the Aunjetitz culture) include a whole constellation of specialized and arbitrary forms of ornament that are now known also in historically dated horizons Ingot torques have been found in Early Dynastic levels at Tel Agrab and recur in North Syria and in the Copper Age graves of Ahlatlibel in Turkey Earrings and lock rings with flattened ends are common in Early Dynastic Sumerian graves and in the treasures of Troy II racquet pins are found in the Royal Tombs of Ur the knot headed pin goes back to Gerzean times in Egypt and appears at Troy II its principle was applied to Sumerian toilet sets in Early Dynastic times By then tin bronze was already known to the Sumerians as to the Lesbians in the time of Thermi I In a word all the type fossils of the Early Bronze Age in Central Europe and the technical discovery that defines the period can be traced back to somewhere about 3000 B C in the Orient On the strictest application of Montelius s axiom the beginnings of the Continental Bronze Age should be nearer 2800 B C than 1800

So far as Central Europe is concerned that chronology would involve no glaring contradiction Oriental parallels can be found to the types that define earlier periods while Mediterranean shells imported even to the Rhine Valley prove intercourse with the south east right back to Danubian I Stone battle axes such as characterize period III are found already at Thermi I The Early Dynastic levels of Tel Agrab have yielded rather degenerate specimens better battle axes come from the al Ubaid settlement at Arpachiya and from Gawra VIII–IX that is equivalent to Uruk in Sumer Hence Danubian III could be equated with the Uruk period

Clay stamps generally called *pintaderas* appear in Danubian II (and in Koros sites that may be older) In form they closely resemble Asiatic stamp seals of stone and like the latter often bear a filled cross design Their distribution justifies their interpretation as copies of Asiatic stone seals But in Asia prototypes can be found so early as Tel Halaf times and in the Chalcolithic layers of Alişar and there are pedestalled bowls remarkably like those characteristic of Danubian II The upper limits for that period could accordingly be pushed back to Alişar Chalcolithic or even Tel Halaf

That is not the end of our comparisons As *Spondylus* shells were being imported from the Mediterranean even in Danubian I times so some Danubian I vases are decorated with patterns in which Neustupny rightly sees a representation of a double axe For the models he looked to Minoan Crete But double axes were used in Assyria as amulets even in Tel Halaf times So the *terminus post quem* provided by that motive can be relegated to a remote Tel Halaf period

Testing this long chronology in the other direction it can still be made to work Åberg and Reinecke have indeed insisted on Middle Helladic and Shaft Grave parallels to Aunjetitz bronzes of period IV But on the whole Middle Ægean armament—rapiers ogival daggers socketed spear heads—is typologically parallel rather to that proper to the Middle Bronze Age or period V in Central Europe A halberd from Shaft Grave IV is admittedly an Early Bronze Age type but Forssander has plausibly compared its contours with those of a Middle Bronze Age sword from Hajdu Samsón The pottery from Middle Bronze Age graves at Vattina and from south eastern Hungary includes many tankards and goblets with crinkled rims and grooved handles that might be copies of well known Middle Minoan silver vessels In a word a limiting date about 1700 B C for the Middle Bronze Age is defensible

With the fall of the Mycenaean culture we have admittedly reached the Late Bronze Age or period VI of Central Europe The barbarian invaders who sacked late Mycenaean Vardaroftsa in the twelfth or eleventh century brought ceramic traditions proper to the Late Bronze Age urnfields like Knoviz and Hötting and this date is for once a *terminus ante quem* for the Continental period An even higher limit might be deduced from the fibulæ and flange tanged swords that

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**Continued from p 559*

appear in Greece during the thirteenth century Accordingly the following scheme of European chronology might be defended

Danubian VI (urnfield cultures fibulae and slashing swords)	1200 B C
Danubian V (Vattina ware rapiers ogival daggers socketed spear heads)	1700 B C
Danubian IV (Bronze ingot torques knot headed pins lock rings)	3000 B C

If geologists and botanists can show good grounds for demanding an enlargement and prolongation backward of the neolithic age archæological chronology can be adjusted to meet theirs without violating Montelius s axioms Danubian I admittedly the earliest neolithic culture in continental Europe would still be limited by Tel Halaf If the former have to be dated to the sixth millennium the latter can just as reasonably be assigned a like antiquity

For the moment let us adopt the maximal dates as a framework for comparing Asiatic and European cultures How would Montelius s general view of the relations between Europe and the Orient be affected by adopting the long chronology outlined here ? What happens to his fifth axiom if the Central European Bronze Age began about 2800 B C ?

By that date we should have the following picture of the tract we have been surveying We should see in Egypt and Lower Mesopotamia populous cities covering like Erech perhaps two square miles of area governed by a well established organization emancipated from immediate dependence on environmental conditions by extensive public works a rich technical equipment and regular far flung commerce and all fully literate Then in Assyria and Syria come smaller cities only slightly less richly equipped and still at least semi literate Farther afield in Anatolia and peninsular Greece are fortified townships whose walls protect a variety of specialized craftsmen so well served by regular commerce that metal at least could be freely used for tools their citizens may already need and use seals but seem to be illiterate Next in the Balkans and on the Hungarian plain we find rustic townships occupied principally by farmers Their rural economy is advanced enough to support a truly sedentary population but virtually the sole outlet in industry for the surplus is offered by metallurgical employments and trade is so imperfectly organized that metal has to be reserved mainly for armaments The same picture would apply to Bohemia and southern Germany with the important reservation that agriculture seems not to have advanced so far as to allow the population to be really stable Denmark and southern Sweden are still frankly in the Stone Age Still farther north food gathering is the sole economy

Look back as many thousand years as may be necessary to reach Danubian I times which have been for this purpose equated with the Tel Halaf period in the Fertile Crescent In the Orient we see already little townships permanently occupied by experienced farmers comprising already expert craftsmen and supplied by trade at least with obsidian In Crete and Thessaly too perhaps more self sufficient farmers are still applying sufficient science to their fields to be able to live permanently on the same site But beyond the Balkans nomadism reigns Danubian I peasants are spreading over the loss shifting their little hamlets of twenty or so households to new virgin fields every few years and beyond the frontiers of the loss are only food gatherers fishing and fowling along streams in the forest or collecting shell fish on the coasts

Yet earlier still beneath Tel Halaf villages we have glimpses of settled cultivators who judging by the few items of equipment so far recovered were at least as far advanced as the Danubians

Even on this extreme chronology Montelius s fifth axiom is justified Oriental cultures are richer than the contemporary European Moreover the first picture discloses a very significant cultural zoning As we pass north westward from the Orient we descend through regular gradations from the many sided richness of urban civilization to the stark poverty and immediate dependence on external Nature of food gathering hordes Such a grading is exactly what would be deduced from Montelius s third axiom Its discovery in the archæological record is the best demonstration of diffusion that I can imagine I take it as confirming the diffusion of bronze working with all its economic implications

But on the extreme chronology this demonstration could not be applied to food production to the more important discovery complex that made possible what I term the neolithic revolution

Montelius s thesis has come unscathed through the severest test Even on a chronology based on geological rather than archæological premises and designed to meet the demands of an extraneous discipline his axioms 4 and 5 prove workable If geologists demand dates of the order just outlined archæologists can meet them without sacrificing any essential principles but preserving intact their own proper methods and all the historically vital deductions therefrom But these high dates for Central European prehistory have been advanced provisionally simply and solely to test the applicability of Montelius s method and not as proved or even probable To justify them archæologically we have had to sacrifice many tempting comparisons and to explain away observed facts that must be admitted as relevant

Remember that down to 1200 B C no date in European prehistory could be justified archæologically by an actual object of Oriental manufacture found in Central Europe still less by an admittedly European product in a historically dated context We have had to rely exclusively on copies of Oriental models made in Central Europe Remember further that all the types on which we have relied enjoyed a long popularity in the Orient seals that could serve as models for Danubian II pintaderas were current in Crete and Asia Minor throughout the third millennium and later Battle axes for comparison to those of Danubian III were brandished equally long in central Anatolia and first appear in peninsular Greece in Middle Helladic times The type fossils of Period IV only came into fashion in the East in the third millennium and fashions did not change abruptly Knot headed pins were still being worn in the third (Hittite) settlement at Kusura during the second millennium Ingot torques racquet pins lock rings and earrings with flattened ends are common in Caucasian graves well after 1500 B C The archæological synchronisms so far considered are really just upper limits

Accordingly until geologists present their demands with more unanimity and confidence it is permissible to recall other comparisons between Central European and south eastern phenomena that entail substantially lower dates for our prehistoric periods Characteristic of Danubian II are cubical blocks of clay with one or rarely two cups hollowed out in them and perforated at the corners These have been convincingly explained as clay copies of Early Minoan block vases of stone Thus interpreted they would bring the limits of Danubian II down into the third millennium under axiom 4

Found allegedly in an Aunjetitz grave of period IV at Nienhagen in Central Germany was a clay cup its curious handle is strikingly like those of the metal Vapheio cups of Late Minoan I most popular between 1600 and 1500 B C Parallels between Aunjetitz weapons and those of the Mycenaean shaft graves of roughly similar age have already been mentioned—and explained away Still the amber beads from these and later Mycenaean graves should re enforce the arguments for a parallelism between Central European Aunjetitz and Late Helladic Greece The amber trade was a mainspring of the Aunjetitz commercial system Did it involve nothing more than barter between barbarians in Denmark Bohemia and Upper Italy ? The brilliance of the Early Bronze Age in Bohemia would become much more intelligible if that region were already connected by the amber trade with civilized Greece The probability of such a connexion is enhanced by Piggott s recognition among the amber beads from Kakovatos (Nestor s Pylos) of massive forms and space plates in the Danish style such as often occur in graves contemporary with Aunjetitz All these pointers converge upon a date for the beginning of the Central European Bronze Age a full thousand years later than the upper limits deduced from the metal ornaments

Such considerations are however frankly speculative and can if needful be dismissed It is less easy to explain away certain actual Ægean or Egyptian imports found in an apparently Early Bronze Age context in Central Europe Segmented faience beads occur in four graves near Szeged associated with pottery of the Perjamos type and in two Moravian graves with Aunjetitz pottery Though the blue glaze is generally less well preserved these beads Dr Stone assures me agree perfectly in form and technique with those from Wiltshire and from Grave 1808A at Abydos dated about 1400 B C Now admittedly the coincidence of Perjamos and Aunjetitz may not be altogether exact and Aunjetitz and Perjamos ceramic forms and even knot headed pins and ingot torques outlast the bounds of the Early Bronze Age or Danubian IV as defined by hoards But even if the relevant graves be transferred to the beginning of the Middle Bronze Age (Reinecke B) it is difficult to admit that Perjamos jugs and Aunjetitz mugs persisted virtually unchanged for 1400 years or to spread over so long a period even the 180 graves of the Szőreg cemetery from which some of our beads come

Perhaps then it may be legitimate to consider a short chronology such as I have previously advanced on several occasions as a still plausible alternative to the long one outlined here Until incontrovertible evidence from the geological or botanical side make it obsolete it is still permissible to consider in conclusion how the low dating endorsed by the fresh data just adduced affects the general credibility of Montelius s hypotheses

In our previous pictures of the Tigris Rhine tract we shall have to transpose individual items to fit a Central European chronology based on synchronisms through Greece with Egypt and altogether independent of Asia We then get two scenes both disclosing the cultural continuity and gradation recognizable only in the first picture on a long chronology At the beginning of the Central European Bronze Age towards the middle of the third millennium B C the picture would be much the same as that already sketched

Fifteen hundred years or so earlier the gradations would be similar, but the zones would have contracted. We should see:

(1) In Egypt and Mesopotamia true cities the walls of which may already enclose nearly two square miles relieved from immediate dependence on environmental accidents by public works and organized commerce, comprising a variety of artisans and officials including scribes.

(2) Smaller cities in Syria less richly equipped and only partially literate.

(3) Copper Age townships in Anatolia and peninsular Greece with a walled area of two to four acres and a population comprising specialized smiths and some other craftsmen adequately provided by trade with metal and other raw materials.

(4) In Thessaly, Macedonia and the Morava-Maros region beyond the Balkans neolithic villages are permanently occupied by experienced farmers who are content to do without metal.

(5) North of the Maros-Koros herdsmen and Bukkian troglodytes are grazing and tilling patches of loess and then moving on; still farther north Danubian I hoe-cultivators are shifting their hamlets of twenty odd huts every few years to fresh fields until they reach the confines of the loess.

(6) Beyond these on the North European plain are only scattered bands of food-gatherers hunting, fowling and fishing and collecting nuts or shell-fish.

In each picture we see within a continuous area of interlocking cultures gradations such as would be deduced from the diffusionist postulate. But a comparison of the second picture with the first reveals just that expansion of the zones affected by the neolithic revolution that would be anticipated were its effects being indeed diffused. The acceptance of axiom 4, the rigorous application of his chronological method alone would virtually allow the graphic demonstration of Montelius's remaining assumptions.

Obituary Notices

Prof. Samuel Alexander, O.M., F.B.A.

WITH the death of Prof. Samuel Alexander in his eightieth year we have lost one of the few creative thinkers of our day. At the end of the nineteenth century many believed that all philosophical systems had been thought of so that there could be no *new* ones and that, as hitherto no British philosopher had ever produced a system, none ever would. Alexander's work refuted both these beliefs.

It has been customary to call his philosophy realist as opposed to idealist, but it is not so easily classified. It is true that he revolted against the Hegelian tradition he was trained in, but even more he revolted against that wider tradition, not necessarily idealist, that makes the theory of knowledge the central and almost the only topic of philosophical discussion. For those of the tradition, the sole starting point of philosophy is the individual conscious mind, and knowing is its unique relation with the world, if there is one. For Alexander the starting point is the world as known; knowing is not a unique relation but is common to all related beings that 'prehend' each other, to use Whitehead's term. As a conscious being I 'enjoy' my activities as knower, but this 'enjoyment' is strictly irrelevant to any discussion of what is known. The iron 'knows' the magnet but does not 'enjoy' it, for it lacks the privilege of consciousness. The spider 'knows' the fly and incidentally may or may not 'enjoy' it, and so *mutatis mutandis* does the fly. The starting point then is the world as known, and Alexander finds its universal substratum or matrix to be space-time, which includes minds and bodies and everything. Bergson helped Alexander to realize that time cannot be left out as a regrettable imperfection, and the mathematical physicists that space and time separately are not primary. Time is related to space much as mind is to body. The main task of philosophy is to point out and classify the recognizable features of space-time, that is to say, the categories. The world as we now see it is the result of a process of development such that there is a hierarchy of natures. Of these the higher can understand the lower but not the lower the higher. Minds are the highest natures we are acquainted with. There is potentially a higher stage in the hierarchy towards which the universe may be said to be striving: this is deity. It is deity that is the end of moral progress and the object of religious worship.

Alexander himself said that his philosophy was Spinoza's "with Time put in". There are, in fact, many resemblances between these two Jewish philosophers and their philosophies. For both of them philosophy must begin with the results of the natural sciences, but must go beyond them to make their crown and completion. Unless in this process philosophy becomes theology and moral theory, it is nothing. Alexander realized, as did Kant, the further point that a philosophy with a naturalistic basis must come to terms with man's sense of beauty and artistic activities. In his later years he was occupied mainly with these problems.

The external events of Alexander's life can be briefly told. He was born in Sydney, New South Wales, in 1859; like Kant, the son of a saddler. He went to Wesley College, Melbourne, then to the University of Melbourne, and in 1878 won a Balliol

Scholarship. At Oxford he performed the unusual feat of a first class in both Classical and Mathematical Moderations before taking a first in Greats in 1881 In the following year he was elected fellow of Lincoln College, where he remained until his appointment to the chair of philosophy in Manchester in 1893 He held this chair until his retirement in 1924, and he stayed faithful to Manchester to the end of his life As presenter for honorary degrees until 1930 and as honorary professor he kept in close touch with the University. He lectured frequently in Manchester and elsewhere as long as his strength allowed The University of Manchester possesses a fine bronze bust by Epstein which has preserved the severe beauty of his bearded head, but leaves the beholder to guess the kindliness and humour that were also visible in life

Alexander's philosophical writings are none of them 'popular' and are not to be read without intellectual effort ; but given that effort they are found to be clear and straightforward and free of unnecessary technicalities. His first book, "Moral Order and Progress" (1889), which was awarded the Green Moral Philosophy Prize, was written before he developed his characteristic views The long interval between this and the appearance of his chief work, "Space, Time, and Deity" (1920), filled with only one small book on "Locke" (1908), represents the incubation period of his philosophy The first expositions of his views, in short papers from 1907 onwards, appeared at the time to be excessively paradoxical and made little impression The invitation to Glasgow as Gifford Lecturer in 1916–18 was therefore well timed to induce him to develop his whole system in one comprehensive work Later books are · "Spinoza and Time" (1921), "Art and the Material" (1925), "Beauty and Other Forms of Value" (1933) His numerous papers in the *Proceedings of the Aristotelian Society*, *Mind*, and other journals have not been published in book form

In spite of his deafness, Alexander was the most sociable of men He never forgot old friends and continually made new ones People of all kinds and all ages were equally drawn to him He was a witty speaker on social occasions, and his technique in presenting honorary graduands will long be remembered : a dexterous mixture of information and compliment spiced with gentle malice. The various honours bestowed on him of late years gave him unaffected pleasure they merely confirmed his modest belief that people were kinder to him than he deserved. Though all his life a poor man who spent more on others than himself, during the last few years he gave to the funds for Jewish refugees as though his wealth was unlimited

At the end, Alexander was ready and even glad to die, tired perhaps of a world where the insane persecution of his people has begun again, and where the reason and humanity in which he had put his faith seem to be fighting a losing battle A D R

WE regret to announce the following deaths :

Sir Philip Dawson, a distinguished electrical engineer, who received the George Stephenson Gold Medal of the Institution of Civil Engineers and also the Albert Medal of the Royal Society of Arts, on September 24, aged seventy-one years

Lord Marks, known for his work in civil, mechanical, hydraulic and electrical installations, and founder of the firm of Marks and Clerk, patent agents, with which the late Sir Dugald Clerk was associated, on September 24, aged eighty years

News and Views

Development of Museums and Galleries

THE Standing Commission on Museums and Galleries, of which Sir Evan Charteris is chairman, has just issued its second report, covering the five years 1934–38 (London · H.M Stationery Office, 1938 9*d* net) The Commission was appointed in 1931 to advise generally on questions relevant to the most effective development of the national museums and galleries of Great Britain The report surveys the very considerable building developments which have taken place in the period under review and directs attention especially to the part played in this by private benefactors : Lord Duveen's provision of sculpture galleries at the Tate Gallery, and one for the Elgin Marbles at the British Museum ; also Sir James Caird's benefactions to the National Maritime Museum at Greenwich, and the gifts made by Sir Alexander Grant to the National Library of Scotland, are referred to. The Commission was invited by the Treasury to advise on the general proposals for future building schemes, which would cost some £1,000,000, and to indicate an order of priority for them Its recommendations, which it is understood have been accepted, provide for the entomology block of the Natural History Museum (second half), and the lecture hall for the Royal Scottish Museum being begun in 1938 and completed in 1939 These are to be followed by the central section of the Science Museum in 1940, the northern wing of the Natural History Museum in 1941, and the Museum of Ethnography in 1942, these being completed in from two to four years.

THE Commission has also been asked to advise on the future development of the site at South Kensington, which has of late been under consideration and was discussed in a leading article in NATURE of September 17. Final plans are not yet available and they will need careful consideration and discussion, nevertheless, more adequate accommodation for the collections of the Science Museum seems at last to be in sight The formation of a collection of ship models at the National Maritime Museum has raised the question of what should be the appropriate spheres of this Museum and the Science Museum in representing naval architecture, the Commission has gone carefully into the matter and has proposed certain broad principles of development which it recommends for future guidance The abolition of fees for admission to museums and galleries, where these are still imposed, is strongly recommended

Man or Gannets

A CIRCULAR letter, signed by Sir Montagu Sharp chairman of the Royal Society for the Protection of Birds, and Mr John M Crosthwaite, honorary secretary of the Scottish Society for the Protection of Wild Birds, has been received by NATURE and has been widely circulated in the daily newspapers It states that the inhabitants of Lewis capture and preserve for winter food some two thousand nestling gannets, after a journey over some 40 miles of open sea to the uninhabited islet of Sula Sgeir sarcastic comment is made on 'the apparent plight of the inhabitants . that of necessity they have to eat Gannets', and suggests that this wilful destruction of these birds for human food should be stopped The letter further states, inaccurately, that such slaughter is without precedent in Great Britain This is scarcely correct Historically, the use for human food of the nestlings of the birds which frequent certain bird rocks in Scotland in great numbers is an ancient practice which throughout centuries has made no appreciable difference to the bird populations In Edinburgh the nestlings of gannets from the Bass Rock used to be sold in the streets, as a luxury and not as something which suggested the plight of starvation or lack of 'sufficient food of a more ordinary and palatable kind', as the signatories describe it At the time when St Kilda was most prosperous, its people preserved and fed annually upon, not two thousand, but many thousands of fulmar petrels, and if the stoppage of that source of food supply has had any effect upon the fulmar population, it has been to threaten to make that bird a nuisance on certain parts of the coast of the mainland

THE circular states that in order to bring about the protection of gannets of Sula Sgeir, the County Council was approached by the signatories or the societies they represent and 'urged" to take the necessary action to make this island a bird sanctuary, so that the men of Ness could be prosecuted if they took the birds The County Council refused to take any steps in the matter on the grounds that the gannets constituted in money and food a great aid to the livelihood of the people of Ness Presumably the County Council, composed of local representatives, knows what it is talking about, and presumably some urge greater than useless destruction causes these crofters of Ness to cross forty miles of the open Atlantic and to spend an uncomfortable fortnight on an isolated island collecting these winter food stores But a curious situation has been reached when sentimental regard would insist that the welfare of birds should be preferred to the welfare of human beings

Influence of Science on Current Thought

THE fifth lecture of a series on the influence of science and research upon current thought, established by the Carnegie Institution of Washington in honour of Mr Elihu Root, who was, until his death last year, a member of the board of trustees of the Institution and its chairman during the last twenty-four years of his life will be delivered by Sir Richard Gregory in the Institution s new auditorium on December 8 The subject will be Cultural Contacts of Science , and the lecture will, therefore, be concerned mainly with associations of science with religion, literature and other aspects of intellectual development and social evolution, rather than with the services rendered to modern communities by utilitarian applications of scientific knowledge As Mr Root was deeply interested in the relation between the advance of science and development of human values, it is appropriate that this should be the general theme of the series of lectures bearing his name The lectures are published in book form after their delivery The subject of the fourth lecture in the series was The Concept of Uniformity Growth and Reactions , by Dr F H Seares, assistant director of Mount Wilson Observatory

Roman Dorchester

ON September 26 the foundation stone of the new Shire Hall in Colliton Park, Dorchester, was laid by Lord Shaftesbury This building is probably unique in Great Britain in that it is the first to be erected on the site since Roman times, and also because there will stand near by permanently preserved, one of the residential buildings of the Roman town of Durnovaria, brought to light by the excavations of the Dorset Natural History and Archæological Society, which were initiated under the direction of Lieut-Colonel C D Drew when attention was directed to the existence of Roman remains at this point by the preparations for building Further discoveries are still being made Colonel Drew records the discovery of a fine tessellated pavement of geometrical design It had been broken in ancient times, and in the fracture was found a delicate Roman balance in bronze, which probably had been used for goldsmith's work The beam was three inches long only One of the pans was intact, the other in fragments The pavement is to be removed to the adjacent Roman dwelling, and the balance has been set up in the Dorchester Museum Further work in the examination of the neighbouring town wall in the North Walk reveals that on this side there was no stone wall, such as was found recently below Colliton Walk Here an earthen rampart had the natural reinforcements of the river and marshy ground

Archæological Excavations at Colchester

Systematic archæological excavation on the central part of the site of the ancient British city at Colchester must, it is announced, cease permanently at the close of October, when this area of some twenty acres is to be developed for building. It will be remembered that the discovery of a British settlement here was made eight years ago in the course of preparations for the Colchester by-pass road; and that since that date, with the co-operation of the local authorities, a Committee of Excavation, under the auspices of the Society of Antiquaries of London, has been engaged in the archæological exploration of the site. Not only has the defensive system been investigated, but also a very large number of antiquities, estimated at something in the neighbourhood of a million, and including fifty tons of pottery, has been recovered. This site has, in fact, proved one of the most prolific of ancient British sites yet examined. The central area now under examination, it was hoped, would afford some evidence of the place of residence of the British king, Cunobelinus, but so far nothing of this nature has come to light. Among the more important objects recently reported in the present season's work are an iron box four inches square and one and a half inches deep. This contains a powder believed to be a pigment used by the potter. A Roman dagger, 15 in. long, has also been found. Although systematic investigation must cease as soon as building operations begin, local members of the Committee will continue to oversee the work of foundation-digging in the interests of archæology.

Burials of Saxon Age in Kent

One of the most important discoveries of burials of Saxon age in recent years is recorded from Risley, Horton Kirby, four miles south of Dartford, in Kent. In the course of road-making on the housing estate of the District Council, burials were brought to light in which were human bones, spear-heads, the umbo of a shield, pottery fragments, and an almost complete glass vessel. Fortunately the finds were brought to the notice of the Dartford Antiquarian Society, and their character as Saxon or Jutish recognized. Further excavation made it evident that this was the site of an extensive cemetery, although another, excavated in 1867, existed only a mile away to the north. That the present site had been in use for burial purposes even before Saxon times was indicated by a Roman cinerary urn and a circular cist burial. The prevalence of inhumation points to a Jutish origin, the period of the burials being from the sixth to the ninth centuries of our era. The people must have been of exceptionally fine physique, as a number of the skeletons are those of men more than six feet in height. So far more than seventy graves have been exposed. The burials as a rule are shallow, not more than two feet deep. In one instance only have valuables been found—in the grave of a woman, in which were five gold brooches and four beads of amethystine quartz. The brooches, it is stated in a report on the excavations in *The Times* of September 16, were circular, of filigree work, with precious stones inset, and represent a style of ornament peculiar to Kent, of which this is the westernmost example. One fine burial of a warrior with shield-umbo, sword and spear, is to be removed and reassembled complete, with the bones, for exhibition. The excavations are being continued on a part of the site which is to be set aside as an open space. A selection of the finds has been on view in the Dartford Borough Museum.

Meare Lake Village

The three habitations (Nos. xx, xxii and xxiv), which have been examined by Mr. H. St. George Gray and Dr. Arthur Bulleid in the course of the current season's investigation of the eastern division of Meare Lake Village, Somerset, by the character of the finds, more particularly those in hut No. xxii, have emphasized both the importance of the weaving industry in the economy of the inhabitants, and their appreciation of personal ornament of a colourful type. In hut xxii, in which five superimposed hearths of stone and clay have been uncovered, no fewer than twelve combs for beating down the weft and woof threads have been found, with bobbins, loom weights and a dozen spindle-whorls of stone, bone or baked clay. Among other finds were half a dozen saddle querns, hammer-stones and whetstones, a polished flint axe converted into a hammer, flint scrapers, bone awls and modelling tools, iron tools, bone gouges and handles and other objects of red and roe-deer antler, including a 'gaming piece'. A scapula, or shoulder-blade of ox, is ornamented with the dot-and-circle pattern. By far the largest series of remains, however, it is stated in a report on the excavations in *The Times* of September 16, may be classed as personal ornaments. These include two toggles or dress-fasteners, one finely engraved with four rows of dot-and-circles, the other of a zoomorphic character, having one end resembling the head of a fish. A remarkable large flat brooch is of bronze, of which the surface was probably inlaid with enamel. The finest of the armlets of Kimmeridge shale is carved, while jet appears in the village for the first time in the form of a bead. Another bead of amber has been found, and beads of glass are numerous, the colours being blue, dark red, yellow and black. Some of the beads of clear glass ornamented with yellow spirals were found in a group. The smallest beads (blue) are only two millimetres in diameter. Canine teeth of the dog had been pierced for suspension as a necklace. In hut xxii more pottery, mostly cooking wares, has been found than in any other dwelling.

Twenty Years of Polish Science

When Poland regained its independence in 1918, a new impetus was given to Polish science and culture, which had had to struggle against adverse conditions for so long. The present year marks the completion of twenty years of constructive achievement in many directions. Much that has been achieved in general science has been recorded in *Nauka Polska*, a comprehensive publication issued at least once annually by the Mianowski Institute for the Encouragement of Science in Poland, which is concerned with the history, organization and co ordination of scientific effort The recently published volume for 1938 (No 23) includes in its 400 pages contributions by several leading Polish men of science Thus, Prof B Kieskowski discusses the question whether philosophy can be considered as a science, and gives cogent reasons for an affirmative answer Prof W Semkowicz has two lengthy contributions, the first being devoted to a comprehensive account of scientific and philological work at Cracow, the seat of the Polish Academy of Sciences and of the Jagellonian University, since the establishment of the republic The second article is a survey of the special needs of science to day There is an informative description, by Dr W Siemaszko, of recent advances in phytopathology both in Poland and elsewhere This branch of applied botany is of special significance to a country like Poland, which has a large agricultural industry as well as extensive forests Particular attention is given to the organization and co ordination of research, and reference is made to the facilities for planned researches in Poland, Czechoslovakia, Britain and America Of immediate interest, too, is a contribution by Dr J Gołabek on Polish cultural facilities in Czechoslovakia and the collaboration between men of science in these two Slav countries A section devoted to reviews makes reference not only to books, but also includes résumés of articles that have appeared in scientific periodicals This volume of *Nauka Polska* concludes with a bibliography of works dealing with the 'science of science' for the years 1935 and 1936

National Museum of Canada

THE annual report for 1936–37 of the National Museum of Canada marks good progress, particularly in the resumption of field investigations During the summer of 1936, field parties were engaged in biological work on the Pacific coast, ornithological investigations in Manitoba, a special biological survey of Thelon Game Sanctuary, botanical surveys in Ontario and the Arctic, archæological excavations in Ontario and the Arctic, anthropological studies of French-Canadian art and handicrafts, and the effect of the contact of the white man upon Indian culture As a result, much material has been added to the collections and scientific information of value has been obtained To the naturalist, one of the most interesting investigations is that mentioned in Dr R M Anderson's report on the work of the Biological Division A survey is being made of the region about Horseshoe Lake, which was burned over about a hundred years ago and now shows the conditions that follow natural reforestation in British Columbia Now these blocks of second growth timber are acting as reservoirs of wild life, islands of refuge in the midst of a country which had been burned so that all small wild life was destroyed For long stretches the burnt area showed no trace of a mammal, and the destruction of mossy ground, cover and rotten logs removed such as weasels, shrews, snakes, frogs and slugs. From the protection of the natural refuges the fauna is beginning to recolonize the burnt-out regions.

A Century of Sociology

IN the R R Kale Memorial Lecture 1938 to the Gokhale Institute of Politics and Economics, Prof C S Ghurye reviewed the social process in the light of a century of sociology Social process, he considers, has two aspects the nature of cultural development as reflected in the trend of thought about man as a living entity, and the process by which the individual is assimilated into the cultural flow of the times Although Protagoras gave effective currency to one of the fundamental requisites of science—to take experience as the only category strictly knowable for the human intellect—the ethical outlook afterwards overshadowed or eliminated the scientific spirit, and Prof Ghurye considers that it was not until Montesquieu that human experience was again viewed with the eye of a man of science In his argument, the force of human motives first received real recognition Stressing the significance of the English contribution to the advancement of knowledge on the Comtian plane, he pointed out that the social life of man is becoming the centre of attraction and motivation the principle of explanation The psychology of motivation found its scientific liberator in Shand, who sought the explanation of human motivation in the social behaviour of man and not in his biological activity

SCIENTIFICALLY, the proper planning of a good life must rest on the understanding of life and the psychological study of the individual and society should precede the study of man as a political and a moral being In conclusion, Prof Ghurye, discussing the institution of marriage, urged that in view of the importance of the first few years of the individual s life in the social process, if accommodation of the individual into his social mould was to be smooth and harmonious, the environment in those years must be provided by a small group, the individual constituents of which are highly sympathetic Such a group is only ideally provided in the family unit Prof Ghurye made an earnest plea for the institution of a chair of sociology in the Gokhale Institute

Photographic Reproduction of Documents

AN exhibition is being held at the Science Museum, South Kensington, of many types of apparatus for the photographic reproduction of documents, suited to both occasional and extensive use, and adapted to varied requirements It comprises several original types of cameras and projectors, suitable for amateur and professional use Some of the apparatus is arranged to utilize standard commercial general utility miniature cameras Other cameras shown are designed specifically for the purpose of book reproduction—in whole or in part—in reference libraries, together with the corresponding projecting apparatus for magnifying the film images to enable natural size or enlarged images to be viewed or prints to be made Finally, there are exhibits illustrating the use of photographic apparatus specially designed to provide at cheap rates both single and multiple copies of documents without reduction of their natural sizes The exhibition, which has been arranged in conjunction with the recent meeting of the International Federation of Documentation will remain open to the public until October 31

History of Luchon

IN his inaugural dissertation on Luchon (*Thèse de Paris*, 1938, No 497), Dr P J M J Molinéry gives an interesting historical account of this celebrated health resort situated in the heart of the central Pyrenees He describes three distinct stages in its development namely, the Gallo Roman epoch, the eighteenth and nineteenth centuries and modern times In antiquity, Luchon enjoyed a high reputation owing to the Aquæ Onesiæ, which were recommended by Oribasius and Antyllus among others for nervous and gastric disorders, skin diseases and rheumatism Then followed a period of more than a thousand years when Luchon fell into entire oblivion In the eighteenth and nineteenth centuries it recovered something of its former splendour Fresh bathing establishments were built over the Roman ruins and new springs were discovered During this period, Luchon was specially recommended for the treatment of skin diseases, rheumatism, menstrual disorders scrofula and syphilis In the twentieth century it became not only one of the most important of the Pyrenees sulphur stations but also one of the most radioactive centres in Europe The diseases treated at Luchon at the present time are mainly disorders of the respiratory tract, deafness of nasal origin, rheumatism, skin diseases and secondary and tertiary syphilis

Annual Report of the Ministry of Health

THE principal vital statistics and the health services for England and Wales in 1937 are surveyed in the recently issued nineteenth annual report of the Ministry of Health 1937–38 (London H M Stationery Office 5*s* net) The estimated mid year population was 41,031,000, the live births were 14 9 and the deaths 9 3, per 1,000 population Maternal mortality in 1937 was at the record low level of 3 11 per 1,000 births, and great efforts are being made to reduce still further this distressing cause of death The infant mortality rate was 58 per 1,000 live births, the lowest on record with one exception (1935) The death rate from all forms of tuberculosis was 657 per million population and the various measures and schemes for the reduction of tuberculosis mortality are outlined Only four cases of smallpox were notified during the year, but 55,896 cases of pneumonia were notified, compared with 46,167 cases the previous year The increase appears to be attributable in part to an outbreak of influenza in the earlier part of the year The notified cases of diphtheria were also more numerous than in 1936, but scarlet fever incidence was lower Cancer deaths numbered 66,965, remaining much the same as in the previous two or three years Much is said on housing and slum clearance, and 337,616 houses of a rateable value not exceeding £78 were completed during the year The Ministry of Health Vote for 1937–38 amounted to the net sum of just over twenty-two million pounds

Liverpool Naturalists' Field Club

THE seventy seventh *Annual Proceedings of the Liverpool Naturalists' Field Club* for the year 1937, recently issued, contain a comprehensive summary of the year s fauna and flora in the Merseyside and Deeside areas, in addition to Mrs R Laverock's presidential address on Defences and Adaptations in Plants', and résumés of the general field meetings of the year at local places of interest The botanical records, compiled by Mr J D Massey, include a number of new district records Insect records are summarized by Mrs Makinson, the entomological referee A comprehensive month by month summary of the bird records by Mr Eric Hardy, the ornithological referee, includes the occurrence of greenshanks, ruffs, peregrines, curlew sandpipers, green sandpipers the sabine s gull and little gull in the area, the increase of nesting tufted ducks, teal, redshanks, and lesser black backed gulls the results of surveys of magpie coot and red backed shrike distribution carried out for the British Trust for Ornithology, and the nest counts at the rookeries and heronries in the district The Society is increasing the number of prizes offered for natural history work during the year to nine

Research at King's College, Newcastle-upon-Tyne

FOLLOWING on the reconstitution of the University of Durham, involving, as it did, the amalgamation in King s College of the former Armstrong College and the College of Medicine, the Standing Committee for Research established in 1923 in Armstrong College with an endowment of £12,000 has been reconstructed so as to include representatives from the Medical School The Standing Committee s report for 1936 37, which gives particulars of twenty four grants, amounting in the aggregate to £900, made during that session, announces the provision of a senior research fellowship tenable during 1938–39, to enable a member of the staff of King s College to undertake research upon a specific problem necessitating complete absence from teaching duties The report shows no signs of diminution of research activities in any department of the College Conspicuous among them have been the Siwa Oasis Expedition, in respect of which Mr J Omer Cooper received a grant from the Committee, Mr R F Peel's investigations of sand formations and the movement of dunes in the Libyan desert, and botanical and zoological researches in the Hebrides

Scientific Work in Moravia

BRNO (Brunn), the capital of Moravia and the home of Mendel, has good facilities for scientific research Besides the Masaryk University, founded in 1919, there are the Czech and German colleges of technology and also medical, veterinary and agricultural schools All these are staffed with specialists engaged in directing research as well as in teaching The results of their investigations are mostly published in the *Spisy vydávané Přírodovědeckou Fakultou Masarykovy University* (Publications of the Faculty of Sciences of the Masaryk University), edited by Prof A Šimek, or in the periodical *Bulletins* of the various colleges and in the *Proceedings* of the Moravian

Scientific Society In this way all branches of the natural sciences in Moravia are represented in publications which reflect the high standard of work performed by contemporary Moravian men of science, including discoveries in archæology, geology, ecology and biology in addition to meritorious physico chemical researches

Mercury Poisoning

A REVIEW of present knowledge as to the liability of users of mercury to contract mercury poisoning by continued exposure to mercury vapour or to solutions of mercury compounds of small concentration has recently been issued (*Rev Sci Inst* Aug) Although there are great differences in the sensitivity to poisoning amongst individuals, it seems certain that prolonged exposure to an atmosphere containing one quarter of a milligram of mercury vapour per cubic metre of air is dangerous As the saturation vapour pressure of mercury at 18° C is such that there is more than 10 mgm of mercury in a cubic metre it is evident that exposure of considerable surfaces of mercury to air at ordinary temperatures should be avoided Good ventilation is the best precaution where exposed surfaces are unavoidable, and this failing, gas masks containing carbon iodine absorber should be used Rubber gloves should be worn to prevent contact with mercury or mercury solutions

Optical Utilities

MESSRS W WATSON AND SONS LTD 313 High Holborn London, W C 1 have issued a booklet entitled 'Optical Utilities containing a catalogue of small optical instruments for aiding vision These include magnifiers mounted as spectacles, the Speera ' for dissecting or viewing minute objects, and the Spectopera" for viewing distant scenes, a magnifying glass with electric bulb in the handle for examining maps prints, etc , a Strip magnifier for reading small print, a pocket lens compass, the needle of which is mounted between two lenses so that it can be used as a pocket magnifier, and other useful devices

Noise Insulation

THE valuable summary of the best methods of reducing noise which Dr G W C Kaye of the National Physical Laboratory, communicated to the *Journal of Scientific Instruments* in June has now been issued by the Institute of Physics as a separate publication, and should be in the hands of all designers of structures in which noise is to be diminished as much as possible The loudest of the offending noises should first be reduced at least to the average level of the others, either by reducing it at its source or by providing fewer facilities for its propagation Against direct transmission through the air the remedy is to enclose the source or hearer in a sound proof building, which may require its doors, windows, walls and floors to be heavy or double with intervening air gaps, and to have its walls and ceilings lined with sound absorbing materials Metal piping should have short lengths replaced by rubber or other less efficient transmitting material, and be supported by insulated clips.

National Research Council of Japan

THE report of the National Research Council of Japan for the year April 1936–March 1937, which has recently been published, contains a list of serial publications issued during the year, with details of the general meeting divisional meetings and committee meetings as well as of the international scientific meetings at which the Council was represented In addition to the Divisions of Astronomy Geophysics Chemistry Physics Geology and Geography, Biology and Agriculture, Medical Sciences, Engineering and Mathematics, a Committee of Pacific Investigation has held five meetings and a National Committee on Radio Research ten meetings dealing with the transmission of short waves, measurements of radio waves during the total solar eclipse on June 19 1936 studies of the ionosphere etc The report also gives the personnel of the various divisions and committees and a full list of serial publications received from abroad

Political and Economic Planning

A BROADSHEET recently issued by P E P (Politica and Economic Planning) summarizes the progress o P E P in 1936–38 In the last two years the volum of published P E P work has approximately doubled, five full reports covering electricity supply international trade social services health services and the Press having appeared within sixteen months besides more than thirty regular numbers of *Planning* This result has been attained by a small voluntary body with a budget of less than £10 000 a year and a paid staff of less than a dozen persons This in itself is a striking indication of the opportunities which exist for organized thought about the future, and the most significant feature about the work of P E P is probably the extent of the opportunities it has opened up The results already achieved suggest that by bringing to bear on public problems even a small proportion of the available intelligence and energy it should be possible to prevent serious national and international difficulties from arising The broadsheet gives a complete list of reports already issued as well as of the planning broadsheets, and indicates the position of the studies of regional development and industrial location, on the gas industry, on partners in industry and of the inquiry into population policies which have been initiated by P E P and on which reports are later to appear

Science for the People

ADVANCE reports promise that science will be well shown at the great 1939 exhibitions in America—the Golden Gate International Exposition in San Francisco and the New York World s Fair (Science Service, Washington, D C) Synthetic foods will be manufactured on the spot, and laboratory rats will be fed upon the foods, and have to stand a comparative test against normally fed individuals A complete 'chemical' garden growing indoors, without sunlight and without soil, will illustrate the production of maize, peas, melons, squash, spinach and lettuce by chemical means and ordinary incandescent lighting Electrical apparatus, television, sound amplifying equipment, at which the visitor will be able to listen to the footsteps of insects, promise to enlighten the populace regarding the more spectacular aspects of scientific discovery It is noteworthy that the site of the New York Fair, which used to be a dismal swamp outside Flushing, Long Island, has been converted into turf, suitable for planting the 10,000 trees taken to the place, by chemical treatment of the acid swamp soil

Current Sunspots

A FAIRLY large single sunspot of area about 700 millionths of the sun's hemisphere crossed the sun's central meridian on September 25 6 in latitude 10° S This was followed by a larger group of stream type which is crossing the disk between September 21 and October 4 in latitude 12° S, the time of central meridian passage of the group centre being September 27 7 The area of this big group on September 23 was 1,800 millionths of the sun's hemisphere Spot groups as large as this are more often than not associated with terrestrial magnetic storms, the average time of commencement being about one day after central meridian passage Two striking examples of the activity of this region of the sun's chromosphere were witnessed at Greenwich on September 20 and 22 with the Hale spectrohelioscope working in $H\alpha$ On September 20 at 14^{h} 38^{m} U T, a highly eruptive prominence was observed to spring from this region then passing into view at the sun's east limb The prominence was unusually brilliant, a photometric measure at 14^{h} 41^{m} giving a central intensity of 66 per cent (where continuous spectrum 10 A from the centre of $H\alpha$ at the centre of the disk = 100) There were big differences of measured radial velocity amounting to 225 km /sec between adjacent filaments at 14^{h} 54^{m} The prominence rose from its point of origin to a height of some 4′ (175,000 km) within 15 minutes On September 22, an extensive absorption marking on the disk, representing the projected image of a prominence, was observed at 8^{h} 50^{m} with a velocity of ascent exceeding 260 km /sec This marking, with both ascending and descending filaments, extended as seen in projection over some 150,000 km of the chromosphere and partly encircled the leader sunspot Activity persisted for at least 3½ hours

The Night-Sky in October

SUMMER Time ends on October 2 at 2^{h} U T The moon is full on October 9 at 9 6^{h} (the Hunter's moon) and new on October 23 at 8 7^{h} Lunar conjunctions with the planets occur as follows On October 5^{d} 11^{h} with Jupiter, October 9^{d} 12^{h} with Saturn, October 21^{d} 4^{h} with Mars, and on October 26^{d} 0^{h} with Venus On October 12^{d} at 9^{h}, Mars is in conjunction with Neptune The planet Jupiter is the dominating bright star of the evening skies, in mid-October it souths at about 20^{h} The various phenomena of the four inner satellites may be followed with the help of data given on pp 618–619 of the *Nautical Almanac* for 1938 or in abbreviated form [illegible] p 170 of *Whitaker's Almanack* On October 16, Venus is at greatest brilliancy, but the planet sets 43 minutes after the sun Saturn is on the southern meridian at about $23\frac{1}{4}^{h}$ in mid-October, on October 8, it is in opposition, the distance from the earth being about 781¼ million miles Mars is a morning star rising at $3\frac{3}{4}^{h}$ in the middle of the month Two well known variable stars are now well placed for observation during the late evenings o Ceti, the variability of which was first recognized by Fabricius in 1596, is a long period irregular variable At maximum the star is usually of magnitude 3 or 4, but is occasionally of magnitude 2, at minimum it sinks to magnitude 9 The period is about 330 days A maximum is expected near the beginning of October The other variable, Algol (β Persei) is an eclipsing binary the periodic variations in brightness of which were discovered by Goodricke in 1782 as occurring at regular intervals of 2 days 20 hours 49 minutes There are several meteor radiants listed for October, the Orionids are seen at a maximum during October 18–20 On moonless nights, the great nebula in Andromeda, visible to the naked eye, may easily be located with the help of binoculars The Pleiades are now well above the eastern horizon in the late evening

Announcements

THE RIGHT HON THE EARL OF ATHLONE, Chancellor of the University of London, will open the new buildings of Queen Mary College on October 12 at 3 p m

SIR MALCOLM WATSON will speak on "Malaria and Empire Development" at a joint meeting at 18 Northumberland Avenue, London, W C 2, of the Planters' and Empire Social Services' Groups of the British Empire Society on October 6 at 8 p m

DR H T CALVERT, chemical inspector at the Ministry of Health, will open a discussion on the present trend of sewage purification at a meeting of the Royal Sanitary Institute, 90 Buckingham Palace Road, London, on October 11 at 5 30 p m

THE Danish Institute for Human Heredity and Racial Hygiene at Copenhagen is to be incorporated in the University under the direction of Dr Kemp.

17,330 persons have recently died of cholera in the United Provinces in the north of India during an epidemic reported to be one of the worst for many years Bodies of victims are thrown into rivers that supply drinking water, and religious Hindus, many infected with cholera, continue to bathe in the Ganges Mass inoculation of exposed persons and disinfection of dwellings have been carried out

A NEW law has recently been passed in the Argentine Republic of which the principal enactments are (1) the abolition of licensed prostitution, (2) compulsory treatment for venereal disease, (3) penalties for wilful transmission of venereal disease, (4) prenuptial medical examination, which is compulsory for men and optional for women, (5) prohibition of quack advertisements for the cure of venereal diseases.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 620.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Transition Temperatures of Superconductive Alloys

THE transition between the normal and the superconductive state of a metal is a phase transition of the second kind, that is, there is no latent heat but a discontinuous jump in the specific heat, as at the λ-point of liquid helium or at the Curie point of a ferromagnetic. At the transition temperature in such phase changes, the entropy of the two phases as well as the free energy is equal. Thus if the entropies of the superconductive and the normal states are plotted as functions of the temperature T, the intersection of these curves determines the transition temperature. In the normal state the entropy is known to depend linearly on T at low temperatures The entropy of the superconductive state can be determined from the magnetic threshold curve[1] and is found for most superconductors to vary approximately as T^2. There is a fairly well established theory which gives the entropy in the normal state, and we can predict with fair certainty how this will change when small quantities of other metals are added in solid solution It is the purpose of this letter to show that the change in the normal state which can be roughly calculated is by itself sufficient to account rather satisfactorily for the observed changes in the transition temperature The conclusion is therefore that the entropy-temperature curve for the superconductive state is not sensitively affected by the addition of small quantities of other metals in solid solution

The entropy of the normal state for low temperatures is given by

$$S_n = aT,$$

where a, apart from universal constants, depends only on the density of electron states in the metal at the boundary between occupied and unoccupied levels. This quantity is usually denoted in the literature[2] by $N(E_0)$ In the Sommerfeld free electron model, $N(E_0)$ varies as $n^{1/3}$, where n is the number of free electrons per unit volume. In an actual metal it is known that $N(E_0)$ is rather greater than the value given by the Sommerfeld model and in general increases rather more rapidly with n. For the superconductive state the entropy may be represented by

$$S_s = bT^x,$$

where x lies between 2 and 3 and is, in fact, in most cases very close to 2. The variation in the transition temperature T_c due to a variation of a with b remaining constant is given by

$$\frac{\delta a}{a} = \frac{x-1}{T_c}\delta T_c.$$

Using the Sommerfeld model for the normal state, we have therefore

$$\frac{\delta T_c}{\delta n} = \frac{1}{3(x-1)}\frac{T_c}{n}. \qquad (1)$$

In the case of an actual metal, the factor 1/3 is replaced by the number $(n/N(E)^2)\,(dN(E)/dE)_0$ which may differ from 1/3 by a factor of 2 or 3 It is more convenient to use the number of free electrons per atom, n_0, in place of n in equation (1), so that in a real metal n_0 will correspond to the valency and in a solid solution to the weighted average valency

Solute	Valency	$(dTc/dc)_0$ exp	dn/dc	$(dTc\,dc)$ calc (1)
Solvent metal lead, Tc - 7·26				
Hg	2	1·7	−2	−1·2
In	3	−0·8	1	0·6
Tl	3	4·1	1	−0·6
Bi	5	+7·1	+1	+0·6
Solvent metal thallium, Tc – 2·38				
Sn	4	+2·7	+1	+0·26
Pb	4	+5·5	+1	+0·26

EUTECTIC ALLOY OF TIN WITH THE FOLLOWING METALS (TRANSITION TEMPERATURE OF PURE TIN, 3·69° K)

Metal	Valency	Limit of solubility in tin	T_c
Bi	5	12% (atomic)	3·79°K
Zn	2	1% ,	3·66
Cd	2	10% ,	3·62

The accompanying table gives the available relevant experimental data[3] $(dT_c/dc)_{c-0}$ is the rate of change of the transition temperature with concentration of solute atoms, c, for zero concentration. This quantity can only be obtained roughly from the existing experiments. The fourth column gives the rate of change of electron concentration with concentration of solute atoms, and the fifth the values calculated from equation (1) Apart from changes in electron concentration, the entropy of the normal state is affected by changes in the lattice parameters arising in the formation of the solid solution, and this may in special cases be of importance

Agreement in order of magnitude between experimental values and those given by (1), and particularly the fact that the transition temperature varies in the same direction as the electron concentration, support the view that the change in transition temperature is brought about largely by the change in the normal state of the metal.

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Aug. 26.

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[3] Meissner, W., *Erg Exakten Nat*, 11, 219 (1932)

A Ponderomotive Effect associated with the Flow of Heat through Liquid Helium II

It has recently been suggested[1,2] that liquid helium II shows a certain similarity with a Knudsen gas, the atoms moving with a very long mean free path. From the formula

$$l = \frac{3\varkappa}{c_v \rho v}, \tag{1}$$

which is quite general (l is mean free path, $\varkappa$ is thermal conductivity, c_v is specific heat per gram, ρ is density, v is velocity of the atoms or quanta performing the heat conduction), one obtains values for l of several millimetres even if one takes for $\varkappa$ the smallest values measured by Keesom[3] and assumes for v either the velocity of sound or a value deduced from the zero point energy (both about $2\cdot5 \times 10^4$ cm./sec.). Thus, if a Knudsen manometer were immersed in helium II, the moving vane should be repelled from the heater plate with a force of the order of magnitude

$$f = Q/v, \tag{2}$$

where Q is the total heat flow striking the vane provided the separation of plate and vane is less than the mean free path. Expression (2) is also of a very general nature and can only be modified by a factor of the order of magnitude of unity arising from the velocity distribution and the type of the collisions of the atoms with the vane.

I have looked for a force of the order given by (2) using a modified Knudsen manometer. The heater (2 cm. × 2 cm.) consisted of a vertical electrically heated plate. The vane (1 cm. × 1 cm.) was suspended parallel to this at a distance of about 1 mm. The deflections of the vane could be observed on an immersed scale through the Dewar vessels from outside, and from the deflections f could be determined.

The results were quite unexpected. Up to a power dissipation of $1\cdot3 \times 10^{-2}$ watt/cm.^{2}, no repulsion of the vane was observed in the whole temperature range between 1·5° K. and the λ point, though at this rate of heat supply one fiftieth of the force given by (2) would have been easily detectable. The plate separation was between 0·8 and 1·0 mm.

On further increasing the supply of heat, the vane was actually attracted to the fixed plate. At the present stage it is only possible to give the order of magnitude of this effect. At about 2·1° K. with a power dissipation of 5×10^{-2} watt/cm.^{2}, the attraction amounted to about 6×10^{-2} dynes, with a plate separation of 1·0 mm. If the heat input was increased further still, the vane appeared to be held close to the heater for the whole temperature range between 1·6° K. and the λ point, provided that the original distance was less than 0·7 mm. However, if it was about 1·5 mm., repulsion was observed at lower temperatures.

It appears therefore that the phenomena are complex and need extended investigation, but that in any event they are not to be explained by the simple assumptions mentioned above. Nevertheless, even at this stage it seems profitable to put forward certain alternative speculations, as they not only suggest an explanation of the above phenomena but may also be helpful in the discussion of experiments of quite a different type.

The attraction and repulsion are both assumed to be due to a peculiar flow of liquid associated with the flow of heat. Though the possibility that this flow is merely set up by variations of density cannot be excluded, it seems more probable that the driving force is the same as in the 'helium fountain', where helium flows through capillaries from regions of lower to higher temperatures even against a pressure gradient[5]. Since this force must be exerted by the walls of the capillary, one can expect such a 'capillary flow' along any wall immersed in helium II along which a temperature gradient is maintained, while the return flow, obeying ordinary hydrodynamics, will take place at a greater distance from the wall.

As the heat resistance of the vane in the present experiment is comparatively high, there will be a radial temperature gradient along the heater, the highest temperature being in the middle of the heater opposite the vane. We might therefore expect a capillary flow towards the centre within a small layer near the heater, gradually changing into a hydrodynamic flow, which streams backwards within the rest of the interspace between plate and heater. In the case of streamlined flow, the latter would cause attraction arising from the Bernoulli force

$$p - p_0 = \tfrac{1}{2}\rho w^2 \tag{3}$$

while under the influence of turbulence the vane could be blown away.

Now the question arises whether perhaps this flow of liquid can account for the high values of heat conductivity observed in helium II. It has been pointed out by Allen and Misener[4] that ordinary heat convection is insufficient to explain them. However, the capillary flow must be associated with an appreciable flow of heat of quite a different character.

Suppose a quantity q of liquid flows per second against a pressure difference dp between two reservoirs at the temperatures T and $T + dT$ by the fountain mechanism. Then the work done per second is qdp, and according to the Second Law of Thermodynamics the capillary flow must be connected with a reversible heat flow

$$Q = Tq\frac{dp}{dT} \tag{4}$$

from $T + dT$ to T. This is in addition to any irreversible heat flow which might already exist if no liquid were flowing. In other words, the fountain effect is the exact mechanical analogue of the thermo-electric effect. Q corresponds to the Peltier heat, dp/dT to the thermo E.M.F. per degree, while the capillary flow and the hydrodynamic flow correspond to the electric current in two different metals.

No quantitative results for Q or dp/dT are available at present. If one assumes with Tisza[6] that the part of the liquid transferred by capillary flow has actually zero entropy, one obtains

$$Q = TS = Tq\rho s, \tag{5}$$

where $S = q\rho s$ is the entropy of q cm.^{3} of liquid helium at the temperature T.

If we apply (3) and (5) to the present experiment using the value of the attraction as given above, we obtain for the heat associated with the flow about 2×10^{-1} watt. The actual heat input was $0\cdot5 \times 10^{-1}$ watt, which is the same order of magnitude.

We cannot, however, at this stage, conclude definitely how far the capillary flow along walls can account for the high heat conductivity of helium II.

A satisfactory test of the above hypothesis would require experimental values for Q or for dp/dT, as well as a more detailed knowledge of the laws governing the flow of liquid helium II

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[1] Michels A Bijl H and de Boer J *Physica* 5 121 (1938)

[2] Keesom W H Keesom Miss A P and Saris B F *Physica* 5 281 (1938)

[3] Allen J F and Jones H NATURE 141 243 (1938)

[4] Allen J F and Misener A D NATURE 141 74 (1938)

[5] Tisza L NATURE 141 913 (1938)

Photographic Tracks from Cosmic Rays

WHILE examining some photographic plates which had been exposed to cosmic radiation, a peculiar grouping of tracks of very short range was observed, which may possibly be due to a novel effect

The plates were half tone Ilford plates ($70\,\mu$ thick) they were protected by a layer of glue free paper and then covered with layers of pure paraffin in varying thickness, from 1 mm to 15 mm The packets were exposed to cosmic rays at 3,400 metres altitude at the Institut fur Strahlungsforschung on Jungfraujoch I am glad to express here my gratitude to the Director and the assistants there for their kindness and help

After an exposure of five months the plates have now been developed and examined They present singular tracks and stars like those reported in previous papers[1], but besides these, many groups of very short tracks are seen for which no parallel has been observed in earlier experiments The number of individual tracks in one group was in general four to eight, certain groups showed up to twenty or thirty and a few were so dense that individual tracks could be distinguished only in the peripheral parts, while the inner parts were visible as black spots, even to the naked eye The range in air corresponding to the length of the tracks is of the order of 1 cm or less, the tracks diverge from closely situated points in the photographic emulsion, sometimes two tracks arising from one point The number of groups seems to increase with the thickness of the paraffin With lead as absorber, or without absorber, only very few groups with a small number of tracks have so far been found

The first question which arises is, whether the groups could be due to contamination from radioactive substances, either in the paper or in the paraffin This, however, seems not to be possible for two reasons (1) The tracks do not start from the surface of the emulsion, but at a certain distance below the surface—generally $8–10\,\mu$, groups with a limited number of tracks have also been observed at greater depths—even $30\,\mu$ below the surface Such an effect might be due to an accidental desensitization of the uppermost layer of the emulsion, say, by pressure from the paraffin, but such a desensitization can scarcely be admitted here because reduced silver grains are often found between the group of tracks and the surface (2) The very short range of the tracks, they could in fact only be due to heavy contamination with samarium, which is highly improbable, while it would also be necessary to admit that groups of samarium atoms had diffused below the surface of the emulsion Moreover, direct experiments with samarium as contaminating substance have never given a corresponding effect.

As a first tentative explanation it may be suggested that cosmic rays give rise in the paraffin to a secondary radiation, which in turn leads to disintegration processes of the atoms in the photographic emulsion The group tracks would then be due to slow moving disintegration particles

This is corroborated by the fact that inside the groups, between the tracks, silver grains, both single and double are observed much more frequently than outside, this reduction of silver of course would be due to the action of electrons, γ rays or heavy particles of very short range resulting from the disintegration process This and other alternative explanations will be discussed in a detailed report, when further observations have been collected

The examination of plates has been carried out in the Universitetets Kjemiske Institutt, Blindern pr Oslo, and I wish to express my sincerest gratitude to Prof Ellen Gleditsch for her kind hospitality that has made it possible for me to continue my investigation

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Sept 2

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Generation of Auroras by Means of Radio Waves

ABOUT a year ago, attention was directed to a new mathematical theory of radio interaction[1] which, contradicting the original mathematical theory[2], leads to the important conclusion that abnormally large impressed modulations may be caused by waves the frequencies of which are nearly equal to the local gyro frequency (that is, the frequency of gyration of a free electron in the earth s magnetic field) This conclusion was strikingly confirmed in the course of experiments[3] carried out in March 1937

It is therefore now appropriate to mention other deductions from the new theory which will be of general interest

Since a gyro wave (that is, one with frequency nearly the same as the local gyro frequency, $He/2\pi m$) can cause such notable effects in the E layer, it is natural to inquire about the details of a radiator of gyro waves which would be capable of generating a visible glow discharge in that layer

From the results of the experiments of H A Wilson[4] with discharge tubes containing air at low pressures and from generally accepted knowledge about the ionosphere and radio waves, it can be deduced that at night, in latitudes where the terrestrial magnetic field is approximately vertical, a visible glow discharge usually can be produced near the lower part of the E layer by means of a radio station which radiates an appropriate circularly polarized vertical beam of gyro waves at the rate of 500 kilowatts by means of an aerial system consisting of 800 horizontal half-wave aerials lying in a plane situated one quarter of a gyro wave length above the ground

This aerial system would have approximately the appearance of a square network with a side 2 kilometres long, a mesh of 100 metres and an elevation of 50 metres About half the beam would be contained mostly within a cone of vertical angle equal to 6°, and the resultant celestial glow discharge would lie below the height of 100 kilometres and be about fifty times as bright as the sky on a moonless night.

No great absorption of the beam by any ionized strata lower than the *E* layer need be anticipated, since the absorption of an extraordinary gyro wave is inversely proportional to the collision frequency and so diminishes very rapidly with the height; this is also indicated by the experiments[3] on radio interaction mentioned above By generating the gyro waves in a series of pulses, a corresponding series of glow discharges could be produced by means of a much less powerful station or with a much smaller aerial system than is indicated above

Such artificial auroras would be of great scientific value, as they would allow those parts of the atmosphere which lie nearly 90 km high to be studied by means of *controllable* spectroscopic and other observations It is therefore to be hoped that means may be found to use the 500-kilowatt broadcasting station at Cincinnati, or that at Moscow, to attempt to produce such auroras.

It can also be deduced that with an aerial array similar to, but much less extended than, that mentioned above, and with gyro waves radiated at the rate of about one million kilowatts, it is possible on clear nights to provide over an area of about 10,000 square kilometres the minimum illumination of 0·02 foot candles prescribed for roadways[5]; this illumination is approximately the same as that provided by the full moon when overhead Only a small fraction of the energy in the form of radio waves would be reflected down to the ground where it might otherwise disturb ordinary radio reception

The above conclusions are supported by the experiments of Mr. Gill[6], who found that the oscillating potential required to start a discharge in a bulb containing air at low pressure can be very much reduced by applying that magnetic field which causes electrons to gyrate with the same frequency as that of the starting potential

The details of the arguments which lead to these conclusions are in the course of publication in the *Philosophical Magazine*

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[2] Bailey, V A, and Martyn, D F, *Phil. Mag*, 18, 381 and 382 (Aug 1934)

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[4] Wilson, H A, *Proc Camb Phil Soc*, 11, 249 and 391 (1902)

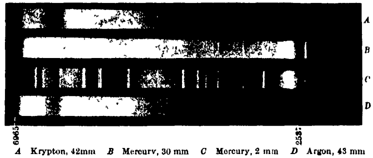
[5] This method of producing useful illumination was described in a Australian Patent Application filed on Nov 27, 1936

[6] Gill, E W B, NATURE, 140, 1061 (Dec 18, 1937)

Spectral Continua of the Rare Gases

IT is known that most of the rare gases emit spectral continua under certain conditions of excitation. The most favourable conditions for excitation are obtained in the uniform positive column of an electric discharge using wide tubes, high pressures and low density currents. In the range of pressures, p, over which the continua predominate, the ratio of the axial force Z to the pressure p is small and decreases slowly with increase of pressure. As the pressure increases, the intensity of the continua emitted increases with respect to the intensity of the line spectra, and the intensity of the lines requiring the higher energies to excite them decreases rapidly with increase of pressure compared with that of the lines requiring the lower energies. For example, in argon and krypton at 40 mm pressure, the only lines with intensities comparable with that of the continuum are those which emanate from the $2p$ levels requiring about 13 electron volts to excite them

The accompanying photograph shows the spectra of the light emitted from the positive column in a tube 3 cm in diameter in argon, krypton and mercury, over the spectral range 7200 A -2200 A



A Krypton, 42mm *B* Mercury, 30 mm *C* Mercury, 2 mm *D* Argon, 43 mm

It will be seen that these gases have the same long-wave spectral limit at about 6850 A, which is about the value of the limit in helium That this long-wave limit is not due to lack of sensitivity of the photographic plate has been shown with long-range plates sensitive to 8800 A

The theory suggested for the well-known hydrogen continua, namely, that the radiation is emitted by an unstable molecule consisting of an excited and a neutral atom, appears to be suitable to the explanation of the phenomena in the rare gases It would explain the long-wave limit observed and would suggest a short-wave limit in the far ultra-violet corresponding to the energy of the excited state involved in the formation of the unstable molecule. It is interesting that the long-wave limit should be the same for helium, argon and krypton, and it is remarkable that mercury, in spite of essential differences, should also have a limit at nearly the same value

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Correlations between Electronic States of Atoms and Molecules in the Alkali Earth Hydrides

IN a recent paper, More and Cornell[1] discuss the potential energy curves for strontium hydride (SrH) based on some absorption investigations of the *C* and *D* band systems of this hydride. Two years ago, in a similar investigation (not mentioned in the paper of More and Cornell), I obtained[2] somewhat different results concerning the correlation between the energy levels of SrH and Sr+H. More and Cornell suggest that the *C*, $^2\Sigma$ state of SrH predissociates into the ^1D level of Sr. Correspondingly, the *D*, $^2\Sigma$ and *E*, $^2\Pi$ are connected with ^3D, and the *A*, $^2\Pi$ and *B*, $^2\Sigma$ with the ^3P state of Sr In my previous work, on the contrary, I proposed the ^1P level of Sr as the predissociation limit of $C,{}^2\Sigma$, all remaining states A, B, D and E dissociating into ${}^2P$ This correlation of mine was suggested as an alternative in the paper of More and Cornell

It is convenient to undertake the correlation SrH – Sr+H in connexion with the similar process CaH – Ca+H, because the energy schemes in both cases are almost identical[2] Further, it must be regarded as most probable that the ground level (N) of the hydrides dissociates into ${}^1S$ and the A and B levels go to ${}^2P$ Accordingly, if the ${}^2P$ or ${}^2D$ levels of the atoms are taken as predissociation limit, two different dissociation values are obtained for the N, A and B states A comparison between these two sets of values and those which are obtained with the Rydberg extrapolation method, shows that the choice of ${}^2P$ as predissociation limit is much more probable than that of ${}^2D$ The same result has also been obtained by Humphreys and Fredrickson[3] although the dissociation values given by them are not correct It is easy to see that the Birge Sponer extrapolation in these cases gives by no means correct dissociation values, because the Birge Sponer values are about 5 000 cm $^{-1}$ higher than the highest possible dissociation values in the N, A and B states of CaH and SrH

A fuller account of these problems will appear in the *Zeitschrift fur Physik*

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More K R and Cornell S D *Phys Rev* **53** 806 (1938)

[2] Grundström B *Z Phys* **99** 595 (1936) Dissertation Stockholm 1936 Funke G W and Grundström B *Z Phys* **100** 293 (1936)

[3] Humphreys R F and Fredrickson W R *Phys Rev* **50** 542 (1936)

Kramers' Law A Correction

IN a recent letter[1] it was shown that the number of arrivals, p_n, in the n^{th} quantum state of the hydrogen atom in a discharge tube and in the planetary nebulæ was not the same as the number of captures predicted by Kramers Law The arrivals, p_n, were computed from measured line intensities for $n \geqq 3$, and the number of captures on $n = 2$ was obtained directly from the Balmer continuous emission, Ba_c If, as convincing arguments[2] appeared to show, these observed arrivals, p_n, were almost wholly due to captures of free electrons, it followed that Kramers Law was wrong This view was strengthened in the case of the discharge tube by a measurement of the Paschen continuous emission, Pa_c, which gave directly the number of captures on $n = 3$, and which was thought to be of the same magnitude as p_3

The infra red measurements of the Pa_c have recently been repeated with greater accuracy and a numerical error found in the earlier measure It now appears that the ratio of Pa_c to Ba_c is very closely that predicted by Kramers Law, namely, 0 06[3], therefore the law is correct for hydrogen, as expected theoretically It is evident, then, that p_3 is one thousand times greater than the number of captures on $n = 3$ both in the electrodeless ring discharge and in the nebulæ, in other words, excitations to the third quantum level are about one thousand times as frequent as captures of free electrons there This fact will necessitate a revision of the prevailing theory of nebular emission

Thus though Kramers' Law should not be used in calculating the absorption of the alkalis and the non hydrogenic elements in a stellar atmosphere, these revised and extended measurements indicate the validity of the law for atomic hydrogen

T L PAGE

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NATURE **141** 113 (June 25 1938)

[2] Zanstra H *Astrophys J* **65** 50 (192[illegible]) Plaskett H H *Pub Dom Astr Obs* **4** 187 (1928)

[3] Note added in proof In a letter in NATURE **142** 443 (September 3 1938) Menzel has directed attention to the significance of this test and has made the forecast now verified that it would confirm the validity of Kramers Law

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The Rotating Pendulum and the State of Adaptation of the Eye

THE experiments of Lythgoe[1] on the rotating pendulum show that the latent period of the eye is not *directly related to the brightness perception* of a viewed object The latent period seems to be more closely related to the sensitivity of the eye with higher sensitivity it is mostly longer, with lower sensitivity shorter Lythgoe was led to assume that nervous interaction tends to shorten the latent period Crawford[2] states that the effect is almost entirely in accord with the hypothesis that the latent period varies in the same sense as the concentration of photochemical substance in the retina, and concludes that the effect might therefore provide a simple measure of the concentration of photochemical substance in the retina

Experiments on the change of sensitivity of the fovea under influence of a glaring light source placed somewhere else in the field of view point strongly against Crawford's and in favour of Lythgoe's hypothesis

It can be shown by means of a binocular method[3] [4] that the presence of a glare source in the field of view causes the sensitivity of the fovea to drop to a much lower level within 0 1 second (α adaptation) If the sensitivity were determined solely by the concentration of a photochemical substance, α adaptation ought to be due either to the stray light within the eye or to a diffusion of photochemical substances over the retina It can be proved, by measurements on diascleral re illumination, that α adaptation is not due to this stray light, but to an influence originating in the strongly illuminated part of the retina By measurements on the velocity of α adaptation over the retina, a value was obtained which is far too great to be accounted for by processes of diffusion

α Adaptation might be of a purely electrical nature, due to the leakage currents which are known to be produced within the eye when a point of the retina is illuminated Although this hypothesis qualitatively accounts for many of the observed characteristics of α adaptation, it cannot account for all of them, especially those with coloured light After excluding the possible explanations of purely physical or chemical nature, we are thus left with only one possibility to account for α adaptation an inhibitive influence transmitted by the retinal synapses from the illuminated area of the retina towards the fovea

Against Crawford's assumption also is the fact that for the one form of adaptation for which photochemical changes seem definitely responsible, namely, prolonged dark adaptation, no rotating effect occurs This alone would already suggest that the effect of varying latent period is due to an entirely different mechanism

Apart from any speculations as to its exact mechanism, the Lythgoe effect is of special importance to visiodynamics because it illustrates once more that the retina is the seat of processes which manifest themselves only indirectly in the ultimate brightness perception

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[1] Lythgoe R J NATURE 141 474 (1938)

[2] Crawford B H NATURE 141 792 (1938)

[3] Ornstein L S and Schouten J F *Proc Kon Acad Wet* 40 376 (1937)

[4] Schouten J F Visueele meting van adaptatie en van de wederzijdsche beinvloeding van netvlieselementen Ac Thesis Utrecht 1937

Efficient Vacuum Fractionating Columns

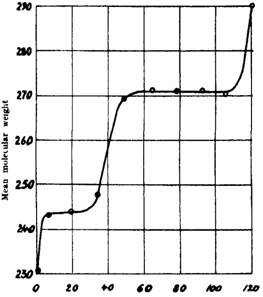
THREE vacuum distillation apparatuses capable of distilling amounts from 5 gm to 500 gm have been constructed for preparative and analytical work particularly in regard to fatty acid esters They are also efficient for other higher boiling mixtures, such as hydrocarbons, alcohols, amino acid esters and dicarbonic acid esters The apparatuses are based *inter alia*, on the experience of Dr Podbielniak in connexion with vacuum fractionation In the choice of material and construction, particular attention has been given to the question of securing an effective apparatus at a reasonable outlay

The apparatuses are equipped with an electrically heated flask, column and column top, each of which can be regulated independently of the other The temperature is controlled by thermocouples with an accuracy of ±0 5° C The columns are fitted internally with spirals of monel metal or stainless steel and are furnished with a high vacuum jacket of Durandl glass fused to the column On the outside, the columns are insulated with asbestos fitted with mica windows The electric heating spiral is wound round a glass tube outside the vacuum jacket Further details concerning the apparatus will be published later

With the aid of the smallest apparatus, a mixture of 9 71 gm palmitic acid methyl ester (iodine value 0 25) and 8 7 gm refractionated C_{18} ester mixture (iodine value 72 3) including oleic, stearic, and eladic acid methyl esters was fractionated The following table illustrates the effectiveness of the fractionation

Fraction No	Ester (gm)	Per cent distilled	Saponification equivalent	Iodine value	Per cent C_{18} ester
1	1 015	5 5	—	0 69	0 3–0 5
2	1 722	14 9	268 8 ±1	0 46	
3	1 416	22 6		0 37	
4	2 389	35 6		0 56	
5	1 518	43 8		0 94	0 9
6	1 131	49 9	—	3 31	4 1
7	0 556	52 9		31 6	41 9
8	1 108	58 9	294 2 ±1	73 2	93 95
9	1 353	66 3	296 5 ±1	74 3	98 100
10	3 761	86 7	296 7 ±1	71 9	98 100
11	1 731	96 1	295 6 ±1	63 8	98 100

The table shows that 83 per cent of the palmitic acid ester recovered has a degree of purity of 99–99 7 per cent Owing to the less accurate method of analysis employed for determining saponification values, the purity of the recovered C_{18} ester fractions could not be determined more accurately than to between 98 and 100 per cent Of the total C_{18} ester, 79 per cent of this degree of purity has been recovered The intermediate fractions, that is to say, ester mixtures of a purity less than 98 per cent, amounted in all to 16 per cent of the total amount distilled The distillation residue was 0 71 gm, that is, 3 9 per cent



Fatty acid methyl ester distilled (gm)

The iodine values show that an accumulation of stearic acid ester has occurred especially in the case of the last fraction (25 5 per cent as compared with 13 per cent for fraction 9 in other words, an accumulation of almost double This also manifested itself in the fact that fraction 11 was solid while fraction 9 was liquid)

As the graph shows, satisfactory results were also attained with apparatus intended for larger quantities An approximately accurate idea of the ester mixture components is obtained from the distillation temperature diagram

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Interfacial Tension between Mercury and Water

THE interfacial tension between mercury and water is generally accepted, on the basis of capillary rise and drop weight measurements, as being about 375 dynes/cm at 20° C [1], but using a sessile drop method, Burdon and Oliphant[2] have obtained a value of 427 dynes/cm The suggestion that the discrepancy might be due to the invalidity of certain assumptions made in the calculations from capillary rise and drop weight observations was disposed of by Brown[3], who obtained a value of 374 2 dynes/cm at 25° C by the sessile drop method

During experiments on the electrocapillary curve of water, using a sessile drop as polarized electrode, it has been found possible to obtain at will either of the above values for the unpolarized interface according to whether oxygen is or is not rigidly excluded from the water, the lower value is obtained in the presence of air, the higher value when oxygen is excluded Confirmatory determinations have been made by the capillary rise method, using the apparatus of Bartell, Case and Brown, suitably modified Working *in vacuo*, the figure obtained was 426 dynes/cm, and in equilibrium with either hydrogen or nitrogen at a pressure of one atmosphere, 427 dynes/cm, the temperature being 20° C When air is admitted the value falls, and there are indications that the tension of a freshly exposed interface may have any value between 375 and 427 dynes/cm according to the oxygen pressure over the system

It is significant that the higher value found for the unpolarized surface is identical with that found by Gouy[4], with cathodic polarization, at the maximum of the electrocapillary curve of pure water This suggested that the effect of excluding oxygen consists simply in a lateral shift of the electrocapillary curve along the axis of polarization This was confirmed by plotting the cathodic branch of the curve (the only one accessible to measurement under oxygen free conditions) in the same apparatus under normal and under oxygen free conditions In the latter circumstances, the maximum of the curve was in fact found to lie slightly on the anodic side of zero polarization It seems reasonable to suppose that the effect of dissolved oxygen is to produce mercury ions which are strongly adsorbed at the interface and produce a lateral displacement of the cathodic branch of the electrocapillary curve in the same way as the so called capillary active ions

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[1] Landolt Börnstein (fifth edition) 1 243 quotes four determinations 375 372 4 and 370 1 at 20° C, 374 at 0° C Bartell Case and Brown *J Amer Chem Soc* **55** 2419 (1933) Glidden *J Amer Chem Soc* **57** 236 (1935)

[2] Burdon and Oliphant *Trans Farad Soc* **23** 205 (1927)

[3] Brown *J Amer Chem Soc* **56** 2564 (1934)

[4] Gouy *Ann Phys* (9) **6** 5 (1916)

Dependence upon State of the Dielectric Polarizations of Ammonia and its Three Methylated Derivatives

NEW measurements recently completed enable us to provide for the first time a set of data to show the dependence upon state of the dielectric polarizations of ammonia (NH_3), methylamine ($MeNH_2$), dimethylamine (Me_2NH), and trimethylamine (Me_3N) The essential results are tabulated below and illustrate the influence of the medium in dipole moment determinations[1] The figures represent the total polarizations of these four substances calculated at 25° by the usual formulæ

POLARISATIONS OF AMMONIA AND ITS METHYL DERIVATIVES

State	NH_3	$MeNH_2$	Me_2NH	Me_3N
Gaseous at zero pressure	49 6	44 9	36 6	28 6
Dissolved in benzene at infinite dilution	46 5[2]	55 4	50 3	35 2
Liquid	23 8[3]	34 9	41 3	30 5

Full details of this work, and a discussion of its implications, will be published elsewhere later For the present the relative magnitudes of the ratios $P_{\text{gaseous}}/P_{\text{dissolved}}$ and $P_{\text{gaseous}}/P_{\text{Liquid}}$ may be noted It will be seen that while ammonia conforms to the more common type of behaviour and has both these ratios greater than unity, the reverse is the case for the di and tri methylamines, where the differences between the polarizations are greater than in other previously noted[4] examples of this kind of abnormal[5] solvent effect

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[1] See Glasstone *Ann Rep Chem Soc* **33** 117 (1937)

[2] Kumler *J Amer Chem Soc* **58** 1049 (1936)

[3] Calculated from measurements by Grubb Chittum and Hunt *J Amer Chem Soc* **58** 776 (1936)

[4] Le Fèvre and Russell *J Chem Soc* 491 (1936)

[5] Le Fèvre NATURE **136** 181 (1935)

The Polarographic Sero-Reaction for Cancer

IN a detailed communication[1] I have described two polarographic sero reactions concerning typical changes in human serum of individuals suffering from cancer sarcoma acute inflammations fever or some bile and liver disorders

A re investigation of the reaction I use has given rise to some erroneous remarks Messrs F Bergh O M Henriques and C G Wolffbrandt state in a letter in NATURE[2] that the great effect in the polarographic sero reaction cannot be due to the presence of cystine compounds as the concentration of cystine had to be 100–1000 times greater than that generally found in serum These investigators however, have wrongly used a solution of cobaltamine (reagent for protein containing cystine) instead of the reagent for pure cystine which is cobaltous chloride (divalent salt) When the latter proper reagent is used a 1000 times smaller concentration of cystine causes the same effect as is shown in the last curve of these authors and is in complete agreement with the cystine content generally found in serum (Their effect is obviously due to a trace of divalent cobalt in the trivalent salt solution used brought in by the reduction with cysteine)

As a result of this mistaken experiment, Messrs Bergh Henriques and Wolffbrandt ascribe the polarographic effect in the cancer reactions to an additive expression of several substances In answer to this suggestion it should be emphasized that only such substances can be considered which cause the typical polarographic effect in the buffered cobalt solution and give an empty curve in the absence of the cobalt reagent This is the chief characteristic of the polarographic double wave produced by proteins containing cystine or by their degradation products Therefore none of the chemically defined substances investigated by Messrs Bergh, Henriques and Wolffbrandt can be taken into consideration except cystine or cysteine

These authors also show that urine and water extract of yeast give in cobaltic solutions similar curves to the deproteinated serum This is in accordance with facts already established[3] as well as with my interpretation of them, that the polarographic effect is to be ascribed to proteins or polypeptides containing cystine nuclei present in these biological fluids Their finding that the substance responsible for the polarographic effect in urine passes slowly a Cellophane' membrane clearly indicates that the proteic substance in urine has a smaller molecule than that in the deproteinated serum

To the discussion of the view of Waldschmidt Leitz that the polarographically active substance in carcinomatic deproteinated serum may be a sulphur free mucoid[4] I would point out that this assumption is not in accord with my experimental facts, the hydrolysates of the deproteinated serum solutions in question show clearly the presence of cystine and moreover, in the same relative content as found in the various non hydrolysed deproteinated pathological or normal sera the cystine content in the deproteinated serum is of the order of 10^{-4} molar and is always higher in the carcinomatic case, against the necessity for a mucoid theory is also the fact that an identical polarographic effect is evoked by a deproteinated solution of pure crystalline albumin, if the albumin is first degradated with the alkali or pepsin[5]

The experimental evidence thus shows convincingly that the changes in pathological sera polarographically detected consist in a proteolytic degradation of serum proteins by which cystine containing high molecular products bearing the character of albumose, are split off The origin of this proteolysis taking place in the blood must be sought in the increase of some products of the pathological metabolism, of the type of Abderhalden s proteolytic reactions

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[1] Brdička R *Acta Unio Internationalis contra Cancrum* **3** 13 (1938)

[2] Bergh F Henriques O M and Wolffbrandt C G NATURE **142** 212 (1938)

[3] Rosenthal H G *Mikrochemie* **22** 233 (1937)

[4] Waldschmidt Leitz E *Angew Chem* **51** 324 (1938)

[5] Brdička R to be published elsewhere

Photo-ammonification of Organic Nitrogenous Compounds in the Soil

IN recent years Gopala Rao and Dhar[1] Gopala Rao[2] Dhar and co workers[3] and Corbet[4] have shown that nitrification in soils occurs partly as a photochemical reaction under the influence of sunlight Dhar and co workers[5] have also brought forward considerable evidence to show that fixation of atmospheric nitrogen is favoured by sunlight

We have now found that the decomposition of various nitrogenous compounds, the so called ammonification occurs as a purely photochemical reaction in the presence of photocatalysts like heated soil or ignited ferric oxide Aqueous solutions of various nitrogenous compounds were exposed to sunlight (for 30 hours) in 'Pyrex glass flasks under sterile conditions The amount of ammonia liberated in the decomposition process is estimated by Folin s method The results are as given below

	Milligrams of ammoniacal nitrogen per litre	
	Ferric oxide as photocatalyst	Heated red soil as photocatalyst
M/20 glycine	43 75	13 85
alanine	61 25	14 00
aspartic acid	65 65	17 30
glutamic acid	8 75	7 00
urea	28 00	12 72

It thus appears that many important chemical reactions in the soil can be brought about by the photochemical action of sunlight, independently of bacteria

Further work is in progress

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[1] *Soil Science* **31** 379 (1931)

[2] *Soil Science* **33** 143 (1934)

[3] NATURE **133** 213 (1934) **137** 462 (1936)

[4] *Biochem J* **28** 1575 (1934) **29** 1086 (1935)

[5] NATURE **137** 629 1000 (1936) **138** 648 1060 (1936)

Effect of Pyridine Compounds on the Nutrition of *Staphylococcus aureus*

RECENT investigations have established the necessity of nicotinic acid (or amide) for the growth of *Staphylococcus aureus*[1] In a previous report it was shown that the ability of this organism to utilize compounds related to nicotinic acid is limited We have since prepared several compounds of interest in this connexion, and the determination of their biological activity is herewith reported

The synthetic amino acid glucose medium of Fildes *et al*[2] was employed in testing the activity of the series of compounds The compounds were tested in the presence of an excess of thiamine (0 05 gamma per 10 c c of medium) using an 18 hour culture of *S aureus*

Nicotinyl glycine exhibited growth promoting activity in the same order of concentration as nicotinic acid Trigonelline, pyridine betaine β-carboxylic acid, α amino pyridine, and α amino pyridine β carboxylic acid were completely inactive as growth factors for *S aureus* It may be of interest to recall that Ackermann[3] isolated nicotinyl glycine and trigonelline from urine following the administration of nicotinic acid

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[1] Knight B C J G *Biochem J* **31** 731 and 966 (1937) Koser S A Finkle R D Dorfman A, and Saunders F, *J Bact* **35** 6 (1938) Landy M *Proc Soc Exp Biol Med* **38** 504 (1938)

[2] Fildes P Richardson G M Knight B C J G and Gladstone G P *Brit J Exp Path* **17** 481 (1936)

[3] Ackermann D *Z Biol* **59** 17 (1912)

A *Saccharum* - *Zea* Cross

BOTH *Saccharum* and *Zea* are distinguished by the readiness with which they cross with related genera For example, while Mangelsdorf and Reeves[1] have crossed *Zea Mays* with *Euchlæna* and *Tripsacum*, Venkatraman and Thomas[2] have crossed *S officinarum* with a species of *Sorghum* and even the remotely related *Bambusa*[3] I have also crossed *S officinarum* with *Imperata Cylindrica* Beaew and *S spontaneum* L with *Sorghum Durra* and *Sorghum halepense* In spite of *Zea* and *Saccharum* being in two different sections of the Gramineæ—Andropogoneæ and Maydeæ (Bews)—I thought it worth while to cross them and after several attempts using many thousands of flowers of a male sterile variety (Vellai) of *S officinarum* $2n = 80 = 8x$ as the female parent, and variety

Golden Beauty of *Zea Mays* $2n = 20$, $2B$ as the male parent, I obtained a single seedling This plant has received the expected 40 chromosomes from the *Saccharum* parent and 12 chromosomes from the male parent *Zea* Amongst these the VI nucleolar chromosome of *Zea Mays* is recognizable

PHOTOMICROGRAPH OF THE CHROMOSOME COMPLEX OF THE HYBRID BETWEEN *S officinarum* (VELLAI) AND *Zea Mays* (GOLDEN BEAUTY) SHOWING THE SINGLE VI NUCLEOLAR CHROMOSOME AND THE *B* CHROMOSOMES RECEIVED FROM THE MAIZE PARENT

The hybrid resembles the *Saccharum* parent more closely as we should expect from these chromosome contributions but it has the characteristic epidermal hair found on the upper side of the leaf in *Zea Mays* and related genera The cross however is dwarf in habit and although it has tillered freely has not produced flowering canes after twenty two months It lacks the vigour and early maturity found in *Saccharum Sorghum* hybrids

This cannot be due simply to the remoteness of the cross since the *Saccharum Bambusa* hybrids are very vigorous It must rather be due to the inequality of the contribution of the polyploid and diploid parents The same consideration is likely to vitiate the fertility of the hybrid The occurrence of these remote crosses in experiments indicates that the degree of anastomosis in the ancestry of polyploid species may be much greater than is commonly suspected

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Mangelsdorf P C, and Reeves R G Hybridization of Maize *Tripsacum* and *Euchlæna* *J Hered* 23 327 343 (1932)

[2] Thomas R and Venkatraman T S Sugarcane—Sorghum Hybrids *Agri J India* 25 164 (1930)

[3] Venkatraman T S Sugarcane—Bamboo Hybrids *Ind J Agri Sci* 7 Pt III 513 (1937)

Vowel Vibrations and Vowel Production

THE dark band in Fig 1 is the reproduction of the speech track of a vowel (*a* in *hatch*) on a sound film The serrated upper edge is the registration of the vibratory movement of the particles of air, that is, it is the curve of vibration It is seen to consist of a series of portions—vibratory 'bits'—each of which begins strong and fades away to zero Such a curve is the registration of a free vibration aroused by an impulse that is not a vibration The glottal action consists of the repeated opening and shutting of the glottal slit A puff of air is sent into the vocal cavity at each opening movement, each puff sets the air in the cavity into vibration

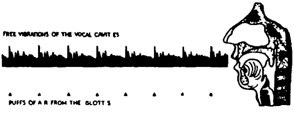
FREE VIBRATIONS OF THE VOCAL CAVITIES
PUFFS OF AIR FROM THE GLOTTIS

Fig 1

The profiles in the vibratory bits are different for the different vowels (Fig 2) The vocal cavity therefore has a different form in each case The progressive change in the profiles of a vowel indicates that the vocal cavity changes its form constantly

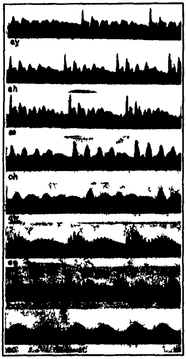

Fig 2

Every element in a vibratory bit has its characteristic rate of fading (logarithmic decrement) This is always large and never zero Forced—or resonance—vibrations do not fade, their logarithmic decrement is zero The vowel vibrations are as the tracks show, not forced vibrations, they cannot have been produced by resonance

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Science and Mankind

IF we are to deal with the science of man, one of the first steps is to know our own position in the recurring cycles of civilization Then we can see in what direction we are heading at present

The cycle of economy and waste covers about 130 years The waste began at 1535, 1660 1790 1920 The more austere periods revived in 1560 1690 1820 , may we therefore look to 1950 or thereabouts ? This is known in the northern saying, from clogs to clogs in three generations

The long general cycle of civilization in Egypt bore the best work in 3700, 2600, 1550, 450 B C , and A D 760 an average of 1 115 years, resembling the 1,100 years of the Great Year" known to the Etruscans In each of the repetitions there was the same order of development—sculpture and architecture, painting, literature, mechanics, science, and lastly wealth, the stage we seem now to have reached Following that other races break in for plunder, and after some centuries of mixture a new dominant rises with a fresh cycle

A still larger cycle is that of race The Sumerian, the Semite, and the Perso Aryan have successively been leaders of the East We seem now to be nearing the end of Aryan rule, unless we can make recovery

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Points from Foregoing Letters

THE transition temperatures of superconductive alloys are considered by Dr H Jones who states that the change in the transition temperatures of superconductors when small quantities of other metals are added in solid solution arises from the change of entropy in the normal phase of the metal , the entropy of the superconductive phase being relatively little affected by the impurities

Dr H London has investigated liquid helium II by means of an immersed Knudsen manometer Instead of the repulsion which might be expected he found an attraction which seems to indicate that the heat flow is associated with a flow of liquid

Clusters of short range tracks observed on photographic plates covered with paper and paraffin wax and exposed for five months at an altitude of 3,400 m are described by Marietta Blau, who suggests that they are due to slow moving ionizing particles arising from the disintegration of atoms in the photographic emulsion This disintegration may be due to secondary radiation liberated in the paraffin wax by the cosmic rays

The possibility of generating artificial auroras by powerful radio stations such as those of Cincinnati and Moscow is discussed by Prof V A Bailey A visible glow discharge near the lower part of the *E* layer of the upper atmosphere could be produced by radiating a circularly polarized vertical beam of gyro waves at the rate of 500 kilowatts from a net work antenna of 2 km square With one million kw it might be possible on clear nights to provide an illumination over ten thousand square miles equivalent of that to the full moon when overhead

Photographs of the spectra of the light emitted from the positive column in an electric discharge in wide tubes (3 cm diameter) filled with rare gases (krypton, argon) or mercury gas are submitted by Dr S P McCallum They show that all have the same long wave spectral limit at about 6850 A

Renewed and extended measurements of the Paschen continuous emission of hydrogen leads Dr T L Page to admit that Kramers' law is valid for atomic hydrogen He still considers, however, that it should not be used in calculating the absorption of the alkalis and the non hydrogenic elements in a stellar atmosphere

Dr J F Schouten points out, contrary to Crawford's assumption, that the Lythgoe effect cannot be explained by theories based on photochemical changes alone The close resemblance between the varying latent period and the α-adaptation strongly supports Lythgoe s assumption that the effect is due to nervous interaction, which, moreover, must be of the inhibitive kind

The discrepancy in the recorded values for the interfacial tension between mercury and water, which vary from 375 to 427 dynes/cm , are due according to D C Henry and J Jackson to the effect of dissolved oxygen , this produces mercury ions which are strongly adsorbed at the interface In vacuum or in the presence of hydrogen or nitrogen the higher value of 426–427 dynes/cm is observed

The dielectric polarizations of ammonia and the three methylamines have been compared at 25° in the gaseous, dissolved (benzene) and liquid conditions by Dr R J W Le Fèvre and P Russell For ammonia the polarization is greatest as a gas and least as a liquid, but for di and tri methylamines the reverse is the case The last named amines are therefore good examples of a less common type of behaviour referred to previously by Dr Le Fèvre

Dr R Brdička criticizes the findings of F Bergh O M Henriques and C G Wolffbrandt concerning the probable substances responsible for the polarographic curve obtained with the serum of cancer patients He concludes that the only active substances are cysteine or cystine, arising from the break up of serum proteins (for example, albumose)

Liberation of ammonia from nitrogenous organic compounds by ignited ferric oxide and heated red soil under the influence of light, has been observed by G Gopala Rao and Ch I Varadanam The authors suggest that nitrification in soils may likewise be due to photochemical action

Nicotinyl glycine alone among a number of related compounds is found by Maurice Landy to possess the same growth promoting action upon *Staphylococcus aureus* as nicotinic acid

A photomicrograph of the chromosome complex in a hybrid between the sugar cane and the Indian corn is submitted by Dr E K Janaki Ammal, showing that a majority of the chromosomes come from the female sugar cane parent The cross is a dwarf plant resembling a sugar cane but having the characteristic epidermal hair found on the upper side of the leaf in *Zea Mays*

Photographs of profiles of vowel sounds on sound films are submitted by Prof E W Scripture He points out that every element in a vibratory bit has its characteristic rate of fading and that the vowel vibrations are not forced vibrations and cannot have been produced by resonance

Research Items

Piltdown Man a Re-examination

THE reconstruction of the skull of Piltdown man has been reconsidered by Sir Arthur Keith in the light of later discoveries, and his results were communicated to Section H (Anthropology) at the Cambridge meeting of the British Association He dwelt in particular on the anatomical resemblances between the Piltdown skull and the later Swanscombe skull Ape like features in the Piltdown bones and brain have escaped notice hitherto Piltdown man's forehead is strongly made, but upright, compared with his contemporaries in Java, China and Africa His head was high vaulted and his brain relatively large Yet in some parts of his face, particularly in the region of the chin and jaw, Piltdown man was the most ape-like of all He blended in the strangest and most unexpected manner characters of ancient ape and evolved man Apparently his progeny became extinct before the dawn of modern conditions Swanscombe man and the 'Lady of Lloyds' seem to be some of his remote descendants The greatest difficulty that the anthropologist has to overcome before he can interpret the Piltdown fossil fragments aright is due to an unexpected feature—the brain of Piltdown man, though moderate in volume and simple in convolutionary pattern, is asymmetrical to a degree rarely met with even in modern heads, although it has been believed that asymmetry is a mark of a highly evolved brain, and confined to modern races of man In the previous reconstruction of the Piltdown skull symmetry had been sought—in error In Swanscombe man there is also a high degree of asymmetry We have therefore to alter our conception of the antiquity and meaning of asymmetry Another unexpected feature is that ape like characters have been replaced by infantile This tendency to pedomorphism appears also in the Bushman, one of the most primitive of modern types

Occupational Risks

IN a paper before the Royal Statistical Society on May 17 last, Dr Percy Stocks, of the General Register Office, discussed the occupational risks of workers in different industries and in different localities of England and Wales He dealt in particular with the attempt to separate the direct effects of a man's daily work from the accompanying indirect effects of the environment in which, generally by compulsion rather than by choice, he lives in order to carry out that work In 1851, 1861 and in 1871, the Registrar-General tabulated the details of men in numerous occupations in different regions of the country, but little use was made of this material Dr Stocks cited examples of certain occupations which have given the statistical impression of being intrinsically unhealthy, as with the high cancer rate in 1930–32 amongst workers in slate, or the 17 per cent excess mortality for Lancashire coalminers over Nottingham and Derby miners in 1930–32, which owe their unfavourable mortality rates to their localization in counties whereby the workers and their families share higher death-rates In 1911–14, London's mortality was 8 per cent above and the average mortality of the neighbouring rural areas was 27 per cent below the rural rate London s excess above the neighbouring rural areas being 48 per cent In 1931 34 this was reduced to 32 per cent The inland towns with more than half their males at work in manufacturing industries, or mining and the northern textile towns, had a standardized mortality in 1911–14 between 35 and 40 per cent above that of the neighbouring rural areas an excess which in 1931 34 was reduced to 25 30 per cent The harmful effects of the older manufacturing industries upon the health of the towns in which they are located appears to have diminished during the last twenty five years, but is still considerable The Registrar General s review for 1934 associated the mortality of residents in the large towns with three factors overcrowding as measured by persons per room , the proportion of partly skilled or unskilled workers in the population , and the latitude, the mortality increasing in the more northerly towns especially among men of the unskilled class and their wives, but not among men of the professional class although present in their wives With rural workers the effect of "northernliness" on men's mortality is slight and is entirely absent in the unskilled class

Phytoplankton of the Thames

A COMPREHENSIVE study of the phytoplankton of the River Thames made by C H Rice during the period 1928–32 has recently been published in two papers (*Ann Bot*, New Series 2, No 7, 539–582, July 1938) In the first paper, the author, after a brief historical review, discusses the chemical and meteorological data such as air and water temperatures, sunshine, rainfall, natural flow of the river, chemical analyses Then follows the author's researches on the phytoplankton of the main river Here are assembled such important data as amount of phytoplankton, relation between its quantity and the environmental factors, composition and periodicity of the phytoplankton, with a list of constituent algæ The phytoplankton consists, as in other rivers, chiefly of diatoms, and monthly maxima of different genera are given Green algæ began to be prominent in mid summer Sunshine and flood rainfall (with its effect on velocity) are shown to be responsible for differences in composition and amount of plankton Further detailed observations on the phytoplankton of the main river are given in the second paper Here are considered periodicity of diatoms, Chlorophyceæ and Chrysophyceæ, and factors affecting periodicity The plankton of the tributary streams and backwaters is then described Evidence is brought forward to show that the plankton of the main river is not derived from that of the tributaries and backwaters, but rather from the bed in the shallow parts of the river

Ash Content of Apple Shoots

V G VAIDYA (*J Pom and Hort Sci*, 16, 101, 1938) has investigated the seasonal cycles of ash constituents in the terminal shoots of 15 year-old Lane's Prince Albert apples growing on Malling stocks II, V, VII, IX and B, in an attempt to find a relation between stock influence and nutrition Well defined seasonal cycles of lime magnesia potash and phosphoric acid were recorded These were similar for all the stocks except *M* IX which showed earlier cycles for total ash and P_2O_5 in the bark Trees on *M* IX alone showed a high percentage of lime and a low percentage of potash in the shoots compared with those on the other stocks P_2O_5 showed a negative and MgO a positive correlation with the known vigour of the stocks and MgO was negatively correlated with precocity the values for *M* IX and *M* VII being particularly low Particular attention is given to the bark/wood ratios of ash constituents and in this respect trees on *M* IX are outstanding the ratio for phosphoric acid being highest and for ash lime magnesia and potash lowest compared with the other stocks The bark/wood ratios are shown to be related to vigour those for ash and magnesia being positively correlated and for P_2O_5 negatively correlated, with tree height

Quadrivalent Nitrogen

The number of known free radicals of the type of diphenyl nitrogen oxide containing quadrivalent nitrogen is at present extremely small W Hucke and W Liegel have recently described the preparation of phenyl 9 *trans* decalyl nitrogen oxide (*Ber deutsch chem Gesells* July) The discovery of this substance resulted from an investigation of the properties of 9 nitroso *trans* decalin which was found to differ from aromatic nitroso compounds through its inability to form azo or azoxy compounds by condensation with primary amines or phenyl hydroxylamine On the other hand it reacts easily with phenyl magnesium bromide to produce phenyl *tert* decalyl hydroxylamine a colourless compound which oxidizes slowly on exposure to the air to form phenyl 9 *trans* decalyl nitrogen oxide (C_6H_5 NO $C_{10}H_{17}$) a stable red substance the molecule of which contains quadrivalent nitrogen and from which phenyl 9 *trans* decalylamine can be obtained by reduction This reaction appears to be peculiar to the aromatic series since the reaction between 9 nitroso *trans* decalin and alkyl magnesium halides results only in the formation of hydroxylamino decalin

Statistical Methods in Engineering Specifications

In a paper entitled A Statistical Examination of Specifications for the Mechanical Testing of Line Insulators by W T O Dea (*J Inst Elec Eng* **83** No 501 September) the probabilities involved in certain clauses of a Central Electricity Board specification are analysed mathematically It is shown that a batch of 2 700 units stands an even chance of acceptance as the result of testing a sample of 18 for guaranteed minimum strength despite the fact that there may actually be 130 defective units in the batch Such an accepted batch is made up into strings of *nine* in which case 35 per cent of single strings or 55 per cent of double strings may be expected to contain at least one defective unit It is suggested that better results might be obtained by the application of one of the statistical methods described in Dr E S Pearson s Statistical Methods in Standardisation (*B S S* 600, 1935) The author also suggests that although there is so much latitude in the applicability of present specifications, their clauses may have forced manufacturers to produce designs in which the quality of resistance to thermal stresses is unjustifiably impaired Statistical methods of appraisement might be expected to restore any such lack of balance in design and also to discount substantially the effects of possible prior testing by manufacturers, which may at present invalidate the conclusions reached by an inspector The paper concludes with appendixes which illustrate the necessity of choosing an adequately large sample a matter upon which existing specifications are commonly in error

Variation of Cosmic Rays with Time

The absence of any marked variation of the intensity of the cosmic rays with the position of the Milky Way in the heavens has been thought to exclude the generation of the radiation within our galaxy H Alfvén (*Phys Rev* **54** 97) shows that the paths of the particles are probably greatly complicated by electric and magnetic fields in interstellar space The east–west asymmetry of the cosmic rays shows that there is an excess of positively charged cosmic ray particles The resulting interstellar space charge will be neutralized by slowly moving ions which should follow the motion of the stars If the cosmic ray particles are not isotropic relative to the stellar system—for example if they have no share in the galactic rotation as formerly suggested by Compton and Getting—the relative motion of fast and slow particles leads to the existence of large magnetic fields in space With even a small anisotropy the fields would bend cosmic ray paths in curves of radii small compared with interstellar distances A high degree of isotropy of the radiation is therefore a consequence of the charge on the particles and tells us nothing about the place of origin of the rays

Physical Changes on the Moon

Mr Robert Barker has a paper with this title (*J Brit Astro Assoc* **48** 9 July 1938) in which he records the results of observations by himself and others on certain lunar features alleged to show physical changes Thus, two of the southern bands radiating from Aristarchus have very variable extensions and these could be best described as due to lowly vegetation subject to fluctuating harvests A mound between Cassini and the Great Alpine Valley shows considerable changes during each lunation and Emley supports Pickering s view that this phenomenon is due to hoar frost Mr Barker claims to have mapped a number of new craterlets in the south west area of Mare Crisium and several other lunar observers have corroborated his discovery He suggests that they escaped detection for a long time because they are the source of obscuring matter Amongst other changes noticed reference may be made to those on the west wall of Plato and the variations in depth of colouring and area were also recorded by Mr W E Fox Newark Mr Barker describes the changes as those that could be produced by quick growing vegetation which has about 15 days in which to complete a cycle of germination growth and fructification Mr T L MacDonald contributes some notes on the paper, and as director of the Lunar Section of the British Astronomical Association he is cautious before committing himself to acceptance of vegetation on the moon Varying libration or changes in the heating of the lunar surface may, he suggests be responsible for alterations in colour effect Further observations by independent observers and the investigation of the correlation of the effect with libration and other factors are most essential for progress in this branch

Three Meteoritic Falls in the U S.S.R.*

STONY METEORITE OF KAINSAZ

A FALL of meteoritic stones took place on September 13 1937, at 11 15 U T near the Kainsaz collective farm (Muslium Tartar Republic) 55° 26 N and 53° 15 E

A fire ball (bolide) with a short fiery train was seen moving in a north west direction leaving behind a smoky trail persisting for 10–15 minutes , in the air the fire ball was divided into parts The detonation was heard at a distance of 130 km

The fragments of a stony meteorite were scattered over the surface of an ellipse stretching in a north westerly direction with the axes 40 km and 7 km long

The largest very well preserved fragment weighing about 102 5 kgm fell at Kainsaz the extreme north west point of the ellipse and the smallest nut sized fragment at the opposite point of the ellipse near the village of Kostcievo Between these two points a number of smaller fragments were found weighing 53 kgm (Kainsaz) 27 5 kgm (Tash Flga) 22 kgm (Krasny Yar) and others a total of fifteen fragments with the total weight of more than 200 kgm have been found

The depressions caused by the largest fragments had the appearance of small pits with the depth approximately equal with one exception to the vertical dimension of the fragment

The fragments found were a dark grey colour with a greenish hue inside had chondrules and were covered with a black somewhat rough crust with characteristic piezoglypts These specimens affected a magnetic needle slightly The meteorite has been provisionally referred to the chondrites

I S SELIVANOV

STONY METEORITE OF KAPTAL ARYK

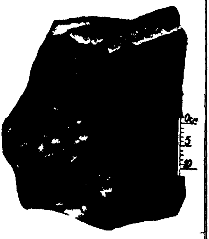
The stony meteorite fell on May 12 1937 at about 16 45 U T in the centre of the village of Kaptal Aryk (Kalinin, Kirghizian SSR) 42° 27 N and 73° 22 E The flight of a fire ball (bolide) of a slightly reddish colour was observed from which a large number of small sparks were scattered forming a bright trail instantly disappearing behind the fire ball

The fire ball was seen moving from east to west All the phenomena of the fall lasted not more than two or three seconds At the beginning a din was heard, resembling that produced by the flight of several aeroplanes , then a deafening detonation was heard, audible at a distance of 20–30 km The flight of the fire ball was noted at Frunze within a distance of 70 km from the place of fall No marked illumination of the country was observed , the illumination within a distance of 45 km from the place of fall (at the Karl Marx collective farm) resembled moonlight The meteorite penetrated 60 cm. into the hard soil of the street

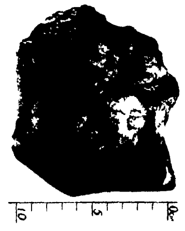
On the surface the stone has a black smooth crust about 0 5 mm thick, and characteristic piezoglypts The inner mass of the stone is traversed by closely spaced black veins On the fracture surface grains of nickel iron are perceptible

The initial weight of the meteorite is estimated at 3 5 kgm The meteorite may be provisionally referred to the veined chondrites The total weight of the three parts of the meteorite delivered to the Academy of Sciences of the U S S R is 2 904 kgm

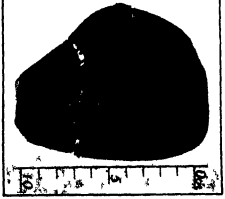
D P MALIUGA



Kainsaz



Kaptal Aryk



Lavr tievka

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* Communicated by Dr W Vernadsky chairman of the Meteorite Committee of the U S S R Academy of Sciences

STONY METEORITE OF LAVRENTIEVKA

On January 11, 1938, at about 10.30 U.T., a meteorite of a lens-like shape, weighing about 1¼ kgm. was seen to fall near the village of Lavrentievka, Orenburg region (52° 27′ N., 51° 34′ E.).

The meteorite fell within a distance of 18–20 metres from T. A. Zhigunov, a hunter, who picked it up immediately. Previous to the fall this witness heard in a northerly direction a din with three detonations following each other at equal intervals, each subsequent stroke being stronger than the one preceding it.

The detonations preceding the fall of the stone were heard by many of the inhabitants of the village of Lavrentievka and other neighbouring villages. However, neither T. A. Zhigunov nor anyone else observed any light phenomena, although the sky was perfectly cloudless.

The stone fell on a frozen ploughed soil not covered with snow; it penetrated only 5 cm. into the soil. During the fall the stone scattered on different sides clods of frozen earth over an area up to two metres in radius; in addition, as observed by T. A. Zhigunov, the stone itself was for some time revolving about its axis.

Two minutes after the fall, T. A. Zhigunov picked up the stone and felt it to be too hot to be held in a clenched hand; therefore he placed it on the ground; in about ten minutes the stone had cooled to such an extent that it could be readily taken in the hand.

During the fall, a small chip was split off from the stone. Later on, three more small pieces were broken from it. All these pieces, placed together with the bulk of the stone, reproduce the original lens-like shape of the stone.

The weight of the four fragments of the stone thus assembled is 793.60 gm. Moreover, probably 200 gm. were lost in the crushing of the stone.

The meteorite may be referred to white chondrites and contains a rather large number of chondrules and metallic grains. The mat smooth crust of the meteorite is of a black-brown colour and has no piezoglypts.

The study of this fall was made by the present writer. The five fragments of the meteorite mentioned above have been placed in the meteorite collection of the Academy of Sciences of the U.S.S.R.

E. L. KRINOV

Greek Earthquake of July 20, 1938

SUDDENLY and without any premonitory tremors in the early morning of Wednesday July 20 a very large area centred in northern Attica, Greece, was disturbed by a violent earthquake (see NATURE, July 30, p. 202) which did much damage to property and caused the deaths of twenty people and injuries to a hundred others. It is now possible to add some further details of this shock from a preliminary report prepared by Prof. N. Critikos of the University of Athens, though the final conclusions will not be available for some time.

The first pulses to reach the seismological observatory at Athens did so at 2h. 24m. 19s. (T.m.E.O.), and thus the initial time of the shock must have been 24m. 13s. ± 2s. The pulses immediately succeeding these were of such violence that both seismographs at the observatory were forced from their bearings and damaged. The 1,000 kgm. Wiechert horizontal pendulum was so seriously damaged that it took several days to repair, but the 1,200 kgm. Wiechert vertical instrument was put right almost immediately, and was registering again about one and a half hours after the initial shock. This latter instrument registered small aftershocks at intervals of five or ten minutes for several hours.

The very strong tremors were felt by people in Athens to last 8–10 seconds, being preceded and accompanied by quite loud deep-toned underground rumblings. The preliminary movement appeared to be horizontal and then undulatory with a slight diminution of intensity towards the middle of the duration. It appeared to come from the north-north-east and to be travelling to the south-south-west. On the coast at Scala Oropos, in the epicentral region, the intensity of the shock was much stronger and it also appeared to last longer. The region over which the shock was felt macroseismically extended as far as the island of Lemnos (Castro), that is, more than 250 km. in this direction, but in the perpendicular direction scarcely 140 km. to Lamia Syra. Thus the epicentral region was elongated in a north-east–south-west direction. The villages affected slightly in Attica were Kakossalesi, Malakasa, Kapandriti, Kiourka and Kalamos, whilst the villages in which most damage was done include Scala Oropos (with Nea Palatia and Pontion), Chalcoutsi, Oropos and Sycaminon.

From the above evidence it appears that the epicentre was near the north coast of Attica at a distance of 42.5 km. from Athens and near a point having geographic co-ordinates lat. 38.35° N., long. 23.8° E. The fact that the seismic energy was propagated to a greater distance in a north-east–south-west direction, that is, in the direction of the great tectonic fault which passes between Mt. Pentelica and Mt. Parnes, suggests that there was a sudden vertical movement of this fault resulting from a positive orogenic movement.

The earthquake has been followed by numerous feeble aftershocks only one or two of which have been felt as far as Kapandriti, Tatoi, Eretrie and Chalcis. Another shock, of moderate intensity, and having the same epicentre, took place on July 27d. 3h. 29m. 19s. (T.m.E.O.) and was just sensible in Athens. Slight aftershocks were continuing infrequently even on August 12.

Although Greece as a whole is liable to earthquakes, the region near and to the north of Athens has not been considered as being active seismically on a destructive scale in recent times. Modern research, however, indicates that it was probably a seismically active region during the seventh and eighth centuries A.D., and this activity appears to have been renewed in the present instance.

The damage done during the earthquake of July 20 was serious chiefly to old and/or badly constructed buildings. An interesting case concerns the primary school at Kalosalesi, the walls and roof of which appear to have moved independently, causing great damage at junctions.

Epidemics in Schools*

THIS volume constitutes an interim report of a committee appointed by the Medical Research Council seven years ago to investigate the subject of epidemic and other illnesses in schools from both the scientific and practical points of view. Of the schools investigated, twenty were public schools for boys and seventeen for girls, the majority of the pupils being boarders, and the social class being very similar in both. Most of the pupils had been to preparatory schools, so that there was no sudden change in environment—from the family to school—and were between thirteen and eighteen years of age. The criterion of sickness adopted was that causing at least one day's absence from school.

The following are some of the points that emerge from the enormous amount of data collected and analysed. Nasopharyngeal infections from the attack rates seemed to be more prevalent among the girls; but this is apparently not because girls are more susceptible than boys, but because the girls are subjected to stricter surveillance. The common cold was one of the most important causes of lost time, and if influenza is included, making one group of "nasopharyngeal infection", accounts for as much as 53 per cent among girls, and 43 per cent among boys, of all time lost on account of minor respiratory troubles. Epidemic influenza was almost confined to the Lent term, and many other diseases showed a tendency to be concentrated into this term. The incidence of injuries was heaviest among boys in the Christmas term; but whether this is due to intensified activity as a result of good health, or to more football in this term, is uncertain. Boys suffer twice as frequently from middle ear disease, two and a half times as frequently from pneumonia, and eleven times as frequently from acute rheumatism, compared with girls. There is no evidence as to the cause of this greater incidence upon boys; it may be a real sex difference, but it may in part be due to the fact that girls are under stricter supervision. More than half the boys and half the girls had had their tonsils removed, but there is no evidence that wholesale tonsillectomy results in a diminished incidence of nasopharyngeal and some other diseases.

In regard to the apparent relation between herpes zoster and chicken pox, it is of interest that in eighteen out of twenty occasions when zoster preceded chicken pox, the first case of chicken pox might, from the point of view of time, have been infected from a case of zoster.

Dr Lempriere contributes an interesting historical introduction on the medical history of public schools, and Dr Griffith a section on the bacteriology of otitis media and mastoid disease, pneumonia and streptococcal infections, with determinations of the types of micro-organisms present in these infections.

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* Epidemics in Schools: an Analysis of the Data collected during the First Five Years of a Statistical Inquiry by the School Epidemics Committee. (Privy Council: Medical Research Council, Special Report Series, No. 227.) Pp. ii+289. (London: H.M. Stationery Office, 1938.) 4*s*. 6*d*. net.

Work of the Forestry Commissioners

PERHAPS the most interesting part of the eighteenth annual report of the Forestry Commissioners for the year ending September 30, 1937 (London: H.M. Stationery Office. 1*s*. net), is the account of the work undertaken to give effect to the Government policy for the Special Areas in connexion with afforestation. In the previous annual report (to September 1936) reference was made to the initiation of a scheme of afforestation and forest workers' holdings in the Special Areas of England and Wales. It was then pointed out that both the acquisition of the necessary land and the provision of plants would take time, so that no large scheme of afforestation could be anticipated during the present year.

The scheme proposed envisaged the acquisition of 100,000 acres of plantable land, its afforestation and the formation of 500 forest workers' holdings in three years. This proposal was regarded as an experimental step which, if successful, would be followed by a larger scheme covering 200,000 acres and 1,000 holdings to be put through in ten years.

At the close of the year under review, 568,000 acres were examined in or within a 15-mile radius of the Special Areas, namely, 225,000 in the Northern Area (Durham, Tyneside, Haltwhistle and West Cumberland) and 343,000 in the South Wales Area. Of this area, 72,000 acres in the north and 80,000 acres in South Wales were found to be subject to rights of common and so not available for the purpose in view. On the whole, owners of land were favourable to the scheme. By the end of the year, 42,900 acres of plantable land had been acquired spread in nearly equal amounts between the two regions.

Nursery work had to be considerably extended and a large new nursery has been established at Tair Onen in the neighbourhood of Cardiff. At this nursery no less than seventeen forest workers' holdings have been established. Although probably but little known to the public, this side of the activities of the Commission is by no means the least interesting, for the work has been brought to a high level of efficiency.

Owing to a shortage of plants it was not found possible to carry out the additional planting work either during the season of 1936–37 or that of 1937–38; in the latter year the projected programme of 3,350 acres being reduced to 3,000 acres. It is added: "Except for any ill-effects due to the prolonged drought of the spring of 1938, plant supply should not in future be a limiting factor". It is to be feared that in some parts of the country at least there will have been a considerable mortality, both on

Government and private estates, in connexion with the plantings of early 1938

During the course of the year, the report states, 'an interesting landmark, the million acres, was passed, the total acquired to the end of the year being 1,008,500 acres

The report contains some interesting remarks on amenity and the opposition of local bodies to afforestation work in what are considered 'beauty spots, on national forest parks and on private woodlands—all points of considerable interest to the general public The Commission is now engaged in undertaking a census of woodlands in Great Britain, the last census, a somewhat inadequate one, having been undertaken in 1924

St. George's Day among Serbian Gypsies

ST GEORGE S DAY (Djurdjev Dan) is of all 'Slavas' that most enjoyed by the Gypsies of Serbia This feast, Dr A Petrović says in his continuing study of the Serbian Gypsies (*J Gypsy Lore Soc*, Ser 3, 17, 2, 1938), is not only a holiday, but also a harbinger of spring and new life—first of all with respect to food when new vegetables are available, from which a woman, using salt and a little bread will make a salad to last a family for a whole day It is also the time when the gypsies cease to sleep in the house and take their bedding and the anvil outside They sit, eat and sleep in the open air

In the old days, when many Serbian gypsies had no permanent dwelling places on October 26 O S (St Demetri s Day) they used to select the village in which they would stay for the winter, but as soon as spring had come, all left their winter quarters to meet at some previously appointed spot on Djurdjev Dan One such place was Mirijevo, near Belgrade At such a meeting two to three hundred tents of gypsies would be gathered together Every family slew a sheep for the ceremonial meal In this meal the whole body of the sheep was brought to the table with the horns still on the head to show how large the sheep had been The larger the horns, it was believed, the bigger the sheep All the gold and silver coins the family possessed were hung around the neck of the roasted sheep, indicating what sort of a year the host had had After this followed greetings and questions as to the happenings of the preceding year Marriages followed Eating, drinking and revelling lasted the whole day In this manner they said they were seeing the winter off down stream, along the Danube

At Kopljari, on the eve of St George, a thread was taken and hung for a time on a rose branch It was then fastened around the neck of a child, where it was left until it broke Members of the family gather and weave garlands of flowers, one being thrown on the wood shed for storing maize with the words "Let the shed be full of maize" Another is thrown on the corn loft with a similar formula At night one of the men goes to the field of a rich man and gathers green corn, which he then throws on his own fields, with a formula expressing his desire to become a "master", as the man from whom he has stolen the corn A branch stolen from another man's tree is made into a cross and painted to ensure fertility "like that of the hazel nut" An elaborate ceremonial is observed in preparation for the feast, and all must first bathe naked in the river.

Science News a Century Ago

The Entomological Society

AT a meeting of the Entomological Society held on October 1, 1838, J F Stevens, president, being in the chair, The Rev M Taylor presented specimens of the different sexes of a species of wasp, and of *Ripiphorus paradoxus*, a singular species of beetle which is parasitic in their nest An extended discussion in which several members joined, took place relative to the hexagonal formation of the cells of bees and wasps in reference to Mr Waterhouse's theory upon the subject The following memoirs were read 'Notes upon the Egg Cases of the Blattæ and their Parasites by Mr Sells 2 A few words in reply to Mr Macleay s Remarks upon the Metamorphoses of Crustacea, by Mr Westwood 3 Observations on the Habits of the Œstridæ by Mr Sells "

Charles Tennant (1768-1838)

ON October 1, 1838, Charles Tennant, founder of the chemical firm of Charles Tennant and Co Ltd, died at Glasgow at the age of seventy years Born at Ochiltree, Ayrshire, on May 3, 1768, he was educated at the parish school and was then set to learn silk manufacturing When twenty years of age he became the managing owner of a bleaching field at Darnley near Paisley, where he discovered a method of controlling chlorine gas by the admixture of lime His discovery led to the abandonment of the old processes of boiling the cloth in weak alkali and of exposing it to the sun and air for several days and effected great savings In 1800, with the aid of four partners, he established the famous works at St Rollox, Glasgow

Although Tennant was unsuccessful in upholding the validity of his patent in the courts, his services to industry were acknowledged by the bleachers of Lancashire presenting him with a service of plate A history of the firm he founded was published in 1922

Science in Austria

ON October 6, 1838, the *Athenæum* published an article by its correspondent in Germany, who referred to science in Austria 'It is a remarkable fact,' he wrote, that Vienna is the only European capital in which there is no academy or association for the cultivation of science, organised under the sanction and encouragement of the State " Leibnitz had made an attempt to found such an institution and a plan was brought forward under Maria Theresa in 1773, but "nothing further was dreamt of the special cultivation of science in Austria, till last year, when twelve men, well known for their learning and abilities presented, by the hands of the Archduke Lewis, a petition for the establishment of an Academy of Science at Vienna These twelve men were—Jacquin, Littrow, Prulite, Baumgartner, Ellingshausen, and Schreiber, as representatives of the Mathematical and Physical class, and Kopitar, Wolf, Buchholz, Arneth, Chonel, and Hammer-Purgstall, for the Philological and Historical class No notice has, we believe, been taken of this petition, and we presume that Prince Metternich does not deem it becoming in a fond and paternal government to give its subjects the pain of thinking "

Societies and Academies

Paris

Academy of Sciences (*C R*, 207, 313–325, Aug. 1, 1938)

A. Cotton, Mlles G Courtot and J Guillemin An abnormal case of birefringence caused by the compression of a transparent substance

A Denjoy : Convergence of trigonometric series

H Pailloux . Fluid movements providing a series of relevant surfaces

R Grandmontagne : Annual variations of the light of the night sky. Comparison with Lord Rayleigh's results.

R. Planiol . Use of dry rectifiers [copper oxide in oil] for the production of continuous high tension [current]

H Gutton and S. Berline : Attempt at the propagation of electromagnetic waves of 16 cm wave-length Good transmission was obtained between the Puy de Dôme and Mont Beuvray (152 km)

Y Ta : Study of the absorption spectra of *cis* and *trans* isomers in the near infra-red It is possible to distinguish between those isomers from the spectra

L Amy . Optical properties of disturbed liquids observed by reflection : influence of dilution. The colour by reflection of a suspension is independent of the dilution.

S Nikitine · Generalization of the theory of photodichroism

H Hulubei and Mlle Y Cauchois Probable existence of element 93 in the free state

M Ferber : A method of determination of the degree of dependence of the disintegrations of atoms of polonium.

P. Mondain-Monval and R Pâris . Thermometric study of the neutralization of weak acids and bases

Mlle M -L. Delwaulle, F François and J Wiemann . Application of the Raman effect to the study of complexes existing in solutions containing mercuric iodide and alkaline iodide

W Broniewski and S Mazois The temper of iron containing iron oxides

R Pajeau : Raman effect in determining the constituents of a mixture of isomeric dihalogen derivatives of benzene

P Couturier : Catalytic reduction of arylaliphatic ketones in the presence of amines , remarks *à propos* a synthesis of ephedrine

E Aubel · Reduction of nitrites by *Bacillus coli*.

L Balozet : Adsorption of the virus of [sheep] rot by aluminium hydroxide [prepared by Willstätter's method] Virulence of the complex Application to vaccination Immunity is conferred on sheep by vaccination with the aluminium precipitate

O Dony-Hénault . Use of forged molybdenum without supporting walls for electrical heating up to 2,000° C (see later paper by Michel)

E Asselberghs Stratigraphic position of J Cornet's Lubudi system A discussion of the geology of part of the Belgian Congo along the Luababa River

M Brelot Subharmonic functions and sweeping out

P Defrise Multiple Abelian curves without *points de diramation*

J Michel Behaviour of refractory metals, and in particular that of molybdenum, at high temperatures A new electric furnace with a molybdenum resistor Measurements on the rate of loss of weight of molybdenum due to evaporation and oxidation at high temperatures have led to a design for an electric furnace in which the molybdenum heater is not in contact with any insulating support, it can be used up to 2,000° C

R Defay The fundamental hypothesis of T de Donder can be demonstrated if the velocity of reaction is a function of the state of the system

P van Rysselberghe Note on the velocity of reaction

Brussels

Royal Academy (*Bull. Classe Sci*, 24, No. 5 , 1938).

L. Godeaux : Researches on the cyclic involutions belonging to an algebraic surface (5)

H. Buttgenbach : Symbolization of crystalline forms. After a discussion of the systems of Miller and Lévy, the author proposes a system believed to combine the advantages of both.

Cape Town

Royal Society of South Africa, June 15

F Gordon Cawston Succession of teeth in molluscs A comparison is made of the relative length of the radulæ of terrestrial and freshwater molluscs, the former possessing many posterior rows of teeth which can never come into play. Terrestrial species, being more exposed to injury during feeding, show more sign of constant succession of teeth than do the shorter radulæ of freshwater species, which also contain far more teeth in each row A comparison of embryonic radulæ with those of the adult shows that some increase in size of the teeth occurs in both terrestrial and freshwater molluscs

H F P Herdman The work of R R S *Discovery II*

T J Hart Plant life in the Southern Ocean

A Ogg, B Gotsman and K W Simpson : The quartz horizontal intensity magnetometer (Q H M) As these magnetometers are to be used for the intercomparison of magnetic standards at magnetic observatories throughout the world, the communication dealt with the intercomparison of two Q H M 's, Nos 29 and 30, at the Magnetic Observatory, Cape Town, which are to be used for diurnal variation determinations of declination and horizontal intensity at stations throughout the Union of South Africa. The results show an excellent agreement between the two instruments and their suitability for diurnal variation determinations. The comparison with the C I W. magnetometer No. 17 was also satisfactory

July 20

A. V. Duthie and S Garside Studies in South African Ricciaceæ. (2) The annual species of the section *Ricciella* (concluded) ; *R. Compacta* sp nov , and *R rautanenii* Steph. *R. compacta* from Stellenbosch is a diœcious, annual, synsporous species and may possibly be of hybrid origin. *R. rautanenii* occurs on alluvial mud and is widely distributed in

South Africa, but appears to be absent from the area of winter rainfall Two noteworthy features of cell structure are the presence of pink sap and a solid anthocyanin body in pigmented cells and of elongated slit like pits in the ventral tissue of old thalli

M R LEVYNS Some evidence bearing on the past history of the Cape flora At the present time the main area of occupation of the Cape flora is along the coastal belt of South Africa Recent work by geologists and archæologists indicates that in Quaternary times South Africa was subjected to considerable fluctuations of climate During pluvial phases conditions would have allowed the Cape flora to occupy much larger areas than it does to day During arid times the existence of this flora would have been challenged and it is suggested that the importance of the mountains of southern Africa lies in the fact that they provided a refuge for the flora when in danger of extermination This would explain the concentration of species on the mountains of the Cape

Geneva

Physical and Natural History Society (May 19)

A CHAIX Geology of the Hirmente (Haute Savoie) A detailed stratigraphical and tectonic study

A JAYET The presence of Riss quaternary deposits at Bellegarde (Departement de l Ain) Road repair work has exposed a succession of formations containing non striated alpine rocks and local rocks It is concluded that this is the nose of the Riss glacier, previously thought to extend nearly to Lyons

June 16

TH POSTERNAK Constitution and synthesis of phœnicine the pigment of *Penicillium phœniceum* Phœnicine is the 4 4 dimethyl 2 2 dioxydiquinone The hexa acetate of its leuco derivative is produced by Thiele s reaction starting from Brunner s ditoluquinone, saponification followed by oxidation leads to phœnicine

E A H FRIEDHEIM Contribution to the chemotherapy of African sleeping sickness Experiments with arsenic sulphonic acids Oxynapthoquinones have a trypanocidal effect and on combining them with substances of known therapeutic value, such as phenylarsinic acids, a definite chemo therapeutic effect is obtained A convenient compound of low toxicity and high trypanocidal effect is the sodium salt of 4 (4 arsono anilino) 1 2 naphthoquinone 8 sulphonic acid This has given good results with human trypanosomiasis

F CHODAT and MLLE G MARTIN Ineffectiveness of colchicine in purely nuclear process Cultures of *Staphylococcus aureus* are not sensibly affected by colchicine Bacteria being essentially nuclear in nature this confirms previous work on the garlic showing that this alkaloid affects the protoplasm of the cell and not the nucleus

J PH BUFFLE, CH JUNG and P ROSSIER Observations and new theory of a lacustrine optical phenomenon irisation of March 8, 1938 This phenomena seems to have been an inferior rainbow Wartmann s view, also held by Forel, that it was due to interference produced by pulverulent matter forming a 'grid' on the surface of the water, is not supported by the measurements made

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

DEMONSTRATOR IN BOTANY in the University of Leeds—The Registrar (October 3)

DEMONSTRATOR IN BACTERIOLOGY in the University of Leeds—The Registrar (October 3)

LECTURER IN MECHANICAL ENGINEERING in the Norwich Technical College—The Principal (October 3)

DIRECTOR OF DAIRY RESEARCH IN INDIA—The High Commissioner for India General Department India House Aldwych London W C 2 (October 10)

JUNIOR LECTURER IN CHEMISTRY in the Imperial College of Tropical Agriculture Trinidad—The Secretary 14 Trinity Square London E C 3 (October 17)

DIRECTOR of the John Innes Horticultural Institution—The Secretary Manor House Annexe Watery Lane Merton Park London S W 20

DEMONSTRATOR IN CHEMISTRY AND PHARMACY in the Portsmouth Municipal College—The Registrar

LECTURER IN MECHANICAL ENGINEERING in Natal Technical College—Arthur Perrott Regent Palace Hotel London W 1

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Rothamsted Experimental Station, Harpenden Lawes Agricultural Trust Report for 1937 Pp 225 (Harpenden Rothamsted Experimental Station) 2*s* 6*d* [139

Standing Commission on Museums and Galleries Second Report Pp 39 (London H M Stationery Office) 9*d* net [149

The Macaulay Institute for Soil Research Collected Papers, Vol 1 Edited by Dr W G Ogg Pp 16+54 papers (Aberdeen Macaulay Institute for Soil Research) 21*s* [159

Committee on Bird Sanctuaries in Royal Parks (England) Report for 1937 Pp 32 (London H M Stationery Office) 6*d* net [169

Joint Board of Research for Mental Disease City and University of Birmingham Annual Report 1937 38 Pp 16 (Birmingham The University) [199

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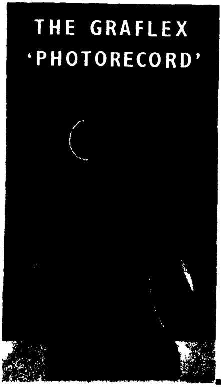

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The Promotion of Peace

THE agreement arrived at by the four-power conference, which met at Munich on September 30 to find a peaceful solution of the conflicting rights of Czechs and Germans to territory assigned to Czechoslovakia by peace treaties which followed the Great War, marks the beginning of a new era in the history of the world, and will be gratefully welcomed by scientific workers in natural and national fields as a significant stage in the progressive ethical evolution of the human race

The British people have expressed their enthusiastic admiration for the self-sacrifice and unceasing endeavour exercised by Mr Neville Chamberlain, the Prime Minister, to secure this end Suggestions have been made that a national tribute fund should be opened, and Sir Charles Hyde has put at the disposal of the University of Birmingham the sum of £10,000 to provide a Neville Chamberlain fund or scholarship Appropriate recognition, independent of nationality, could be given by the Nobel peace prize, which is awarded "to the person who shall have most or best promoted the fraternity of nations and the abolition or dissemination of standing armies and increase of peace congresses"

The immediate object of the meeting between Mr. Chamberlain, M Daladier, Herr Hitler and Signor Mussolini, reinforced by letters from President Roosevelt, was to find a peaceable settlement of a bitter dispute between Czechs and Germans, and though the people of Czechoslovakia naturally regard the terms imposed upon them as harsh, they and other nations would suffer far more if active hostilities had eventually to determine them Even more important than the agreement of the four great European powers as to new boundaries between Germany and Czechoslovakia was the declaration signed by Mr Chamberlain and Herr Hitler as the result of a further talk

"We regard," it says, "the agreement signed last night and the Anglo-German Naval Agreement as symbolic of the desire of our two peoples never to go to war with one another again We are resolved that the method of consultation shall be the method adopted to deal with any other questions that may concern our two countries, and we are determined to continue our efforts to remove possible sources of difference and thus to contribute to assure the peace of Europe"

This is, indeed, a step forward in the promotion of peaceful methods of settling disputes between nations, and however much we may deplore the intolerance of intellectual freedom, and the persecution of a defenceless minority, by which Germany is suppressing the advancement of knowledge and the rights of man, the declaration of the new Anglo-German undertaking makes the outlook much brighter. Sixty years ago, another Prime Minister, Disraeli, avoided a war between Russia and Britain by the Treaty of Berlin, as the result of consultation with the councils of Europe, and secured his "peace with honour" We hope and believe that the resolution now made between the German Fuhrer and Chancellor and the British Prime Minister will have more lasting influence than that reached by Disraeli, of whose treaty it was said soon afterwards.

"Once 'peace with honour' home was brought;
  And there the glory ceases,
For peace a dozen wars has fought,
  And honour's all to pieces."

The Cyclotron and its Applications*

By Prof. J. Chadwick, F R S

IN the early work on the artificial disintegration of elements by α particles it was thought that particles of very high energy were necessary in order to penetrate the nuclei of even the lighter elements and there appeared little if any hope of ever extending these experiments to the heavy elements

The application of quantum mechanics to the problem of the penetration of potential barriers however indicated that particles of comparatively low energy should have a small but not negligible probability of entering the nuclei of the light elements Now the small chance of penetration can be compensated by using large numbers of particles and Cockcroft and Walton realized that this might make it possible to observe disintegrations with particles of energy of only a few hundred kilovolts They carried out the first successful experiment of this kind in 1932 when they observed the disintegration of lithium under the bombardment of protons Using potentials up to 600 kv to accelerate the ions obtained from a hydrogen discharge tube they were able to disintegrate several of the lighter elements They were however unable to produce disintegrations in the heavier elements The reason for this limitation is that the height of the nuclear barrier opposing the entry of the proton increases with the atomic number of the element In order to disintegrate the heavy elements we must use particles of much greater energy than those used by Cockcroft and Walton In fact we require accelerating voltages of some millions of volts instead of some hundred thousands

During the last ten years several methods have been developed for accelerating ions—protons deuterons or α particles—to the very high energies necessary for these experiments on the transmutation of elements The methods may be divided into two classes the direct methods in which a high voltage is developed and applied to a discharge tube and the indirect methods The direct methods have some serious disadvantages First they are limited to what for the present purpose are moderate voltages Experimental difficulties increase rapidly as the voltage is increased and so far the highest voltage which has been used directly for the acceleration of ions is two million volts Secondly high voltage outfits need much space The cost of installing an outfit operating at say 5 million volts would be very high for the building alone for few if any physical laboratories possess the large and lofty hall which is necessary to house such an apparatus

In the indirect methods of accelerating ions a relatively small voltage is applied many times in succession increasing the energy of the particles in a series of small steps

The most successful of these indirect methods is that used in the cyclotron or magnetic resonance accelerator which has been developed by Prof E O Lawrence and his collaborators in the University of California

Suppose a particle of mass m and charge e moves with velocity v in a plane at right angles to a magnetic field H The particle will move in a circular path of radius ρ where ρ is given by

$$mv^2/\rho = H e v$$

The time taken to complete a revolution is

$$\frac{2\pi\rho}{v} = 2\pi \frac{m}{e} \frac{1}{H}$$

The time of revolution does not depend on the radius of the path or on the velocity of the particle For ions of the same e/m the time of revolution will always be the same in the same field

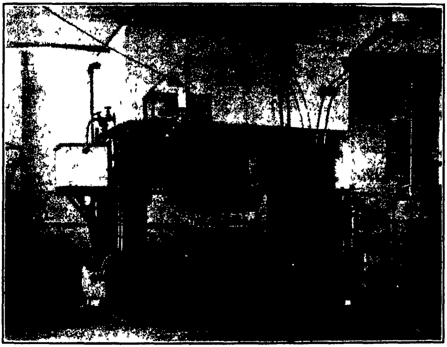
Now suppose that we have in the field two electrodes between which we can apply an alternating voltage V Let an ion start with very small velocity at some point between the electrodes If the top electrode happens to be positive at that moment the ion will be driven downwards It will travel in a semi circular path and return to the gap between the electrodes Its energy will be eV If at this moment the top electrode is negative it will be driven upwards acquiring another increment of energy eV Since the particle always takes the same time to go round the semi circle and return to the gap it should be possible by adjusting the frequency of the A C voltage and the strength of the magnetic field to keep in step with the particle that is to give the particle an impulse every time it crosses the electrodes

Whether this method is possible in practice will depend first on whether one can produce oscillating voltages of the required frequency Let us calculate what frequency is required for a proton

---

* From the Friday evening discourse given at the Royal Institution on May 27

The time of rotation is $2\pi . \frac{m}{e} . \frac{1}{H}$, and for a proton is equal to $6{\cdot}57 \times 10^{-4}/H$ sec The final velocity of the proton is proportional to $H\rho$, where ρ is the radius of its final orbit Since it is desirable to keep the dimensions of the apparatus—and especially the dimensions of the magnet—as small as possible, H must be large With good mild steel, H may be as much as 19,000–20,000 gauss Let us take H equal to 15,000 gauss as a readily attainable strength of field Then the time of rotation is $4{\cdot}38 \times 10^{-8}$ sec. The frequency of the alternating field must therefore be $2{\cdot}28 \times 10^{7}$ cycles per sec, corresponding to a wave-length of about 13 metres



Magnet of the Liverpool cyclotron

The photograph, taken at an early stage in the construction of the cyclotron, shows the magnet assembly with its water supplies, etc, but without the vacuum chamber and its auxiliaries

As the time of rotation is proportional to m/e, the frequencies of the oscillations required to accelerate deuterons or helium ions (α-particles) under the same conditions will be half as great, corresponding to a wave-length of 26 metres.

We have now to calculate what speeds the particles can acquire in this way. The maximum velocity is determined by $H\rho$, that is, it depends not only on the strength of the field but also on its extent. In the magnet at Liverpool the diameters of the pole faces are 94 cm., and we can allow ρ to be about 38 cm. With H equal to 15,000 gauss, the proton would reach a speed of $5{\cdot}4 \times 10^{9}$ cm/sec, or an energy of 15 million volts. Under corresponding conditions, deuterons would acquire an energy of 8 million volts

At first sight it seems that exceedingly high energies might be reached, for it is quite feasible to increase H to 20,000 gauss and ρ to 60 cm, or more A proton of $H\rho$ equal to $1{\cdot}2 \times 10^{6}$ would have an energy of about 60 million volts However, a serious difficulty appears when the protons move at a speed corresponding to more than about 10 million volts (deuterons at about 15 million volts) This difficulty arises from the relativity increase of mass of a particle with its speed The relation $H\rho = mv/e$ is no longer sufficiently precise, and we must write

$$H\rho = \frac{m}{e} \frac{v}{\sqrt{1 - v^2/c^2}}$$

The particle will not keep in step with the electrical oscillations, that is, there will not be resonance One could try to obtain exact resonance by adjusting the magnetic field so that it increases gradually as ρ increases, but this introduces another defect which may result in complete loss of the ion beam. It may prove possible to find a suitable device to overcome these troubles, but at the present moment it seems that limits are set to the energies which it is feasible to reach, about 10 million volts for protons, 15 million volts for deuterons and α-particles Even these limits have not yet been quite attained.

The possibilities of the cyclotron are so outstanding that, in spite of the expense and labour of construction, many machines have been or are being built in laboratories all over the world In Great Britain there are two cyclotrons nearly ready for use, one in Cambridge and the other in Liverpool. It may be of interest to give a few details of the construction of the Liverpool cyclotron, although it is not yet in operation.

The electrodes between which the ions are accelerated are two short, hollow semi-cylinders of large diameter, about 2 inches high and about

30 inches diameter made of copper sheet These known as the *D* plates are contained in a large chamber or tank Hydrogen (for a proton beam) or heavy hydrogen (for deuterons) is admitted to the tank so that a pressure of about 10^{-4} mm is maintained

The ions are produced at the centre of the chamber between the *D* electrodes by bombarding the gas with an intense stream of electrons from a heated filament

The alternating voltage is applied to the *D*s by coupling them to an oscillating circuit The generator of the oscillations consists of two large triode valves coupled in push pull using a self oscillating circuit It is important to make the voltage difference between the *D*s as high as possible and therefore the oscillation generator must be able to supply a considerable amount of power certainly more than 20 kw The voltage between the *D*s in Lawrence s experiments is about 45 000 volts

The vacuum chamber containing the *D* plates etc is placed between the poles of an electro magnet As it is important in order to obtain resonance that the field should be uniform over the whole path of the ions the diameter of the poles must be sensibly greater than that of the *D* plates The magnet must therefore be very large and a fair amount of power will be required to maintain the magnetic field Our Liverpool magnet contains 46 tons of iron and 8 tons of copper (The copper was generously presented to me by the directors of British Insulated Cables Ltd) The diameter of the pole faces is about 36 inches and the air gap between them is 8 inches The power consumption in normal running conditions will be from 40 to 50 kw under full load about 70 kw The maximum field under the conditions of experiment that is with a working gap of 5 inches is about 19 000 gauss

When the ions come to the periphery of one of the *D*s they are allowed to pass through an opening where the *D* is cut away An electric field is applied between a plate—the deflector plate—and the *D* to deflect them from their circular path towards a window in the tank The ions can thus be brought out of the tank and made more readily available for experiment

The intensity of the ion beam which is obtained in this way depends of course on the number of ions produced initially at the centre of the chamber It depends also on a very careful adjustment of the magnetic field by means of which the ions are concentrated near the median plane of the *D* plate In Lawrence s early experiments the ion current was of the order of 0 01 microampere Now by improvement of the conditions Lawrence can maintain an ion current of 150 micro amperes for many hours The number of particles carried by such a current is 10^{15} per second equal to the number of α particles emitted by 30 kgm of radium Moreover the energy of the particles is greater—about 8 million volts—nearly double the energy of the fastest α particle from radioactive bodies

THE APPLICATIONS

When the stream of fast particles—protons deuterons or α particles—issuing from the cyclotron is allowed to fall on a target of an element some of the atomic nuclei may undergo transmutation The incident particle enters the nucleus and a new nucleus is formed which disintegrates with the emission of a different particle In many of these transmutations neutrons are emitted and these in their turn can be used as projectiles for the transmutation of elements

The general processes of nuclear transmutation are well known and need not be described in detail here It will be sufficient to note that more than four hundred nuclear reactions of this primary type have already been discovered Many new forms of atomic nuclei have been produced in these reactions Nearly all these new atomic nuclei are isotopes of the ordinary chemical elements They differ from the known isotopes in that they are unstable and transform in the course of time with the emission of a negative or positive electron into a stable nucleus This is the phenomenon of artificial radioactivity discovered by Mme and M Curie Joliot Such changes as these may be called secondary nuclear reactions About two hundred or more cases of this type are known some of which are of special interest

In general terms one may say that the physical applications are directed to the study of atomic nuclei their transmutation by bombardment with different nuclei the investigation of the properties of neutrons and of the interaction of fast particles with matter

I should like however to refer to certain applications of the cyclotron which depend on these nuclear reactions and in particular to the biological applications

One may draw an analogy between the cyclotron and the X ray tube In the X ray tube the stream of electrons is used to produce X rays the fast ions issuing from the cyclotron can be used by bombarding beryllium for example to produce a stream of neutrons When we remember the uses of X rays and of radium in the treatment of malignant tissues it is natural to ask what are the possible applications of neutrons

The ionizing effects of neutrons are rather different from those of X rays The X rays impart their energy to the electrons of matter through which they pass and these secondary electrons produce relatively small ionization over a long path Neutrons do not lose energy in collision with electrons but in collision with the nuclei of atoms In passing through living matter neutrons will lose energy mainly in colliding with the hydrogen atoms producing recoil protons which ionize very strongly over a short path For example 2 M e v neutrons passing through tissues will frequently produce recoil protons of about 300 000 volts energy These will produce about 10 000 ions in a distance of some 4–5μ A secondary electron produced by X rays would give less than 100 ions in the same path

It seems that biological effects on individual cells depend more on ionization density than on the total number of ions and therefore one might expect that neutrons will be biologically more effective than X rays giving the same total ionization There is a certain amount of evidence which indicates that this is indeed the case but the results are too meagre to permit a definite conclusion For a given ionization neutrons appear to be about five times as effective as X rays in destroying malignant cells or in changing the blood picture of the rat and about ten times as effective in retarding the growth of wheat seedlings Many experiments are now in progress both on plant and on animal tissues

By means of neutron irradiation it may be possible to produce biological effects in specific regions There are some elements which show strong absorption of slow neutrons for example lithium and boron Ordinarily animal tissues do not contain any significant amount of these elements but it may prove possible to inject into the tissues in a suitable form compounds of such elements Irradiation of the tissues with slow neutrons would then cause the release of considerable energy in the small volume containing the injected substance

RADIOACTIVE INDICATORS

Another aspect of the application of the cyclotron to biological investigations arises from its use in the production of artificial radioactive elements Nearly all the ordinary chemical elements can now be obtained in radioactive modifications These have exactly the same chemical properties as the usual forms The radioactive isotope will accompany its inactive isotope through any series of chemical processes however complicated these may be but the active isotope can always be recognized by its radioactivity which acts as a label enabling us to detect the presence of a particular group of atoms and to follow this group throughout the chemical processes Thus if we wish to study the distribution of a certain element in a series of biological processes we can mix with it a radioactive isotope and we can follow the distribution by means of the radioactivity

Up to the present the use of active indicators in biological investigations has been almost entirely confined to the role of phosphorus in metabolism Apart from its structural function along with calcium as a major constituent of bones and teeth phosphorus as phosphoric acid plays a predominant part in the intermediate metabolism of a variety of substances An active modification of phosphorus can be produced in different ways one of which is the deuteron bombardment of phosphorus

$$_{5}P + {}^{2}H \rightarrow {}_{5}P + H$$
$$^{32}_{5}P \rightarrow {}^{32}_{6}S + {}^{0}e$$

The radio phosphorus breaks up with the emission of a β particle and the formation of ^{32}S It decays to half value in 14½ days a very convenient period

Radio phosphorus was first used as an indicator by Chiewitz and Hevesy in the study of phosphorus metabolism in rats The active phosphorus is mixed with inactive phosphorus and converted into sodium phosphate This can be mixed with the food of the rat The fate of the phosphorus—whether excretion deposition transfer from one tissue to another and the biological synthesis of compounds which contain phosphorus—can then be followed by tracing the radioactive atoms

In this way it was found that a large part of the phosphorus was incorporated in various compounds in the bones and muscles from which it is gradually displaced The experiments confirm the idea that the mineral matter of bone is in a dynamic state in which the bones are continually losing phosphorus atoms and taking up others which are later in their turn replaced

Another example of the use of phosphorus is given by an experiment of Hahn and Hevesy It is generally assumed that no regeneration of the brain tissue of adult animals takes place Hahn and Hevesy found however that one hour after a subcutaneous injection of labelled sodium phosphate labelled lecithin was already formed in the brain tissue of fully grown rats Their experiments suggest that a constant breakdown and building up of lecithin takes place in the brain tissue

These examples are sufficient to show that by the use of radio phosphorus as an indicator it is possible to provide a ready answer to such questions as How much of the phosphorus taken in by the body at a given moment reaches the bones or teeth ? How long does it take to arrive there ?

By what path does it arrive ? How long does it stay ? How does the distribution of phosphorus depend on abnormal conditions of diet or disease ?

Investigations such as these are now beginning in various laboratories They will not be restricted to the study of phosphorus for other elements of interest in bodily metabolism such as calcium potassium iron etc are available in active modifications I think it is clear that this method of radioactive indicators has many interesting possibilities for its power and delicacy make it possible to attack problems which have so far been inaccessible to experiment

There are also other applications of the radio active modifications of suitable elements If an element is concentrated in certain organs then these organs can be subjected to selective irradiation by using an active isotope of the element For example radio phosphorus can be used to irradiate bone and bone marrow or spleen radio iodine for thyroid etc So little work has been done on these lines that it would be premature to discuss these therapeutic applications further They may however prove to be important and among the most spectacular results of experiments on artificial transmutation

History of the Fenland*

WITHIN historic times the English fenland stretched over the greater part of the area to the west and south of the Wash extending as far north as Lincoln and as far south as Huntingdon and Cambridge On the seaward side the surface deposits are semi marine silts laid down and afterwards occupied during the Romano British period On the landward side the upper layers are peat produced by discharge of the flood waters of the Rivers Witham Welland Nene and Ouse into the extensive shallow basin of the fens The fen peats are alkaline and therefore support a vegetation of the true fen type Very little of the original vegetation of the peat fen remains however since the whole area has been drained and brought under extensive cultivation Its present characteristics are the black peaty soil uniform flatness and deep ditches full of reeds (*Phragmites communis*) which separate fields of cereals potatoes and sugar beet

Cambridge is at the head of the fens and the town and University have become the centre of the activities of the Fenland Research Committee formed in 1932 under the presidency of Sir Albert Seward and aided by grants from the British Association the Percy Sladen Trust and the Department of Scientific and Industrial Research Thus have the geology botany archæology stratigraphy and climate of the fenland area been closely investigated One fen area which has yielded exceptionally valuable results is Wicken Fen the largest area still uncultivated covering about one square mile now in the hands of the National Trust and lying about ten miles to the north east of Cambridge on the margin of the fenland itself

Very little is known of the fenland in glacial times for most of our knowledge of the area we must turn to the post glacial period during which the most important single key to its history lies in the recognition of the land and sea level movements which have left their record in the deposits of the basin

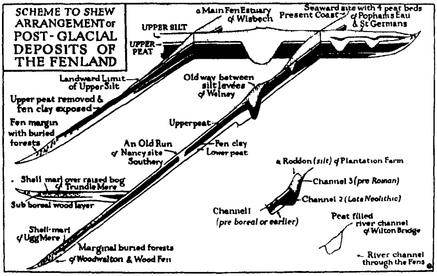
The upper layers are very similar to those of the German coastal marshes Although the peat is continuous at the margin it is soon separated into an upper and lower layer by wedging out of soft grey clay The lower layer contains brushwood of oak pine and alder the upper layer contains some tree remains and above this a layer of *Sphagnum* peat of a type similar to that of the large red bogs of the central Irish plain In certain parts there is a layer of calcareous shell marl overlying the *Sphagnum* peat This reflects very changed conditions since *Sphagnum* could not have grown in water so deep or so calcareous From investigations of the diatoms and foraminifera of the fen clay it is concluded that it was deposited in brackish water and that there was also considerable marine influence This shows that a phase of freshwater peat formation with fen woods was interrupted by a marine transgression and that after the upper peat had formed a phase of increased wetness produced shallow lakes

In places nearer the sea there is upper silt several feet thick and several feet above sea level Its foraminifera content shows it to represent another marine phase The upper peat extends below it at about ordnance datum for many miles seawards The surface of this silt shows abundant traces of Romano British occupation In parts the upper peat has been worn away by drainage and cultivation exposing the surface of the fen clay at ordnance datum Thus evidence is found of two periods of freshwater conditions and two periods of marine transgression as major phases in fenland history.

---

* Based on the evening discourse by Dr H Godwin to the British Association at Cambridge on August 19

The lowest and oldest deposits of fenland, however, are out in the North Sea, where big deposits of moorlog have been discovered. These deposits have been found in water as much as 200 ft. deep, and have been shown to contain many species characteristic of the present-day fens or Norfolk Broads That these deposits may be looked upon as the earliest phase of fenland history has recently been established by the technique of pollen analysis By identification and statistical analysis of pollen in the deposits, not only can the species of plants be identified but also their periods of dominance For example, in south Germany there was an early phase of birch-pine dominance, then a phase of hazel, then a replacement of conifers by mixed oak woods followed by beech dominance, culminating in an increase in spruce and fir possibly to be attributed to the felling of beech in historic times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UPPER SILT
UPPER PEAT
Landward Limit of Upper Silt
Old way between silt levées of Welney
Upper peat removed & fen clay exposed
Fen margin with buried forests
Upper peat
An Old Run of Nancy site Southery
Fen clay
Lower peat
a Roddon (silt) of Plantation Farm
Shell marl over raised bog of Trundle Mere
Channel 3 (pre Roman)
Sub boreal wood layer
Channel 2 (Late Neolithic)
Channel 1 (pre boreal or earlier)
Peat filled river channel of Wilton Bridge
Shell-marl of Ugg Mere
Marginal buried forests of Woodwalton & Wood Fen
River channel through the Fens

From "A Scientific Survey of the Cambridge District", prepared for the Cambridge meeting of the British Association, and to be published under the title "The Cambridge Region" (Cambridge University Press, price 6s).

These phases of forest history have been correlated with archæological remains. For example, the Bronze Age was contemporary with the greatest expansion of beech, and the hazel maximum corresponded with the Tardenoisian. Forest history has been correlated not only with archæological horizons but also with climatic and geological events; thus is forest history dateable in years and may be utilized as an index to all kinds of events of the past For example, the analysis of a peat bed now buried under salt marsh on the Norfolk coast revealed a marked sequence of phases. To begin with, pine and birch dominated, then hazel, then pine which was later displaced by oak and elm and more especially alder. The last transition was at the Boreal-Atlantic level. Since this pre-Boreal peat is now 10 ft. below ordnance datum, the sea must have been 20 ft. lower in relation to land than it is now, but pollen analysis of the peat from the floor of the North Sea shows that it was in fact much lower than this The analyses made show only pine-birch with negligible amounts of other trees or hazel, and they almost certainly relate to the pre-Boreal They are from depths so great as 30 fathoms, so that it is very probable that at this time (about 8000 years B.C.) the North Sea was at least 200 ft lower in relation to the land than now, and the fens extended right over most of the present floor of the North Sea As the sea formed during the following centuries, more recent peats were restricted to the shallower coastal areas The considerable age of the deeper peats has been confirmed by the discovery of a bone fish spear of Mesolithic type in a lump of peat dredged by fishing boats from the Leman and Ower banks off the Norfolk coast.

The excavations and inquiries of the Fenland Research Committee have been limited to the more landward sites Of particular interest was the excavation of an ancient river channel at Shippea Hill, between Ely and Mildenhall Here, no fewer than three archæological horizons were discovered stratified into the fen deposits

Broadly speaking, the fenland history has shown alternating phases of marine invasion and of freshwater conditions The first freshwater phase in the present fens extended through the Mesolithic and Neolithic periods, and for much of the time the fens were covered with alder-birch fen woods. It was probably about the end of the Neolithic period that marine invasion caused formation of the fen clay. In the Bronze Age which followed, fen woods grew extensively, but these must have been dry enough for prehistoric man, since Bronze Age remains are found abundantly in the fen peats It is probable that the fens became too wet for occupation in the Iron Age.

In the Roman period, marine invasion once again dominated fenland history All the silt of the Wisbech Spalding area was laid down and its surface intensively cultivated Along the tidal rivers, silt banks were built up and stood above the surrounding peat land as habitable areas

After the Romans left Britain, the fens were not exploited until the drainage which began seriously in the seventeenth century As it became effective, the shallower lakes, such as Whittlesea Mere, Soham Mere and Benwick Mere disappeared The ground level sank by shrinkage and wastage of the peat, often as much as one inch a year, and the silt banks of the Romano British water courses began to appear as raised banks, or 'roddons', crossing the peatland

There is no reason for supposing that the land and sea movement, which has played such a large part in former fenland history, has now ceased entirely There is some evidence that recent drainage troubles in the fens are due in part to sinking of the coast It seems possible that the subsidization of work like that of the Fenland Research Committee would be of value not only to science in general, but also to such scientific applications as the drainage of the fenlands

Obituary Notices

Dr Charles Carpenter

BY the death of Dr Charles Carpenter on September 7 at the age of eighty years, industry loses one of its greatest administrators and applied science one of its staunchest advocates Trained from his youth as a gas engineer and with an intimate knowledge of gas engineering practice, his delight in precision caused him to realize the value of allying the scientific mode of thought to engineering practice It was this combination of science and practice which gave the keynote to his technical work The development of the Metropolitan Argand No 2 burner was an example of his personal interest in accuracy of detail and the desire to express a quantity so difficult of measurement as illuminating power with the greatest precision possible It was recognition of the need for closer co operation between the scientific and the practical man that led him to take so keen an interest in the work of the Society of Chemical Industry, of which he was president in 1915–17, and the dominating theme of both his presidential addresses was the necessity for bringing the often impractical chemist into closer touch with the engineer, whose work was incomplete without the co operation of a man viewing things from a more academic viewpoint

Dr Carpenter s belief that a vigorous chemical industry was necessary to the welfare of Great Britain was behind the strong support he gave to the formation of the Association of British Chemical Manufacturers During the Great War, his work as adviser to the Ministry of Munitions was made possible by the deep interest he had taken in the practical application of science, and when in 1917 the Advisory Council for Scientific and Industrial Research decided to establish a Fuel Research Board, Dr Carpenter was able to give material assistance in arranging for a site and facilities to be placed at the Board's disposal As a member of the Coal Conservation Committee appointed by the Ministry of Reconstruction in 1918, he showed his belief in the importance of applying scientific methods to the problems of fuel treatment and utilization The value of his work in designing and putting into production gas burners of standardized characteristics and of ensuring a gas supply unchanging in chemical composition and properties has, in later years received the recognition that it deserves, but the introduction of what seemed to many unnecessary refinements in the control of gas quality and in the removal of naphthalene and sulphur made him appear often to occupy a position of isolation among his contemporaries

As a pupil and the successor of Sir George Livesey, it was to be expected that the ideals of co-partnership should form the keynote of his relationship with the employees whom he controlled, and if Livesey planted a sapling, it is Carpenter who has cultivated it until it has grown to the dimensions of a healthy tree His career is throughout a record of pains taking devotion to duty inspired by ideals of honesty and fairness Entering the South Metropolitan Gas Co as an engineering pupil at its Vauxhall works, his unusual ability caused him to be appointed to the position of works engineer at the age of twenty six years, and on the death of Sir Frank Livesey in 1899 he was appointed chief engineer of the Company When in 1908 Sir George Livesey died, he was chosen by the Board of Directors to succeed him as their chairman, a position which he held, with the altered title of president, until ill health compelled his retirement in 1937

E V E

WE regret to announce the following deaths

Cavaliero Filippo de Filippi, Hon K C I E, a well known Italian explorer, who led the Italian expedition of 1913–14 to the Himalaya, Karakoram and Eastern Turkestan, on September 23, aged sixty nine years

Prof Derrick Norman Lehmer, emeritus professor of mathematics in the University of California, on September 8, aged seventy one years

Dr A S Mackenzie, president of Dalhousie University, Halifax, Nova Scotia, during 1911–31, formerly professor of physics in Bryn Mawr College, Dalhousie University and the Stevens Institute of Technology, aged seventy-three years

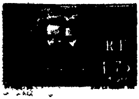
News and Views

Hugh Miller Commemoration at Cromarty

THE cottage at Cromarty in which Hugh Miller was born on October 10, 1802, was handed over to the National Trust for Scotland on September 26 The occasion was of interest not only to geologists but also to many who have been attracted to his writings by their highly individual style and charm and to those who are interested in the religious history of Scotland in the nineteenth century Few geologists have appealed to such a large reading public as did Hugh Miller, his assured place in the history of the science depends perhaps no less upon the stimulus and influence of his work than on its actual scientific content His apprenticeship to a stonemason turned his attention to the geology, and particularly to the sedimentary rocks, of the north east of Scotland He made the Old Red Sandstone a familiar term all over the world, and his book with that title 'amazed and delighted such an eminent geologist as Buckland Many of his other books were original attempts to make palæontology a contribution to Christian apologetics, Miller, as editor of the *Witness*, played a large part in the "non intrusionist" movement in the Church of Scotland Other collectors such as Robert Dick of Thurso (an acute observer who might, one feels, have rivalled Miller as a writer) looked upon Miller as their mouth piece, and their new specimens and information were often made known through him Miller's lack of orthodox anatomical knowledge was balanced by a "natural insight', and, even though much of his writing is now disregarded, his contributions to geology and to English letters form a durable record

Anniversary of the Discovery of Radium

THE fortieth anniversary of the discovery of radium is the occasion for the issue in France of a special postage stamp in honour of the discoverers, Pierre and Marie Curie Their lives and characters have been well revealed by their daughter Eve Curie, who wrote that her mother did not know how to be famous, while Einstein declared that Mme Curie alone of famous people was unspoiled by prosperity. Her other daughter, Irene, has carried forward the illustrious scientific work of her parents by her discovery, with her husband, Prof Joliot, of 'artificial' radioactivity The stamp, printed in blue, is excellent in design and carries faithful portraits, as may be seen by the accompanying reproduction It carries a surtax of half a franc for the benefit of the 'Union Internationale contre le Cancer On its merits, this stamp should have a wide appeal, enhanced by the desire to aid in the fight against a baffling disease



THE International Union against Cancer which comprises ninety two organizations representing fifty two nations, has succeeded in arranging for an International Week against Cancer on November 23–30, which it is hoped will take place simultaneously in fifty countries In connexion with the celebrations, an international commemoration of the discovery of radium, electrons, X rays and Hertzian waves will take place on November 23 at the Sorbonne, and a number of papers have been promised by distinguished scientific workers, including O Hahn (Berlin Dahlem), G Hevesy (Copenhagen), G P Thomson (London), M von Laue (Berlin), A Sommerfeld (Munich), J Errera (Brussels), F Carter Wood (New York), J D Bernal (London), H Stubbe (Berlin Dahlem), A Bouwers (Eindhoven) and L Marton (Brussels), in addition to French men of science Further particulars of the meeting can be obtained from the secretary general of the Semaine Internationale contre le Cancer 18 rue Soufflot, Paris (V)

Czechoslovakia's Future

DR GERALD DRUCE, who was the first English graduate of the Charles University of Prague after the Great War, writes as follows Relief that war has been averted is shared by the peoples of all nations Thanks to the uses that would be made of accumulated scientific knowledge and skill, a world war to day would be of such intensity and so ruthless that there would be no victory for the victors, whilst the vanquished might well suffer extinction Mankind has been mercifully spared this fate, but at the expense of a cultured and highly respected, if small, nation The Czechoslovaks have accepted proposals made without and against them", the economic and cultural consequences of which cannot be foreseen The territory ceded at once includes the whole of the Ore Mountains, so that the mineral wealth of north west Bohemia will no longer be available for the metallurgical and engineering establishments of Pilsen and Prague The pitchblende mines of Jáchymov (St Joachimsthal), together with the radium institute so largely developed by the Czechoslovak Ministry of Health, have also been lost In this area, too, the Aussig chemical concern has most of its plant and research stations The economic losses, of which the above are but examples, will necessitate curtailment of expenditure upon scientific and educational work in the residual State Hitherto, the Czechoslovak Ministry of Education has generously supported the universities and other scientific and educational establishments, but it cannot continue on the same scale that has hitherto been possible From the maps published in the Press, it appears that Brno (Brünn), the capital of

Moravia, is included in one of the areas where a plebiscite is to be held Should this city, with its university erected after the War and named after President Masaryk, and its technical colleges and museum be transferred to Germany, it may well be asked how the republic is to continue The future of the German University of Prague (the only one provided for a minority in Europe) is also a matter for concern Will the Czechs feel justified in expending money upon it whilst their own establishments languish ? Whatever happens, it is highly probable that serious academic research such as the world has become accustomed to associate with Prague and its ancient university, will be impeded for a long time to come

The Physical Society

WHEN the Physical Society of London was founded in March 1874, a paper On the New Contact Theory of the Galvanic Cell was read by J A Fleming (now Sir Ambrose Fleming) Since then sixty four years have elapsed yet this veteran physicist and engineer is still taking part in scientific work It is therefore with particular interest that we see the announcement in the Society s programme that he is to give an address on January 13 next, on Physics and Physicists of the Eighteen Seventies Other noteworthy meetings included in the programme are the twenty third Guthrie Lecture by Prof A V Hill, on the transformation of energy and the mechanical work of muscles (Nov 11), a discussion on electro acoustics, to be opened by Dr C V Drysdale (Dec 9), discourse by Dr J D Cockcroft on the cyclotron and its applications (Jan 3), discourse by C S Wright on geophysical research in Polar regions (Jan 4), joint meeting with the Royal Astronomical Society for a discussion on the expanding universe, to be opened by Prof G F J Temple and Dr G C McVittie (Jan 27), the Thomas Young oration by Brigadier M N MacLeod on some recent developments in British surveying instruments (March 24), and joint meeting with the Chemical and Royal Meteorological Societies for a discussion on chemical and physical investigations of the upper atmosphere, to be opened by Prof F A Paneth (May 4) The president of the Society this year is Prof Allan Ferguson, and it is evident from the programme that he desires the meetings to be of wide interest and not confined to the communication of technical papers which are better presented by title for publication in the *Proceedings* than read

Roman Villa in Yorkshire

REMAINS of a Roman villa have been brought to light, contrary to anticipation at Well, a village of the Dales in the North Riding of Yorkshire Although the site was known to be Roman, it was thought to be too far north to be likely to provide evidence of occupation of any considerable interest As the result of a week of excavation, however, the walls of bath buildings, which had been connected with a villa, and the floor of the cold water plunge bath have been brought to light The floor has a tessellated pavement with plaster moulding, and the walls are plaster lined There is evidence that the walls had been twice rebuilt, once after a fire A piece of Huntcliffe' pottery indicates that occupation had been so recent as the last quarter of the fourth century Other pieces of pottery and a coin have been found Excavation is now being directed to a search for the hot bath room and the walls of the main buildings of the villa, which it is hoped to discover nearby In view of the geographical situation of the villa, this find is likely to prove of no little interest as an indication of the relation of civil settlement and military occupation, more especially at so late a date The excavation is being carried out under the supervision of Mr Gilliard Beer and Mr Kitson Clark of Leeds both members of the Roman Antiquities Committee of the Yorkshire Archæological Society It is stated in a report on the excavation, which appeared in *The Times* of September 28 that owing to lack of funds it will not be possible to continue the work of excavation beyond the middle of October It would, indeed be unfortunate if what may prove an important investigation in its bearing on a critical period should have to be abandoned before completion

Houses of Viking Age in Eire

PROVISION for archæological exploration and research continues to be made as part of the measures for the relief of unemployment put into operation by the Government of Eire In the systematic plan of archæological investigation which it has been possible to frame as a result of the resources, financial and other, made available in this manner, the exploration of the forts which form such an important class of Irish antiquities, naturally take a prominent place An account of the results obtained in an examination of one such site on Lough Gur, Co Limerick, of which the excavation was carried out under the supervision of Prof S P O Riordain in the present season, is given by a correspondent of *The Times* in the issue of October 3 These results are of special interest as the excavation of the fort brought to light evidence of the character of the house in Ireland in, it would appear from the associated finds the period of the Vikings about A D 800–1000 Both inside the fort and outside its walls were the remains of several houses built of stone One of them outside the southern rampart, was a long rectangular structure, built in such a way that the face of the wall of the fort formed a wall of the house The houses outside the wall to the north were provided with yards Although of different types, all were of stone They were paved, and in some of the rooms were hearths In one building the roof had been supported by timber posts, for which the holes were found A large number of objects for everyday use of iron, bronze, stone, and bone were found, which serve to date the site as of the Viking period A coin has been identified as an imitation, or copy, of a coin of Constantine, such as continued to be made in Britain long after the Roman period A hoard of Viking silver would appear to have belonged to a metal worker, and included silver bracelets which had been broken up preparatory to being melted down

Atmospheric Pollution

Readers of the daily Press might excusably conclude that physical fitness is solely a matter of physical exercise It appears to be taken for granted that everyone has free access to the essentials of wholesome food, water and air Yet the free access to good air does not in fact exist in our large towns and without it full advantage of facilities for physical culture cannot be taken For this reason it is of timely interest to inquire how efforts progress towards improving urban atmosphere The twenty third report of the Investigation of Atmospheric Pollution (H M Stationery Office 7s 6d) discloses statistical evidence of slight improvement, but cautiously expressed One large city at any rate—Leicester—has started an intensive survey of its own area and surroundings At twelve stations, systematic records will be taken of pollution by suspended matter sulphur impurities and of ultra violet light Although the collection of data may of itself effect nothing it may stimulate and provide a guide to ameliorative action Previous reports have directed attention to the considerable atmospheric pollution of central London In this one, a recommendation is reported by a committee formed on the initiative of the London County Council, to reduce the emission of grit which modern practice of intensive firing seems to promote This recommendation refers to the important contribution which could be made to the diminution of the grit and dust nuisance if they themselves [that is public authorities] made a practice in their municipal undertakings of using washed coal wherever possible and if they would press industrial undertakings in their respective areas to do so This is a timely recommendation for public authorities control a very large amount of fuel using plant and some do not by any means set a good example

Shale Oil Industry

The present position of the shale oil industry was clarified at an International Congress held in Glasgow in June last under the auspices of the Institution of Petroleum Technologists Dr E F Armstrong reports (*J Roy Soc Arts*, August 12 1938) that at the beginning of the Great War the yearly production of shale reached a maximum of 3¼ million tons to day only about half this quantity is produced This is partly due to the fact that the oil yield is directly proportional to the fossil algæ content of the shale, from which it is believed to originate this fossil algæ content is less in the lower and geologically older shale strata Thus the average yield to-day is 16–20 gallons per ton, whereas, in 1875, it was 30 gallons per ton Rapid development of natural petroleum has also influenced the shale industry Shale has to be mined and distilled before oil can be obtained and, therefore, without some form of protection, shale oil cannot compete with petroleum oil Nevertheless, in spite of obvious handicaps, the shale oil industry is being kept alive in Great Britain and other countries, and it may be that at some future date when natural resources of petroleum have been depleted it will become a major industry, particularly as it is capable of producing both Diesel oil and motor spirit

International Studies of Health

In May 1937 the Health Committee of the League of Nations decided to organize a sixth meeting of the directors of institutes and schools of hygiene in Europe These periodic meetings consider the studies carried out by the institutes as co ordinated by the Health Organisation and the future programme of activity At their meeting last November, the directors agreed that the institutes represented should undertake studies on health indexes, enteric fever, brucellosis the incidence of tuberculosis and methods of tuberculosis control and nutrition in rural areas The studies are to be co ordinated by the Health Committee and technical meetings of representatives of the institutes concerned have been organized by the Committee in preparation for the European Conference on Rural Life the Preparatory Commission of which has commenced its labours M A Wauters, the Belgian Minister of Health who was elected president of the Commission stressed the value of the scientific work it was undertaking independently of the international situation Particular questions which are being examined by the Commission with a view to inclusion in the agenda of the Conference are the problem of raising the standard of living the development of agricultural credits , the results of the inquiry on nutrition , the study of housing problems medical equipment in rural districts physical education and the combating of certain diseases which have particularly serious consequences in rural districts The Preparatory Commission includes a certain number of persons who have undertaken responsible work for their Governments in rural life

Cultural Pedigrees Some Recent Examples

Some interesting examples of culture lag and pedigrees of cultural elements are afforded in several of the articles which appear in *Antiquity* of September Of these the most considerable is Dr E Cecil Curwen s note of The Hebrides in which it is argued that If we had visited Lewis even fifty years ago, we should have been able to study the life and manners of a Celtic speaking race emerging from roughly the same state of culture as the Celtic people of the pre Roman Iron Age in Wessex Dr Curwen naturally devotes careful attention to the details of the still numerous but disappearing black house and the now disused beehive shielings a survival of the megalith builders in use fifty years ago Of the black houses he remarks that it is only since the recent introduction of tuberculosis that they have become unhygienic, and that in the seventeenth and eighteenth centuries centenarians were far more common in the island than they are now, even attaining the ages of 140 and more A contribution to the pedigree of the St George cult is made in an article, in translation, by Dr Gawril Kazarov, in which he links St George with the numerous pre Christian rider hero cult shrines and figures of Thrace The hero cult survives in Bulgaria in folklore, the siting of shrines, and the overwhelming importance of St George's day in the popular festal calendar. An inquiry on somewhat similar lines by Mr Stuart Piggott traces Hercules, "the simple good-hearted strong man", back to Akkad, c 2550 B C, and in post classical Europe down to Harlequin, a polished and sophisticated version of the god of the underworld The discerning will note that *Antiquity* shows no falling off in demonstrating practically that solid learning need not be dull

Protecting Marine Cables

ONE of the most prolific sources of damage to ocean cables is the heavy drags called otterboards which are attached to the nets of steam trawlers and dragged along the ocean bottom In the *Nickel Bulletin* of September it is estimated that the damage caused to cables by the steel runners of otterboards averages about £100 000 a year To get rid of this source of loss, the Western Union Telegraph Co has for some time, been experimenting with a submarine plough which will automatically make a furrow in the bottom of the ocean, feed the cable into it and cover it up The cable will then be buried at a depth sufficient to ensure that the otterboards cannot come into contact with it Encouraging results have been obtained from experiments made so far, but many difficulties have had to be faced A new series of experiments has now been started off the Irish coast The plough is towed by the cable ship *Lord Kelvin* In handling the equipment a very flexible towing line had to be provided able to withstand a load of 29 tons The ordinary equipment necessitates that the line must be neither too light nor too rigid It must be capable of being paid out gradually from the ship while ploughing under full load After careful investigation and a series of tests it was found that di lok', a special chain made of 3½ per cent nickel steel, was quite suitable In order to get continuously smooth operation a very minute tolerance on the size and shape of each individual link was imposed The requirements were about five times as severe as those imposed by the U S Navy in their specifications There are eleven Western Union trans Atlantic cables and eight of these pass through fishing areas off the Irish coast where most of the ploughing work will be carried out

Carnegie Institution of Washington

A VALUABLE addition to the administration building of the Carnegie Institution of Washington has for some time been under construction and will probably be completed in time for the usual Institution lectures in late October or early November The new structure has been designed primarily to facilitate development of the public relations programme of the Institution by improving conditions for handling its publications, and for more direct contacts with the public through lectures, conferences and exhibitions The principal room in the addition is an auditorium, designed to seat about five hundred which, under the name of Elihu Root Hall, is being dedicated to the memory of Mr Root Up to the present time the facilities for lecture programmes have been limited to a room seating comfortably about half that number, and it has been necessary in most cases to limit invitations to those who have something more than a general interest in the subjects presented With the accommodation now in preparation it will be possible to include a larger invitation list with freedom to invite men of science and laymen representing all fields of interest Committee and conference rooms have been designed for the special purpose of arranging for discussions with a limited group of special students of subjects under consideration, and thus promote inquiries and research into the particular field of natural knowledge in which they are engaged

THE exhibitions of the Institution held in recent years at the time of the annual meeting have served an important purpose in bringing together representatives of all the departments and in presentation of some of the most important results of their researches These contacts have had much value in development of co operative relations between research groups of the Institution The exhibitions have also served an important purpose in that they make possible the contact of the Trustees at the time of the annual meeting with all of the departments especially through giving opportunity to see results of some of the most interesting investigations In past years, the annual exhibition has been possible only by use of the regular offices of administration to the exclusion of much of the ordinary business at the time of the annual meeting The new building will include rooms which are much more commodious and better organized for exhibition purposes than those thus far available, and use of these quarters will permit the regular business of the administrative offices to be carried on during the period of the annual meeting The new exhibition rooms will also permit certain exhibits at the administration headquarters to be retained throughout the year if this seems desirable

The Institution of Professional Civil Servants

THE nineteenth annual report, for 1937, of the Council of the Institution of Professional Civil Servants refers to the spectacular increase in membership from 9,076 in 1935 to 13,896 at the end of 1937 Activities of the Institution during the year were directed largely to obtaining improvements in the salary scales of its members Despite the multiplicity of grades and salaries, considerable success has been achieved both by negotiation and by arbitration The common scale possessed by certain architectural surveying and civil engineering grades in the Civil Service enabled the Institution to secure improved salary scales by central discussion, and acceptance of the Institution's proposals for the simplification of grades and salaries of the professional, scientific and technical classes in the Civil Service which were submitted to the Tomlin Commission would greatly reduce the task of negotiation and lighten the work of the departmental establishment officers The Institution has also participated in the work of the National Whitley Council, and the report includes a full account of discussions on the increased cost of living. It has also taken part in the consideration of problems involved in the reorganization of the Post Office through its Post Office Committee, and the Post Office Engineering and Stores Departmental Whitley Council. Preliminary consideration is also being given to the adequacy of the Carpenter scheme in view of the magnitude and rapidity of developments in scientific establishments since the publication of the Carpenter Report in 1930.

The Strangeways Laboratory

In the report for 1937 of the Strangeways Research Laboratory, Cambridge, the trustees are able to announce that an anonymous donor has guaranteed an additional £500 a year to the income of the trust for five years. This subscription has enabled the trustees to accept the offer of the Rockefeller Foundation of the capital cost of an extension. The new buildings will provide additional accommodation for laboratory work, and will enable satisfactory arrangements to be made for the library and the workshops. During the year, the record number of twenty-five persons has worked in the Laboratory, and it is a testimony to its reputation that of these eleven should be visitors from other laboratories in Great Britain and abroad. The British Empire Cancer Campaign has equipped the Laboratory with a 200 kv. X-ray apparatus, and has purchased a 300 mgm. radium plaque, which had been on loan. This has enabled the work on the irradiation of tissues to be continued, and it is now being extended from the preliminary observations *in vitro*, to the more difficult problems encountered *in vivo*. Of the sixteen papers published from the Laboratory during the year, nine are concerned with embryological problems, three with the effects of radiation on living material, and the remainder with the metabolism of tumour tissue and the physiology of the embryonic heart.

Forest Products Research Board

The report of the Forest Products Research Board for the year 1937 forms an introduction to the report of the Director of Forest Products Research at Princes Risborough for the same year (London: H.M. Stationery Office, 1938. 2s. net). The Research Board briefly reviews the work of the year and the measures laid down to be observed in future in the preparation of reports on mechanical tests of timbers, the grading of structural timbers, and plywood and other materials built up from wood. An extensive investigation into the latter and allied materials is proposed, a study being made of 'composite wood', that is, of industrial materials made of laminated or disintegrated wood. An investigation is also to be carried out into the possibility of producing from home-grown timbers charcoal for use in the chemical and other industries, a prominent manufacturing firm having made an offer of a grant towards the cost of this work. The Director in his report acknowledges the important direct help which the physicist and chemist can give to the various branches of the timber-using industry.

Central Medical School, Fiji

The Central Medical School at Suva, Fiji, founded in 1929, of which an account was given by Sir James Barrett in Nature of September 11, 1937, p. 472, has recently issued its annual report for 1937. During the year there were 43 students in the school, 13 of whom were in their first year, 13 in their second, 14 in their third and 3 in their fourth. In addition to students from Fiji, the school was attended by students from Samoa, Tonga, Cook Islands, Gilbert and Ellice Islands, Solomon Islands, New Hebrides and Nauru. The approximate annual cost for each student was £74, which included board and lodging, tuition fees, maintenance expenses, clothing, servants' wages, and pocket money; so that the four years course of study amounted to about £300 per student. The average number of Fiji students who qualify each year is four and there is an average annual loss of two. In Fiji, there is one native medical practitioner for every 1,600 of the population, and if the seven Indian medical practitioners and the 86,000 Indian population are included there is one qualified man for 2,700 of population. Lists of the lecturers, prize winners and text books used at the school are included in the report.

Social Services and Venereal Disease

The Secretariat of the League of Nations has recently issued an account of the systems prevailing in different countries for the provision of social, as well as medical services in the treatment of venereal disease ("Social Services and Venereal Disease". Geneva: League of Nations; London: Allen and Unwin, 1938. 1s. 3d.). The necessity for cheap medical treatment for venereal disease is now widely recognized, in some countries is compulsory, in others including the United Kingdom, it is voluntary but is encouraged by the State. There is not the same wide recognition of the need for social help, and the number of countries where social service is combined with medical treatment at clinics and hospitals is still comparatively small. Where they exist these social services take different forms. An account is given in the booklet of the systems in use in the United Kingdom and France, and suggestions are given for future planning which should prove of value to social workers in all countries.

Yields of Fruit and Vegetables

Some figures issued by the Ministry of Agriculture on September 2 outline the condition of various horticultural crops in many centres of Great Britain. Whilst the main interest of this survey is doubtless economic, it should also be interpreted as indicating a potent need for research into the cropping of fruit trees. Apple yields of Bramley's Seedling, Cox's Orange Pippin and cider varieties have only amounted to between 10 and 40 per cent of their capabilities. They were somewhat higher in 1937, but even then the crop average was decidedly below 50 per cent. Runner beans, Brussels sprouts, cabbage, carrots, parsnips, peas and onions yield, in general, crops of 60–80 per cent, and were slightly better last year. The poor cropping of the apple for 1937 and 1938 revealed by these returns is not an isolated instance, for the crop of 1935 was also very low Damage by spring frosts and inadequate pollination are doubtless causes of low yield, but it should be possible for modern science to raise the apple's cropping potentialities above 50 per cent in most years

A Practical Form of Electrophoresis Apparatus

IT has long been known that proteins differ widely in their rates of migration in an electric field, and many attempts have been made to use this phenomenon for purposes of separation and identification by so called 'electrophoresis' The principle is particularly attractive since even highly unstable substances are unlikely to be damaged by the treatment One is therefore at first surprised at the scanty results yielded so far by so promising a method The reason is that until recently no apparatus had been designed which could claim to have overcome the many technical difficulties In the last few years however, there has been steady improvement in this respect, associated largely with the names of Dr Theorell of Stockholm and Prof Tiselius of Uppsala The latest form of Tiselius apparatus, which has now been placed on the market by Messrs F Hellige and Co, of Freiburg, enables the separation to be followed both optically and analytically, while the resolving power for small differences of mobility has been greatly increased A direct result of these improvements has been the detection and isolation of the three components of serum globulin (Tiselius, *Biochem J*, **31**, 1464, 1937) which has answered an old and much disputed question The apparatus is already in use in several other laboratories, and promises a host of further interesting results, for example, in the study of pathological sera, immune bodies and enzymes

Quekett Microscopical Club

THE Quekett Microscopical Club is holding its annual conversazione on October 11 at 7 30 p m at Burlington House, Piccadilly, London, in the rooms of the Royal Society Dr Arnold Renshaw of Manchester will lecture upon the microscope in the detection of crime It is not generally known that pieces of tissue (flesh, etc) can be cut in slices so thin as a twenty five thousandth of an inch A film made by Mr Pittock of the Department of Anatomy and Embryology, University College, Gower Street, will be projected following Dr Arnold Renshaw's lecture, showing all the stages in preparation and the actual cutting of these sections Eighty microscopes will be set up each showing different specimens In addition there will be several demonstrations Mr Edwards of the Haslemere Museum will give continuous projection during the evening of living pond life A group of members will show the method of collecting, cleaning, etc , of Diatomaceæ Methods of recording by means of drawing specimens and structures seen under the microscope will also be demonstrated Dr Gunther, of the Old Ashmolean, Oxford, will stage a demonstration of contributions by the late Mr E M Nelson to microscopy In addition to this Dr Gunther will give a demonstration of the original works of Hooke, showing proofs of the plates and the first editions of his book It is hoped that the Royal Society, which owns a Hooke microscope, will exhibit it. Demonstrations are also expected from the British Museum (Natural History), King's College, Queen Mary College, etc Cards of admission can be obtained from the Assistant Secretary Miss Arnold 58 Warwick Road, Ealing, W 5

Announcements

DR HAROLD J PLENDERLEITH has been appointed deputy keeper in charge of the research laboratory of the British Museum in succession to Dr Alexander Scott, who has been honorary director of the laboratory since its institution in 1919

THE following representatives to the Scientific Advisory Committee of the Trades Union have recently been appointed by the General Council Mr J Hallsworth (chairman of the General Council), Mr E Bevin, Mr J Brown, Mr C Dukes, Mr H H Elvin Mr G Gibson, Mr W Holmes, Mr W Lawther, Mr G W Thomson, and Sir Walter Citrine On advice furnished by the general officers of the British Association the scientific representatives on the committee will be nutrition and agriculture Sir Daniel Hall and Sir John Orr, physics, Prof Allan Ferguson and Prof P M S Blackett, chemistry, Prof F G Donnan and Prof A C G Egerton, physiology and psychology, Prof Winifred Cullis, population, Prof L Hogben, metallurgy, Prof J D Bernal, geology and geography, Prof P G H Boswell, engineering, Mr J S Wilson

THE Hydrobiology and Fisheries Laboratory Alexandria, a description of which appeared in NATURE of June 18, p 1107, has, by Royal decree, been named the Fouad I Institute of Hydrobiology and Fisheries

THE fiftieth anniversary of the foundation of the Pasteur Institute of Paris will be celebrated on October 26 in the presence of the President of the French Republic and the Minister of Health

THE American Academy of Arts and Sciences gives notice of the Francis Amory Septennial Prize for outstanding contributions to knowledge of diseases of the human sexual organs The first award, which will be made in 1940, will exceed 10,000 dollars There will be no formal nomination and no formal essays or treatises will be required Further information can be obtained from the Amory Fund Committee, American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass , U S A

A PRINTED supplement (Bulletin 1937, No 3, Supplement No 1, Washington, G P O , 1938 10 cents) to the index to Public Affairs Pamphlets has now been issued by the Office of Education, United States Department of the Interior It contains an annotated list of a further 552 pamphlets together with a report on the pamphlet display demonstration centres, and author, subject and title indexes

Letters to the Editor

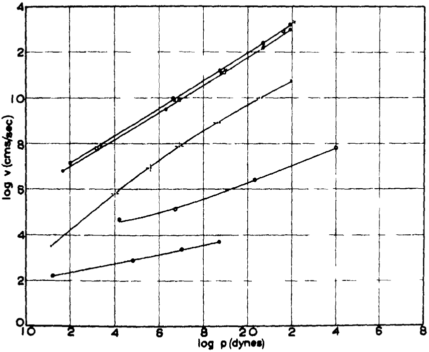
The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 675

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Flow Phenomena in Liquid Helium II

RECENT measurements on the flow of liquid helium II through capillaries have yielded very varied results We reported earlier[1] that the flow through long capillaries bore no relation to a normal laminar or turbulent condition of the liquid and that the velocity depended only slightly on the pressure head



Capillary length	T°K	Capillary length	T°K
☐ 6 mm	2 164°	✕ 6 mm	1 161°
◉ 11 5 mm	2 164°	• 11 5 mm	1 161°
● 40 cm	2 164°	▫ 40 cm	1 161°
┼ 11 5 m	2 2° (helium I)		

Since that time we have made many further observations on flow through capillaries varying in radius from 0 05 cm down to 6 × 10^{-5} cm, as well as through tubes filled with tightly packed rouge The smallest capillaries were produced by drawing down german silver tubes closely packed with fine stainless steel wires The full details will be published elsewhere but the main results are as follows

(i) The rate of flow in all cases in capillaries more than 15 cm in length depended only slightly on the pressure head (ii) The smaller the cross sectional area of the capillary the more independent of head did the velocity become For the finest capillaries the flow became completely independent of head for all pressures from zero to 200 dynes (iii) The pressure independent velocity increased very rapidly between 2 177° K and 1 15° K

Although Kapitza[2] was only able to observe turbulent flow Burton[3] and Giauque Stout and Barieau[4] in recent papers, have recorded laminar flow in helium II and suggest that the type of pressure independent flow which we have observed might be due to the transport of liquid in surface films such as have been observed by Daunt and Mendelssohn[5] In all our experiments precautions were taken against such a flow For some of the measurements on the larger capillaries a reservoir was used which was completely closed except for the capillary opening When open reservoirs were used, they were invariably made with constrictions 1 mm in diameter at the top thereby reducing the surface transport In these cases duplicate reservoirs with no capillary attached and closed at the bottom were fastened side by side with the flow reservoir The correction for the flow due to surface films was usually less than one per cent and for the finest capillaries was not greater than seven or eight per cent

Since the above results might appear to be in conflict with those of Burton[3] and Giauque[4], we have made some measurements under experimental conditions similar to Burton s A reservoir diameter of 16 mm and a capillary diameter of 0 03 cm was used, and observations were made using three different lengths 6 mm, 11 5 mm and 40 cm The results are shown in the accompanying diagram Logarithmic curves are given for two measuring temperatures in helium II, and in the case of the 11 5 mm capillary for a temperature in helium I of approximately

2 2° K In no case in helium II was a purely laminar flow observed, although in the case of the two shorter capillaries the curves might indicate a semi turbulent condition If we assume the flow to be laminar and calculate the viscosity from Poiseuille s formula, we obtain a value of 7 8 × 10^{-6} c g s units with $R = 280$, which agrees with Burton s value for a capillary of somewhat the same length On the other hand shortening the capillary length to 6 mm appears to have very little effect on the velocity and lengthening the capillary to 40 cm has the effect of decreasing the velocity only by a factor of five at 2 160° K Lengthening the capillary also has the effect of making the velocity much more independent of pressure It is noted that although the velocity through long capillaries increases with decreasing temperature, the velocity through the shorter capillaries actually decreases by about 5 per cent from 2 160° to 1 165° K For purposes of comparison a measurement of the flow in helium I, just above the λ point, was made The flow was observed to be laminar for low velocities and turbulent for high velocities The viscosity was found to be 1 4 × 10^{-4} c g s units which is in fair agreement with previous measurements

J F ALLEN
A D MISENER

Royal Society Mond Laboratory,
Cambridge

Allen J F and Misener A D NATURE 141 75 (1938)

[2] Kapitza P NATURE 141 74 (1938)

[3] Burton E F NATURE 142 72 (1938)

[4] Giauque W F Stout J W and Barieau R E *Phys Rev* 54 146 (1938)

[5] Daunt J G and Mendelssohn K NATURE 141 911 (1938)

Effect of Collisions on the Intensities of Nebular Lines

THERE appears to be a widespread misconception concerning the effect of electron collisions on the intensities of forbidden lines The prevailing view appears to be that, at high densities collisions of the second kind operate to de excite atoms from the metastable levels before the atoms have a chance to radiate, and that only at low densities as in the gaseous nebulæ, can a sufficiently high population of atoms be obtained to give appreciable intensity to the forbidden lines The mathematical reasoning advanced to support this argument[1] is as follows Let N_1b_{12} be the number of atoms excited per second from the ground to the metastable level by inelastic electron impact which process is ordinarily assumed to be the predominant source of excitation Let N_2b_{21} be the number of super elastic collisions per second Let A_{21} be the Einstein probability of spontaneous emission Then the intensity of the line may be written

$$I = \frac{N_1 b_{12}}{b_{21} + A_{21}} A_{21} h\nu \tag{1}$$

The customary argument is that the increase of b_{21} with density causes the value of I to decrease

The fallacy in the reasoning lies in the fact[2] that the excitation coefficients, b_{12} and b_{21}, both being proportional to the electron density, keep exactly in step Furthermore, they are closely related, so that one may be expressed in terms of the other Equation (1) is easily transformed to the following equivalent expression

$$I = N_1 \frac{\bar{\omega}_2}{\bar{\omega}_1} e^{-h\nu/kT} \left(\frac{1}{1 + A_{21}/b_{21}}\right) A_{21} h\nu, \tag{2}$$

where the $\bar{\omega}$ s refer to the statistical weights of the respective levels Since practically all the atoms are in the lower level, we may regard N_1 to be the total number of atoms in the assembly The first factor represents a Boltzmann distribution, which would be accurately attained if A_{21} were zero The second factor, enclosed in parentheses, is always less than unity A_{21} is an atomic constant I reaches a maximum when $b_{21} \gg A_{21}$, that is, when the electron density is *high* This conclusion is the reverse of that stated in the first paragraph

Part of the misunderstanding may arise from the erroneous belief that if the probability of collisional de excitation is greater than the probability of emission, the atoms do not have time to radiate This reasoning would imply a difference between an atom that arrived in a metastable state 10^{-6} seconds ago and one that may have existed in that level for some seconds The argument would imply that the quantum equation

$$I = N_2 A_{21} h\nu \tag{3}$$

is wrong The intensity depends solely on the population and atomic constants and the highest intensity occurs when N_2 is greatest

When equation (2) is applied to the normal lines with high values of A_{21} we discover that serious departures from thermodynamic equilibrium, with consequent fading of permitted lines, may be expected at densities from 10^6 to 10^8 times greater than for the forbidden lines Where, in a nebula, the forbidden lines may occur with intensities not far from their thermodynamic values, the permitted lines will have their intensities greatly decreased from the laboratory values The predominance of the forbidden lines in nebular spectra, therefore, is attributable, not *to the effect of collisions in de exciting an atom* before it has a chance to radiate but to the weakness of the permitted lines The high absolute intensity of the forbidden lines is explicable only in terms of the large total mass of the nebulæ The predominance of normal lines in laboratory spectra is due chiefly to the high values of the associated Einstein A's, though collisions of excited atoms with the cool walls of a tube, an essentially irreversible process, may affect the relative intensities

The foregoing analysis can be extended to atoms with more than one excited level One may also show that removal of the atoms from the metastable levels by radiation processes does not result in an appreciable lowering of the level population, in contradiction to the results of Eddington[3]

Note added in proof (Sept 19) Kaplan[4] reports that certain forbidden lines, observed in the nitrogen afterglow, drop in intensity as the pressure goes down He remarks, 'Since these radiations originate in relatively forbidden transitions, it is of considerable astrophysical interest to report an increase in intensity with pressure rather than the expected decrease " The observational proof of the points raised in the foregoing letter seems to be already available

DONALD H MENZEL

Harvard Observatory,
Cambridge, Mass

Aug 19

[1] cf Bowen, I S *Rev Mod Phys* 8 55 (1936)

[2] cf Fowler R H Statistical Mechanics (2nd ed) 677-684

[3] Eddington A S *Mon Not Roy Astro Soc* 98 134 (1937)

[4] Kaplan J *Publ Astro Soc Pacific* 50 228 (1938)

(*Continued on p* 669)

NATURE

SUPPLEMENT

Vol. 142 SATURDAY, OCTOBER 8, 1938 No. 3597

REVIEWS

Audubon

Audubon, the Naturalist:
a History of his Life and Time. By Prof. Francis Hobart Herrick. Second edition, two volumes in one Pp xcii+451+500+56 plates (New York and London: D Appleton-Century Co, Inc, 1938) 25s net

THIS work may be described as the standard biography of Audubon, from which the lighter and more romantic versions which have appeared from time to time have largely been drawn. It is strange that a life so full of genuine romance and adventure, a personality so individual, magnificent alike in stubborn courage and childlike carelessness and candour, should fail to satisfy the appetites of so many biographers without the added condiment of a fictitious royal birth Prof Herrick's careful account of Audubon's early life, in the first edition, would seem to have settled the matter; but subsequent publications have again promulgated the wild hypothesis that the poor fragile Dauphin and the vigorous naturalist were one and the same certain members of the Audubon family were drawn to the idea, disliking the illegitimate and Creole birth of their ancestor Prof. Herrick's new foreword and postscript must convince all but the wilfully credulous

The first part of the book deals with the life-history of Audubon from his birth and adoption, his short period in a naval college, his abortive studies in the studio of the celebrated David, his emigration to America, his many struggles in business, and the two fixed points in the kaleidoscope of his life—his great wife Lucy and his dominating passion for birds and beasts and for their portrayal. Such business ventures as he made, even to portrait painting and the teaching of dancing, were all undertaken so as to get means for pursuing this, his chosen work, his Lucy loyally bore privations and separations, and her self became a paid worker, so as to help to provide for their children, and to ensure the fame and recognition which she never doubted

In the next section—Audubon the naturalist—we have the account of his various explorations, extracts from his diaries, certain aspects of the controversies in which this pioneer ornithologist and artist was involved, sidelights on his contemporaries, the account of his ultimate triumph and recognition, and his subsequent work, aided now by his sons There are several appendixes · original documents, birds of America, likenesses of Audubon, a very full bibliography, and that most useful feature, a careful index

The illustrations include likenesses of relations and contemporaries, scenes from the homes of Audubon and many reproductions of his pictures, from the early simple drawings to the splendour of the decorative colour plates. This great innovation, namely, the representation of birds and animals in life and motion, in something approaching natural habitat, obtained favour in America only after England, Scotland and France had recognized its charm and value Prof Herrick does not omit to pay tribute to the great part played by Havell, the engraver. The large size of the plates, some of no less than five square feet, entailed the most skilful combination of aquatint with etching and line engraving It was indeed fortunate that the pioneer artist and naturalist should have found a coadjutor of like courage and enterprise.

In biography, romance makes a good servant, but a bad master, and it is well to have this scholarly and critical presentation of a personality and life-history so unusual as almost to invite exaggeration.

E. G. G.

The English 'Open Field' System

The Open Fields
By C S and C S Orwin Pp xii+332+29 plates (Oxford Clarendon Press, London Oxford University Press 1938) 21*s* net

THE layout of the countryside of England as we see it to day is a very recent development even the strict four course rotation that in many places preceded it and which is often regarded as the real old English system of farming, lasted but little more than a century The system that had the long life in England was the one associated with the open fields It comprised two distinct features sub division of the land among those entitled to share in it, and a rotation which usually consisted of winter corn spring corn fallow it is thus described by Tusser in 1573

First rie and then barlie the champion saies
Or wheat before barlie be champion waies
But drinke before bread corn with Middlesex men,
Then lay on more compas and fallow agen

Although the land was very much sub divided the cropping appears to have been usually con solidated and the total area of arable land of the village was set out in three fields, each devoted wholly to one part of the rotation Each field was divided into small areas which were allocated to those entitled to receive them, but each man's holding was scattered over all three fields each could, therefore in principle, receive his share of good and of poor soil The land was left open, unenclosed by hedges the system is therefore called the 'open field system' and the process of bringing it to an end was called 'enclosure'

Mr and Mrs Orwin have rendered splendid service to all interested in the history of the countryside by drawing up a full and detailed account of the working of the system in the ancient Nottinghamshire village of Laxton of which, fortunately unusually full records have been preserved and where indeed part of the system still survives Their book thus becomes valuable source material, and the copious extracts from the old documents and a complete transcription of the "Booke of Survaye" of 1635, give it unusual value for those who wish to acquire more than the usual sketchy knowledge of the subject

Experts will be particularly grateful for the useful account of the management of grazing for livestock under this system Grazing was, of course very inadequate, and much slaughtering and salting down had to be done round about Michaelmas, because there would be no food for the animals during winter to quote Tusser again

At Hallowtide, slaughter time entereth in,
And then doth the husbandman's feasting begin
From thence unto Shroftide kill now and then some,
This offal for houshold the better wil come

But it was always obvious that some provision had to be made for what farmers call winter keep' and the authors show how this was done

The extensive quotations from the records of fines throw valuable light on the agricultural and general life of the village indeed the whole range of country life in England in the seventeenth century is illuminated by the well chosen extracts

The origin of the system is still obscure Part of the system the sub division of the land and the scattering of the holdings, was widely spread around the Baltic it is still in use in Poland, it has not long been displaced in Russia, also it is still practised in Northern India The rotations also showed some resemblances to those used in England, but consolidation of cropping was not so common, and is not usual either in Poland or Northern India, except where some special circumstance has necessitated its adoption

The system had the advantage of permanence, and there is no evidence of soil deterioration throughout all the years that it was practised Also it accorded with the peasants' fundamental rule of husbandry, 'safety first' for if the crop on one of his strips was bad there was always the possibility that the yield on another might be better But it had the grave disadvantage that yields were low and improvements extremely difficult only when the scattered holdings were brought together into one piece could better methods be used In England this process of consolidation began in Tudor times, and was continued almost to our own day In Russia it was achieved after the Revolution under the name 'collectivization' in Poland, France (where necessary) and India it goes on more gradually and by persuasion

The system can find no place in modern country life It belongs to the old village life the days of the craftsman, of folk dances and folk songs, of the old feasts and fairs, but it has passed One cannot regret it, because it could not produce food in sufficient quantity or variety to maintain the village population in health But it has left its mark deeply on the countryside indeed the plan of the village to-day is frequently in the main lines almost the same as when the system was in operation E J RUSSELL

Growth of Astronomical Thought

A Hundred Years of Astronomy
By Reginald L Waterfield (The Hundred Years Series) Pp 526 (London Gerald Duckworth and Co Ltd 1938) 21s net

MR WATERFIELD has undertaken a very heavy task and has produced an interesting and useful work There are especially in the United States many text books of descriptive astronomy with formulæ diagrams and (some times) excellent illustrations This is something quite different Its production has evidently entailed a very considerable amount of research into historical questions and yet it is not by any means purely a history The layman will probably feel after a first reading that there is an astonishing amount of astronomy of which he had scarcely heard but which appears on the whole to be within his powers of comprehension and is fascinating in its interest once it is grasped For the author has set out to describe not merely the development of knowledge but also the development of understanding he sketches the processes of thought the conflicting evidence the puzzles and their solution (when it has been attained) and he outlines present knowledge and speculation in a very readable way Such a question as the motions of the stars as a whole might seem poorly suited to exposition for the lay mind with no formulæ and practically no technical terms allowed but by an apt use of analogies from everyday life Mr Waterfield does in fact hold the various classes of motion distinct in the reader s mind and guides him if he has a reasonably strong determination to follow through a maze that was largely uncharted even by professionals at the start of the present century

Mr Waterfield is an amateur astronomer and astronomy is pre eminently the science in which amateurs always have distinguished themselves On topics that usually interest amateurs most he may be taken as authoritative such matters as physical observations of the planets the behaviour of long period variables and the construction of telescopes may fairly be expected to be competently handled and in fact dynamical and statistical astronomy are at least as well treated It must however be added that he is less sound on the details of astrophysics atomic theory and also fundamental astronomy The errors are as a rule not of a nature to damage the whole presentation seriously but they are more numerous than one would wish

The book also suffers from some defects in arrangement especially in the earlier chapters. The author describes it himself as at first sight somewhat chaotic and it must be said that it does not improve with acquaintance Wireless Time Signals and Stellar Evolution is perplexing as a chapter heading so is Solar Physics and the Motions of the Stars The arrangement is apparently due to an attempt to group together questions that arose at the same time but even so the author is not consistent since Stellar Evolution is allowed to run right on to the latest developments in curved space The later chapters are better in this respect There are other signs of inadequate revision but it should perhaps be said that the author can in fact plead that at the time he was seriously hampered by circumstances beyond his control

Perhaps in a second edition which it is much to be hoped will be called for these superficial blemishes may be rectified The book as a whole is altogether too good to be judged by its defects

R d E A

Vanishing Tribes of India

The Travancore Tribes and Castes
By L A Krishna Iyer Vol 1 Pp xxi + 277 + 60 plates (Trivandrum Government Press 1937) 7 rupees

IT was the ardent wish of that veteran ethnologist L K Anantakrishna Iyer to complete the survey of South India with volumes on Coorg and Travancore His work in Coorg was cut short by his death and it is fitting that the Travancore Survey should be entrusted to his son Wisely the Travancore Government decided that first attention should be given to the hill tribes whose social and religious institutions are fast vanishing Only seven of these tribes are dealt with in this volume which repeats and amplifies the admirable synopses of the Census Report for 1931 based on the author s notes

Of the seven tribes three are assumed to be offshoots of Hinduized communities well known in the plains the Kuravans the Pulayans and the Vedans The Hill Pandarams who number only

187 souls may be kinsmen of the Paliyans of Madura and Tinnevelly the most primitive folk in South India Of very different status are the Kanikkars of South Travancore a well knit community more than 6 000 strong with a wealth of traditional lore the Mannans of the Cardomom Hills (1 276) and the Hill Arayans in the woodlands to the west of them (3 182)

The pivot of tribal life in India—social economic and religious—is the clan (*illam* house in Malayalam) a group of families so closely related that marriage between them is considered incestuous brothers they are called (*annan tambi*), as distinguished from in laws (*machambi*) groups with whom marriage is permissible Sometimes the marriage law is simplified by grouping the clans into moieties each of which must take its brides from the other The limits of the marriage circle and prohibited degrees may vary from time to time and from place to place but the distinction between brothers and in laws is clear cut

Thus the clan lists of the Kanikkars differ in the five different areas for which they are recorded yet most of the clan names are common to more than one locality and in each area they are grouped into moieties Similar social patterns are found among the Mannans and among the Arayans Kuravans and Vedans of the hills

Mr Krishna Iyer s account of the clan systems of these people with their local variations is a big advance on the hasty generalizations of his predecessors but the picture is far from complete Evidence is lacking of the relations of the Kuravans and Vedans of the hills with their namesakes in the plains of the Pulayans Pandarams Kanikkars and Mannans with their kinsmen and neighbours across the border in British India The map reprinted from the Census Report excellent so far as it goes shows but a fraction of the places named in the text a separate map for each tribe is essential

It is to be hoped that in future volumes greater care will be taken with proof reading and the transliteration of proper names and with the printing of the plates

Civilization spells ruin to these tribes The drop in tribal religions from more than 28 000 in 1901 to less than 3 000 in 1931 is not solely due to deaths a few of the tribesmen have turned Christian the majority are now registered as Hindu It is their solidarity that is decaying the social autonomy which controls morality and is the traditional right of every Indian community The Travancore Government are alive to the problem with the facts now before them they may stop the rot F J R

Foundations of Nutrition

(1) The Foundations of Nutrition
By Prof Mary Swartz Rose Third edition Pp xi +625 +2 plates (New York The Macmillan Co 1938) 15*s* net

(2) A Laboratory Handbook for Dietetics
By Prof Mary Swartz Rose Fourth edition Pp xi +322 (New York The Macmillan Co 1937) 12*s* 6*d* net

(3) Food Tables
By Prof V H Mottram and Dr Ellen M Radloff Pp 63 (London Edward Arnold and Co 1937) 5*s* net

(1) WHETHER dealing with the early history or tracing the latest developments of the science of nutrition Prof Mary Swartz Rose s book The Foundations of Nutrition is a delight to read and distinguished by its clarity and vitality In these days of specialized work on the chemistry of foodstuffs, it is salutary to look back as Prof Rose has done

We tend to forget that Lavoisier and La Place made the first calorimeter and measured the heat evolved by animals and the oxygen consumption and carbon dioxide output in man With improved apparatus Regnault and Reiset discovered that in proportion to their size small animals use more oxygen and give out more carbon dioxide and heat than larger animals Next Bidder and Schmidt found that for every species of animal when no food is taken there is a typical minimum metabolism—our basal metabolism—varying with age size and sex Then followed Voit and Pettenkofer and Rubner who established the law of conservation of energy for the living body Rubner observed also the extra heat produced by food the greatest with meat—the specific dynamic action By means of perfected respiratory chambers Atwater Rosa and Benedict established the equivalence of *direct* calorimetry by heat measurement with *indirect* calorimetry calculated from the gaseous exchange Portable apparatus could then be designed for the easy measurement of energy metabolism Regarded as a machine man could have his energy expendi ture measured under every condition of life At rest and without food his basal metabolism averages 1 calorie per kgm of body weight per hour and is doubled by moderate exercise Unexpectedly, an hour s sweeping with a vacuum cleaner expends 2 7 calories per hour as compared with 1 4 with a hand broom and 1 6 with a carpet sweeper Such data make it possible to tot up the caloric expenditure of families and nations and to ration armies and civilian populations in emergencies

But food is not merely fuel for the engine Food in its relation to growth and health has to be studied separately One essential is protein Consideration must be given to the so called complete and incomplete proteins Experiments on man have shown that the daily requirement of mixed protein is 1 gm per kgm of body weight

Few books have such an admirable account of the mineral requirements of the body Most work on this aspect of nutrition has been done in the United States particularly by Sherman who recommends for the adult man 1 32 gm phosphorus 0 68 gm calcium and 15 mgm of iron per kgm of body weight per day Women during pregnancy and lactation and also children need much more Prof Rose prefers to give the quantities per 100 calories of food and shows pictures of portions of common foods which supply these amounts There are so many ways of expressing quantities that it is difficult to say which is the best

The thoroughness and impartiality with which the supply of each vitamin is considered is an example to those of our British dietitians who lavishly prescribe the fat soluble vitamins and provide the others in sub minimal amounts, especially neglecting vitamin B_1 the cheapest and easiest to provide Prof Rose is not content with their provision in anything less than the optimal amounts The chapters on vitamins are up to date Flavin is recognized as vitamin B_2 The latest finding of nicotinic acid as a cure for pellagra came too late for publication in the book

(2) and (3) Data of food analyses and calorie values are indispensable for the dietitian Prof Rose s Laboratory Handbook contains a summary of food requirements eleven practical examples in dietary calculations 250 pages of tables of figures and a helpful note on planning a dietetic laboratory

Food Tables by Prof V H Mottram and Dr Ellen Radloff gives in a handy form a collection of analyses of British foodstuffs Although these authors advocate the exclusion of figures beyond the decimal point they have not had the courage of their convictions and retain the original figures to three places of decimals

Both books include figures for the calcium phosphorus and iron contents of foods Prof Rose gives many vitamin values in Sherman units Mottram and Radloff prefer to wait until more vitamin values can be expressed in international units The data in these books represent years of tedious analytical work and innumerable calculations The student and dietitian now have all this labour done for them and should be duly thankful

With all this knowledge so easily available the obliging food manufacturer may in the future print on the labels of his cans the analyses calorie and vitamin values of the contents Eventually we may live on one perfect tin a day !

Plant Culture without Soil

Soil less Growth of Plants

Use of Nutrient Solutions Water Sand Cinder etc By Carlton Ellis and Miller W Swaney Pp 155 + 1 plate (New York Reinhold Publishing Corporation, London Chapman and Hall Ltd 1938) 13s 6d net.

THE growth of plants in liquid media instead of in soil is a method that has been much used in laboratory work for many years For experimental purposes the method has the great advantage of permitting close control of environmental conditions and of food supply, to a degree that is impossible when soil is used For some purposes the combination of nutrient solution with an inert substratum such as sand forms a useful modification Much of the conclusive work on the importance of trace elements in the economy of plants could scarcely have been carried out without the use of water culture methods

Comparatively recently attempts have been made to develop these methods from the commercial point of view A most expensive item in the glasshouse cultivation of crops is the periodical removal and replacement of the soil and it is claimed that growth in solution or sand culture would greatly reduce these costs if satisfactory equipment and technique could be evolved Californian workers state that considerable success has already been attained but so far as other countries are concerned the method is still in its preliminary stage It must be recognized that success in developing the necessary technique depends on the close co operation of skilled engineers and expert plant physiologists and as yet the ordinary commercial grower however skilful is not in a position to make an economic success of the method As it happens premature press publicity has attracted much popular attention and in some quarters has raised undue hopes of revolutionary crop production

Information on soil less growth is much scattered and C Ellis and M W Swaney have now provided a useful summary written primarily for the non scientific reader but embodying details of use to the biological worker The various examples quoted demonstrate the elasticity of the various methods but deal only with successful cultures tending to gloss over the possibility of failure At least one of the quoted culture solutions should have been omitted in an elementary work of this nature as concentrated acids are dangerous when used by inexperienced workers The assumption throughout the book that algæ and fungi are identical is inexplicable and misleading

One of the most useful features of the book is the demonstration that elaborate equipment and expensive chemicals are unnecessary for the amateur who desires to attempt a novel method of horticulture All kinds of vessels can be adapted for use and the nutrients obtained from any chemist The general outlines of the function of the major and trace elements in plant growth the action of hormones ethylene and plant stimulants and the notes on diseases and pests are all helpful to the non technical reader

It is much to be hoped that at a later date when a new edition is required the needs of the scientific worker and the large scale commercial grower will be met by a full discussion of the position with a frank and critical comparison of types of equipment and appropriate nutrient solution for the various crops There is no one optimum solution which can be maintained as a commercial secret and there is much to be gained by a general pooling of information in an attempt to ascertain whether the method of growth without soil has a real future from the commercial point of view as well as for fundamental laboratory investigation

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Forest Management in Great Britain

Practical British Forestry
By C P Ackers Pp xviii+387+14 plates
(London Oxford University Press 1938) 15s net

THIS book bears the imprint of the practical man and is based on the experience of an owner of woodlands during thirty years of management of his own estates In his preface Mr Ackers alludes briefly to the training he went through to prepare himself for the work he has since carried out In a foreword Lord Clinton himself no mean forester in connexion with his own woodlands says It seems safe to predict that with the greater interest in forestry which is apparent to day a practical book upon the subject should meet with a very ready demand

Lord Clinton points out that there has always been a tendency to criticize the system of management as practised in Great Britain He admits that on many private estates no system exists and that often species are not suited to soils and environment In consequence the owner receives no regular income from the forestry portion of his estate and holds the opinion that forestry cannot pay The author tells us that from the outset he had to regard forestry as a purely business proposition He gives us an instance

I held the opinion and still do that the art of raising high class nursery stock has a bearing in many aspects on the problems of growing first class woodland produce I also felt that to do really well the grower should realize some of the tribulations and aims of the timber merchant With the object of correlating some of these ideas I now have 30 acres of commercial nurseries some 2 000 acres of commercially run woodlands and a sawmill utilizing some 1 000 cubic feet of timber a week The nursery and sawmill were formed with a minimum of capital and have to pay their way or be closed down

Space will not permit of following the author in great detail Following an introductory chapter two chapters are devoted to the hardwoods or broad leaved trees and conifers or soft wood trees the sylviculture of the most important species being treated in a general manner the chief pests being mentioned and the chief uses to which the timber is put Other chapters deal with damage by the elements vermin and so forth nursery work planting and establishing, thinning and pruning, extraction, conversion and sale of timber, sylviculture, minor forest produce and miscellaneous, in which various forestry operations are discussed, and a chapter entitled 'The Future" in which such matters as taxation on forestry lands, conservation of our forest resources, future supplies, and so forth, are dealt with

It is a pity that the author should have discussed working plans (Chapter xl, in Miscellaneous), the preparation and *raison d'être* of which he obviously misunderstands A working plan for a forest area is not necessarily confined to Universal High Forest", nor are working plans of necessity subject to 'regular fellings of areas identical in acreage year in year out decade after decade century after century" The provisions of a working plan are drawn up as the objects of management of the owner, whether State or private proprietor, prescribe A plan can be prepared for 100 acres of coppice with an annual or periodic yield, as well as for high forest on a long rotation The object of placing an area of woods under the provisions of a working plan is to safeguard it from the possibility of irregular fellings when money is wanted and poor management which produce the state of affairs the author's book is designed to improve

Mr Ackers is to be congratulated on his treatment of Sport and Modern Forestry' (Chapter lx) It is possibly the best exposition of a widely misunderstood subject amongst landowners in this country which has ever appeared in a modern book devoted to British forestry

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Science and Practice of Brewing

Brewing Science and Practice
Vol I Brewing Materials By H Lloyd Hind Pp xiv + 505 + 27 plates (London Chapman and Hall, Ltd, 1938) 50*s* net

A LONG STANDING hiatus in English scientific and technological literature would seem to have been filled at last by the work of which the first part is now under review

The realization, growing extremely rapidly during the last fifty years or more that the art of brewing has a strictly scientific basis has led a number of investigators in all parts of the world to inquire into the fundamentals and the details of the processes involved As in other fields of research, a marked acceleration in the output of original papers is to be observed since the close of the Great War and it has been the lament of many English readers interested in brewing that there are few, if any, books in the language which convey an adequate idea of the present position of brewing science and practice Nor do German text-books, for example, completely bridge the gap, since Continental practice differs in many respects from that in vogue in Great Britain

The present volume is concerned with materials, and, following an interesting historical introduction, is divided into six main sections devoted to barley, the biochemistry of malt and wort, malt, sugars, hops and brewing waters

The section on barley is extremely well done and serves to indicate the importance of the work of the geneticist in this field, and the valuable results accruing from a systematic study of the biochemistry of the raw material of the industry The work of Bishop in this connexion is well known in brewing circles, but even so it is of considerable value to have a succinct account of a number of papers which appeared originally in the *Journal of the Institute of Brewing*

From considerations of protein and carbohydrate composition of barley, and prediction of extract, we come to the next section, on the biochemistry of malt and wort This may be regarded as a somewhat extraordinary feat of compression, since in some seventy pages the author has discussed colloids, hydrogen ion concentration, carbohydrates, proteins and enzymes Clearly he has been in some difficulty here as he has had to cater for some technicians who may not be familiar with certain scientific conceptions of which others may be well aware When a second edition of the book is called for, it might be advisable to place this section first in order to pave the way to the section on barley and to preserve the continuity The sub section on carbohydrates might also be revised and slightly expanded for the sake of clarity

Following this digression, the main outline is again followed with a full account of malt, its constituents and analysis and the interpretation of the latter Analysis as an aid to the valuation of barley and determination of quality in malt has made large strides in recent years, but when the analyst has done his best (or worst, according to viewpoint) there still remain factors which in the judgment of many technicians may only be assessed in the light of experience.

In the case of sugars as in the next section the analyst is on safer ground since now he is dealing not with the complex products of plant growth but with much simpler substances obtained by more or less drastic treatment from the natural source

With the next section on the hop we return to the natural product and the treatment follows somewhat the same lines as in the case of barley Indeed there are parallels between the work on these two materials the nitrogenous constituents of barley have been the foremost objects of attack whilst those which determine the preservative value of hops have been most investigated Again the work of the geneticist on hops has produced results comparable in importance with those obtained for barley Thanks to this type of investigation hops of extremely high preservative value are now being produced and marketed

The concluding section deals at length with water supplies brewing waters the influence of salts and the general treatment of brewing liquors On the technical side the importance of the correct type of water for any particular process or product is not easily exaggerated on the more academic side the relations between the constituents of waters and the colloidal systems involved in malting and brewing provide a fascinating study for the physical and bio chemist alike

The book is well produced in large type on good paper references to many modern papers are given at the end of each chapter whilst author and subject indexes terminate the volume The author is to be congratulated on the successful issue of what must have constituted a difficult and laborious task We look forward with interest to the second volume on brewing processes

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Advances in Biochemistry

Annual Review of Biochemistry
By James Murray Luck and Carl R Noller Vol 7
Pp ix+571 (Stanford University P O Calif
Annual Reviews Inc 1938) 5 dollars

THE Annual Review of Biochemistry appears for the seventh time a little late this year no doubt in spite of the efforts to ensure an early appearance three reviews previously announced have not materialized The academic success of the venture by which we mean the utility to workers in this ever widening field has led its sponsors to enlarge their activities by proposing to publish as a companion volume an Annual Review of Physiology which will be a joint undertaking with the American Physiological Society It will be possible to avoid duplication and make the two reviews mutually supplementary

The intensive culture of high yielding crops under conditions which render them very vulnerable to insect attack has brought to the fore the question of their protection and hence as a topic of timely nature the volume includes a review by F B La Forge and L N Markwood of the Bureau of Entomology Washington on organic insecticides of plant origin which includes the rotenone group pyrethrin quassin and nicotine There is considerable progress to report in the knowledge of the structure of these compounds the method of their application and their testing This review would have been of wider value if it had been more general in character

The enzyme section appropriately contributed by J H Northrop is now proudly headed Crystalline Three new enzymes—ficin protinase catalase and papain—have been isolated and crystallized last year the protein of reductase has been crystallized also the coenzyme of carboxylase The total of crystalline enzymes has now reached ten Even so the preparations may contain more than one protein

The carbohydrate section by E F Armstrong is devoted to the question of the structure of cellulose and starch materials which though so different in appearance as in behaviour are both entirely composed of glucose molecules Within the space available a readable account is given of this most difficult problem

The chapter on proteins by Max Bergmann and Carl Niemann rightly stresses the renewed interest in protein chemistry arising out of the question whether the biological activity of enzymes hormones viruses and toxins all of which are proteins is to be attributed to some unknown prosthetic group or to the intrinsic nature of the protein molecule itself It is recognized that the knowledge of the chemical molecule of the protein molecule is of primary importance far more so than physical chemical measurements made with impure materials

In reviewing progress in relation to hormones O Wintersteiner and P E Smith rightly select one or two sections for fuller treatment, namely the hormones of the adrenal cortex, testis and ovary Similarly the vitamins are divided into three articles the first by R A Peters and J R O'Brien is restricted to the B group the second by Peters and H W Davenport to the C group whilst a third by J C Drummond deals with the fat soluble vitamins In this way satisfactory stories of high interest are produced and this method of treatment should be insisted on by the editors in all sections

As showing the interest even in such a highly complex and special subject as the terpenes and saponins which are off the fashionable track of biochemical research it is stated that five hundred papers have been reviewed in chemical abstracts during the last four years This year s article is by W A Jacobs and R C Elderfield who strive to make clear the complex structure to the understanding of which they have contributed so much themselves

Sufficient has been said to show how adequately the reviews present the subject of biochemistry As it grows they form the only means of maintaining any kind of contact with it for many of us It is well therefore to urge upon the editors that they should err if necessary on the more general and descriptive side with an appeal to many, rather than be highly specialized for the few workers who in fact are of necessity forced to maintain touch with the literature as it appears week by week

Practical Organic Chemistry

Laboratory Manual of Organic Chemistry
By Prof B B Dey and Prof M V S Raman
Pp xii + 158 + xlv (Madras G Srinivasachari and Sons 1937) 7 rupees

IF one were to try to find any cause for adverse criticism of this excellent book it would be that it fails to suggest to the student the need for reading the original literature on the subject and fails to provide him with any help should he wish to impart some human interest into the dry details of experimental manipulation It is true that names are not entirely omitted but it is difficult to find any references by which the worker can be guided to the place where first hand details are to be found

Even now some teachers of chemistry do not recognize to the full the value both psychological and chemical attached to the human association of discoveries with their discoverers Surely there is nothing more fascinating than to read the story of the sugars as told by Fischer or the synthesis of nicotine as told by Pictet Something of the glow of accomplishment which must have been experienced by them still clings to the written description of it and imparts some of the thrill they felt to the reader Even in the elementary sections of the subject organic chemists can gain nothing but good by reading the original literature and to the advanced student it is absolutely essential

The book under review is divided into two parts Part I it is stated in the preface is intended to fulfil the requirements of the elementary student, while Part II should be suitable for the advanced students' A praiseworthy feature of Part I is the detailed description of many of the more important and more commonly recurring organic compounds whereby the student can make himself acquainted with the actualities of these substances It happens not infrequently that a student by failing to visualize the actual character of organic materials fails to appreciate the realities of the science Obviously the practical method is the best in all cases but sometimes this is difficult of accomplishment for lecture specimens are often nur Kochsalz und Wasser In this section the apparatus described is admirably and clearly reproduced One slight slip is noticed on p 27 where the failure to indicate that the safety tube passes to the bottom of the steam generator may cause trouble

The second part starts with some useful estimations which will be found of great service There follows a short description of the methods by which a mixture may be investigated This will be useful but it has to be remembered that the bad old days of spotting are past and the most that can be usefully achieved with an organic compound is to assign it to its class This point has been fully recognized by the authors although it would have been better had the results of the analysis on page 48 been stated thus The mixture was therefore composed of a phenol and a phenol carboxylic acid The former was shown to be β naphthol and the latter to be salicylic acid

The longest portion of this part is devoted to preparations There is nothing striking about this section but its inclusion is justified by the fact that any user of a handbook of this character must possess such information and it is well not to multiply the number of books required in laboratory work There is a useful appendix

The book is a good one and both authors and publishers are to be congratulated on its appearance It will be found entirely adequate by those who require a self contained laboratory manual on organic chemistry Nevertheless there are many such books differing from one another as the varieties of motor cars They are all made to go, and it seems to be the main duty of the reviewer to indicate that they will go' and to leave the user to choose for himself which particular variety suits him best

J F T

Asphalt Bitumen Pitch

Asphalts and Allied Substances
Their Occurrence Modes of Production Uses in the Arts and Methods of Testing By Herbert Abraham Fourth edition Pp xxiv + 1491 + 7 plates (London Chapman and Hall Ltd 1938) 60s net

THE use of bituminous materials can be traced back to very early times and the occurrence of natural asphalts had an undoubted influence on the course of civilization in Eastern countries A substance which could be softened or liquefied by heat and with which solid materials could be incorporated had obvious practical uses in addition to embalming and sculpture Perhaps the early civilizations of the Near East may be largely attributed to the possession of a constructional material which could be used as mortar in building for road making and on account of its water proofing qualities for the construction of boats and baths

The work under review first appeared in 1918 the second and third editions were issued in 1920 and 1929 (reprinted in 1932) respectively The author is both a practical man and also president of the Ruberoid Co and of Asphalt Shingle and Roofing Industry In the preface to the first edition it is stated that the author has taken it upon himself to draw freely from contemporary text books and journal articles adding that he has endeavoured to place credit where it belongs Inspection of the long bibliography and list of references suggests that the author has no cause to reproach himself in this respect

The work is divided into six parts of unequal length the same remark applies to the thirty seven chapters The first part contains a very interesting historical introduction and also gives a classification and terminology for bituminous substances The earliest use of asphalt is ascribed to the inhabitants of the Euphrates valley the remarks are illustrated by a map of the country from the Mediterranean to the Indus and by numerous photographs from recent excavations following the use of asphaltic materials through the centuries it is mentioned that the first mastic pavement made with Seyssel (Ain) asphalt was laid in Paris in 1835 and London followed in 1836 whilst rock asphalt from the Val de Travers was used for road making in Paris in 1858

With regard to terminology the author is careful in defining the way in which he uses such terms as bitumen mineral wax asphalt tar pitch etc this is the more necessary as terms are used occasionally with different meanings The materials dealt with are divided into four genera namely bitumens pyro bitumens pyrogenous distillates and pyrogenous residues The four genera are made up of ten species and the latter in turn of numerous members

In the second part of the book the occurrence and handling of native asphalts receives attention, needless to say considerable space is accorded to the Trinidad lake But although the author is an American he affords quite a lot of space to the deposits in the Old World illustrating his remarks with maps photographs of mining operations and numerous analyses

Tars result from (1) destructive distillation for example wood tar coal tar etc (2) partial combustion as in the case of producer gas and blast furnace tars or (3) cracking operations In Part 3 the author describes not only the more familiar tars but also devotes Chapter xix to fatty acid pitch and bone tar and pitch Considerable amounts of the former are obtained as by product of the soap and candle industries and from the refinement of vegetable oils and refuse greases Thus in refining cotton seed oil half a million barrels of foots are obtained annually in the United States from which the fatty acids are liberated and steam distilled Of the crude fatty acids treated thus ten to twenty per cent appears as cotton pitch Such fatty acid pitches find a ready use for cheap lacquers and japans and they may also be converted into infusible masses by treatment with sulphur or a phenol and formaldehyde Bone tar pitch is produced in comparatively small amount but is used by varnish makers to deepen the colour of japans

One large source of asphaltic material is afforded by the petroleum industry Petroleums may contain asphalt, and even when they are non asphaltic, asphalt may be formed during the distillation process An interesting sketch of the cracking and refining industries is given in Part 4, plant used being illustrated by clear line diagrams The discovery that petroleum asphalts may be converted into less fusible materials by partial oxidation has led to a large industry in blown petroleum asphalts

The manufactured products and their uses are dealt with in Part 5 (280 pp) A bituminous substance may be blended with other materials in order to modify its properties (fluidity, adhesiveness, tensile strength etc) and the compatibility of the added substance is of importance, this applies whether the added material is miscible or only a filler Other 'mechanical mixtures' are the aqueous dispersions which have acquired so much importance for road surfacing and which have many other uses Of the industries in which bituminous materials are employed special attention is paid to road making and roofing sheets and shingles (tiles) The thirty pages devoted to the latter includes directions for laying asphalt-shingle roofs, which some may consider outside the scope of the work

Part 6, on methods of testing occupies more than 400 pages and cannot be reviewed as it deserves in the space available The directions given are usually clear and each test has a number assigned to it Since the test number is given for each determination in most of the numerous recorded analyses doubt as to the method used in obtaining any particular result is eliminated

Paper printing and reproduction of illustrations (333) are good and despite the size, the volume is not unwieldy Spelling is American, to which the reviewer is accustomed and not averse Misprints are few those noted relating mostly to chemical formulæ and arising occasionally from misplacing or omission of brackets Thus Ca(OH) and ($CaOH_2$) occur on p 496, whilst on p 509 $CaOH_2$ as well as $FeOH_3$ and $AlOH_3$ are to be found

The book conveys the impression that the author found pleasure in writing it this in turn, reacts on the satisfaction of the reader

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Statistical Interpretation of Experiment

Statistical Physics
By L Landau and E Lifshitz Translated from the Russian by D Shoenberg Pp viii + 234 (Oxford Clarendon Press, London Oxford University Press, 1938) 20s net

As a result of the many sided developments of the last twenty years the theoretical physicist has come to draw more and more upon statistical mechanics for the detailed interpretation of experimental results On opening a recent book with the comprehensive title Statistical Physics", one receives then at least a mild surprise to find that the subject is treated in an earlier manner, as a branch of mathematical physics divorced from any detailed connexion with experimental material The authors evidently decided to give a concise and lucid treatment of a definite field, and they have fulfilled their intention admirably Since in doing so they have kept within their chosen territory with an inflexibility that is unusual, it is desirable to mention the boundaries of this territory, without implying that these limits are unwelcome limitations

In their preface the authors state that their aim has been "to give a unified presentation of thermodynamics and classical statistics, based on the point of view associated with the name of Gibbs no attempt has been made at mathematical rigour in the treatment since this is anyhow illusory in theoretical physics, but we have instead tried to make clear the fundamental physical assumptions on which the results are based Having decided to confine their attention to classical methods the authors adopt the reasonable point of view that the reader scarcely needs to be reminded of the existence of the quantum theory When, for example, Dulong and Petit s law is derived, no indication is given that any progress has since been made in understanding the specific heat of solids , the subject is dismissed with the remark "At low temperatures and for all complicated solids, the law is obeyed very badly Even if one set out to write a book on statistical physics in which the electrical nature of matter was to be ignored throughout, and no known substances were to be mentioned by name, in these days care would be needed to prevent one's knowledge from slipping in unawares In this volume there are two or three passages where chemical substances are mentioned Apart from a passing reference to the size of the universe, only one experimental numerical value is mentioned, namely that of Boltzmann's constant.

In short the scope of the book is to present the mathematical theory giving a very readable exposition of the classical methods The authors have exerted themselves to convert the Gibbsian raw material into a palatable form To ensure that the underlying principles shall not be concealed by a notational undergrowth they have devoted the first two thirds of the book to assemblies containing only one species of particle They have provided more than fifty diagrams illustrating various aspects of the theory and scattered through the book are sixty examples—problems for each of which the method of solution is given these are a valuable feature

The later chapters include a section based on Onsager's treatment of irreversible processes and another section founded on Wagner and Schottky's theory of ordered solid solutions A chapter on anisotropic bodies is based on Landau's own work published in the Soviet journals R W G

Epistemology and Anti-Metaphysics

(1) Critical Realism

Studies in the Philosophy of Mind and Nature By Prof G Dawes Hicks Pp xxiv + 346 (London Macmillan and Co Ltd 1938) 15s net

(2) A Basis of Opinion

By Adrian Coates Pp xvii + 461 (London Macmillan and Co Ltd 1938) 16s net

PROF DAWES HICKS and Mr Adrian Coates agree in their decisive rejection of any form of subjective idealism and in their vigorous repudiation of an idealistic interpretation of physics They both expend much trouble upon criticizing various forms of sensum or sense data theories they are both concerned to deny that a sense datum is an object and they seek to draw important conclusions from this denial They diverge however so widely in their respective conceptions of and methods of approach to philosophical problems that even when they reach the same conclusions the grounds upon which their acceptance of these conclusions are based are entirely different

(1) The critical realism of Prof Hicks is critical in the Kantian sense of that word He agrees with Kant in putting in the forefront of philosophical inquiry the attempt to answer the question *how* knowledge of objects is possible His exposition of Kant's point of view is singularly clear and helpful He further agrees with Kant in holding that knowledge of objects involves both sensuous and conceptual apprehension But he discerns the weakness that led Kant to an unduly subjective view Prof Hicks directs his polemic mainly against the mistaken assumption that sense elements are discrete units that must somehow or other be synthesized into the object perceived He maintains that the sense datum is not an *entity* (*etwas*) upon which the act of perceiving is directed (*gerichtet*) The erroneous assumption that the sense datum is an object cognized is the cardinal error alike of Berkeley's subjective idealism and of those forms of contemporary realism that have been designed to avoid the difficulties of a representative theory of perception If we once admit that there is a *tertium quid* (sense datum or idea) between the cognizing mind and the world of real existence then we are driven to conclude either that the real object is unknowable or that the object known is a *construction* on the part of the mind itself a product of the mind's own making (p 5) I assume that a well known view of Bertrand Russell's would be a variant of the second alternative

Prof Hicks utterly rejects such views He replaces the notion of sense data or ideas as *objects* by the notion of *contents* There are three kinds of contents the content of the object the content apprehended and the content of the mental act Up to a point the distinction between these three kinds of content is made clear Unfortunately it is very difficult to know what exactly content is used to signify and why the same word should be used for the content of the object and the content of the mental act Content' seems here to be used as a synonym for a way in which the gap being filled in a way appropriate to the object apprehended and the mental act of apprehending it But a way in which stands as much in need of clarification as the word content that it is used to explain

I regret that lack of space prevents me from discussing Prof Hicks's theory in detail since it well repays study I must be satisfied with pointing out that he has provided good grounds for the view that colours sounds temperatures force energy strain, etc , are not mental constructs but are contained within Nature , that in perceiving we apprehend more or less accurately sense qualities which really are qualities of that which we perceive that is, of material objects finally that mind is not to be set over against Nature On all these points I should like to comment did space permit

(2) Mr. Coates shares with Prof. Hicks his impatience of the philosophizing men of science Unfortunately, he has not much tolerance of philosophers; he repudiates "as metaphysical nearly the whole course of philosophical speculation from the time of Thales to the present day" (p 27) "The root fallacy of the metaphysician", he says, "consists in applying the categories of science outside the sphere where they properly belong, and in reducing the whole of existence to the form of the subject-object relation" (p 29) Mr. Coates believes that the proper attitude of the philosopher should be that of the historian for whom the problem of appearance and reality, of subject and object, never arises in the form which this problem has taken in the philosophical tradition. The historian deals with persons knowing, acting, and feeling, one with another, he recognizes a plurality of persons in intersubjective intercourse

The working out of this point of view occupies the greater part of the book It is extremely well done Mr Coates is emphatic that a philosophy is a personal point of view. He is, however, more concerned to convert others than he is perhaps himself aware The method of conversion is to induce acceptance of a common language Perhaps Mr Coates unduly simplifies the problem At times he seems to suggest that if only you and I would agree to accept the commonsense usage of language as our norm, then our philosophical perplexities would be dispelled "People exist, things are real" (p 227) Accordingly, "existence is not subordinate to reality, but reality to existence"

How far does such a statement enlighten us? To know the answer to this question, it is necessary to read Mr Coates's book Whether one agrees or not with his point of view, it must be admitted that Mr Coates has written an interesting book and has much that is important to say with regard to the relation of language and logic

L Susan Stebbing

Indian Realism

Indian Realism

By Prof Jadunath Sinha Pp xvi + 287 (London Kegan Paul and Co, Ltd, 1938) 10*s.* 6*d* net

THIS is no simple exposition either of the doctrine of the Yogacara *Vijnanavada* or subjective idealism, or of the criticisms of the doctrine by the different schools and representatives of Indian realism The arrangement of the text is so confusing that although the book would probably be an excellent accompaniment for the student who is preparing to read the original texts for himself, it is emphatically not a work for the philosophically minded reader who wishes to be orientated in traditional Indian philosophical thought To begin with, the exposition is presented in a very complicated form. The co-ordination is faulty, there is no summarizing to help the reader, and it is difficult to disentangle the author's own comparisons with the views of European realists, where these occur. However, once the student has straightened out this confused presentation and has managed to ignore the unnecessary repetitions of Sanscrit terms, he will find that he has acquired a good deal of valuable knowledge on the subject

In the opening chapters, Madhavacarya's account of Yogacara subjective idealism is followed by a reconstruction of the doctrine from the works of such typical exponents as Santaraksita and Kamalasila, whose arguments against the existence of external objects have not apparently been given in any other works dealing with Yogacara idealism

The Yogacara arguments may, in general, be divided into two classes--epistemological and metaphysical The epistemological argument shows that cognitions are self-aware and cannot apprehend external objects, of which, again, the existence cannot be proved, and the metaphysical argument consists in showing that the nature of an external object cannot be ascertained Then in the following chapter, the arguments of the Sautrantika realists against the Yogacara doctrine of the non-existence of the external world is outlined by Madhavacara, while their own doctrine, which advocates a representationist theory of perception akin to that of Descartes and Locke, is expounded. This is followed by the counter-argument of Yogacara idealism against the Sautrantika representationist theory, which is set forth by Jayanta Bhatta, and an exposition by Sridhara of the Yogacara argument against the realist doctrines of the Sautrantika Further expositions and criticisms of Yogacara subjective idealism by the Jaina, Sankhya Yoga, Mimasaka and Nyaya-Vaisesika realists, take up the succeeding chapters Finally, the Vedanta critique of subjective idealism, in which the absolute idealism of Sankara is contrasted with the Yogacara subjective idealism, is set forth in the concluding chapter.

SHORT NOTICES

Agriculture

Mother Earth

being Letters on Soil addressed to Professor R G Stapledon By Prof Gilbert Wooding Robinson Pp viii+202 (London Thomas Murby and Co, 1937) 5s 6d net

THIS is an interesting and useful little book for the general reader Although couched in the form of letters the material apparently consists of the author s lectures to first year students of agricultural science omitting the more complicated diagrams and tabular matter but retaining the occasional shafts of professorial humour which relieve the tedium of yearly repetition—at any rate for the lecturer There are seventeen chapters or letters beginning with a discussion of soil material they pass to a description of soil profiles and surveys and their bearing on problems of soil fertility and the correct agricultural utilization of the various soil types

Leguminous Forage Plants

By Dr D H Robinson Pp vii+119 (London Edward Arnold and Co 1937) 6s net

THIS little book is not primarily designed for the expert, but rather to enable the inexperienced to identify the various legume crop plants that are grown in Great Britain and to explain their agricultural uses It accomplishes its purpose very well and is written in a clear and readable style The account of each legume commences with a description illustrated with excellent drawings This is followed by a short outline of the crop s agricultural uses A typical chemical analysis is given for most of the legumes described

The book contains a few inaccuracies which might be corrected in the next edition Thus it is not true to say that the nodule bacteria from red clover cannot infect white clover The variation in efficiency of different strains of nodule bacteria is an important and widespread characteristic and is by no means confined to the organisms that infect lucerne The discovery of such strain differences amongst the lucerne nodule bacteria is incorrectly credited to the reviewer The problem of clover sickness appears to be less simple than is suggested on p 18, and cannot always be attributed either to eel worm or *Sclerotinia* H G T

Theory and Practice in the use of Fertilizers

By Dr Firman E Bear (Wiley Agricultural Series) Second edition Pp ix+360 (New York John Wiley and Sons, Inc London Chapman and Hall, Ltd, 1938) 20s net

THIS well known text book, first printed in 1929, has now been brought up to date During the last nine years the subject has made great strides in its chemical, engineering and agronomic aspects, and within the limits of a single book, it is only possible to touch lightly on some of these The form of the book remains unaltered, but sections are added dealing with the inclusion of dolomite in fertilizer mixtures for use on acid soils, the use of granular fertilizers the addition of calcium sulphate to high analysis mixtures and the rapid methods of soil analysis for 'available nutrients' now being extensively used in the United States and elsewhere A new chapter has been added on the minor elements in soils and crops and examples of the necessity for the provision of traces of boron, copper, iron, magnesium, manganese and zinc are quoted mainly from American sources

Anthropology and Archæology

Other Men s Lives

a Study of Primitive Peoples By Sir George Dunbar Pp xiv+355+1 plate (London Ivor Nicholson and Watson Ltd 1938) 10s 6d net

THIS book is difficult to handle fairly It aims at giving an account of the mode of life of a primitive people as it develops from the stage of the simple hunter and food gatherer to that of the small farmer at the point of transition from the use of stone to that of metal The author describes the culture of the old and the new stone ages, and then passes on to give an account in considerable detail of the culture of the extinct Tasmanians and of the Indians of North America, who may be said to be, in a cultural sense, no less extinct The book is brought to a close with a description of the Abors, the little known, and for long inaccessible people living between the Assam valley and the Tibetan border land These people are taken as exemplifying in modern times a type of culture which has been shown to have existed in the stone age

Setting aside the question how far a modern so called primitive people presents an exact analogy with a prehistoric stone age people, from which it is separated by a gap of thousands of years, Sir George Dunbar s book appeals primarily to the non technical reader, since neither his account of the Tasmanians nor of the Indians of North America is other than a compilation At the same time, although he is not in the professional sense an archæologist, his account of the peoples of the stone ages interprets the material with the eye of an ethnographer with first hand acquaintance of how a people of simple culture really does live In the concluding section of the book, however, the author records the results of his experience during some years of residence among a people in a stage of transition from stone to metal. If on this account alone, his book deserves the attention of the scientific anthropologist

L'Art des Iles Marquises

Par Willowdean C Handy Pp 56+43 plates (Paris · Les Editions d'Art et d'Histoire, 1938) 75 francs

MRS HANDY, who in 1920–21 accompanied her husband, Dr Craighill Handy, on the Bayard Dominick expedition of the Bernice P Bishop Museum of Honolulu to the Marquesas, there devoted herself to the study of the tattooing for which the islanders have always been noted Her observation of this practice, highly important both in its ritual and in its decorative aspects, has afforded her an exceptional insight into the artistic activities and conceptions of the people, of which she here gives an admirable summary, while analysing the highly conventionalized designs into their component motives Of these motives the most important is the human form, a logical outcome of the idea, inherent in Marquesan thought, that to make anything is an act of creation, standing in definite evolutionary relation to the first act of procreation, by which Alea, the celestial father, fertilized One u i, the earth mother

In a brief comparative study, the author indicates her conclusions as to the relation of Marquesan art on one side to the archaic Maori art, with its divergent development owing to the technique of the chisel, and on the other to the art of ancient Peru, with which there are indications that there may be affinities

Canoes of Oceania

By A C Haddon and James Hornell Vol 2 The Canoes of Melanesia, Queensland and New Guinea (Bernice P Bishop Museum Special Publication 28) Pp vi+342 (Honolulu Bernice P Bishop Museum, 1937) n p

IN the second volume of this joint study of the canoes of Oceania by Dr A C Haddon and Mr James Hornell, the former has brought together and analysed an enormous mass of detail relating to the canoes of Melanesia and adjacent waters It is drawn in part from personal observation, in part from published, or in some instances unpublished, observations of travellers and ethnologists, sometimes going back to the earliest recorded visits to the islands by Europeans On the whole, this latter source is more satisfactory than the corresponding material under contribution in the preceding volume, which dealt with Polynesia

The problem, or rather series of problems, of the canoe in Melanesia, to which, as is well known, Dr Haddon has devoted many years of study, is infinitely more complex than that of Polynesia Not only is there the question of modifications possible through contact in trade, etc , but also this region has been subjected to racial and cultural drifts which have left their mark on the canoe perhaps as much as on any other element in culture This applies not only to general lines of construction but also to details, often, it might appear, of relatively little significance Thus, for example, in the Massim area of New Guinea, which is remarkable for the decorative carving of its canoes, Dr Haddon is able to discriminate between no fewer than four areas of difference, according to details of outrigger, sail, etc , while in the area of marginal communities in north-eastern Melanesia, south east of the Solomons (Tikopia, Rennel, Ontong, Java, etc), he shows how the canoes not only differ from those of their Melanesian neighbours, but also show traces of Polynesian and Micronesian influence, corresponding to differences in physique, language and culture

Biology

Genetics

an Introduction to the Study of Heredity By Prof Herbert Eugene Walter Fourth edition Pp xvii+412 (New York The Macmillan Co , 1938) 12*s* 6*d* net

IT is unfortunate that the fourth edition of this book should have been published in its present form The earlier editions provided an interesting account of the work of the early investigators and reflected the influence of this work on the current biological thought The present edition also contains much which is interesting from a historical point of view The author s lack of appreciation of modern genetics is shown, however by the description of crossing over in the two strand stage, the emphasis placed on Weismannism, the implication that the genes for sex are on the sex chromosome alone, and by the stress laid on the arbitrary division of genes into lethals, modifiers and other categories Much loose thinking vitiates the praiseworthy attempt to express genetical facts in popular language Eugenics not Bluegenics' , 'The cytological approach tries to find out what is the make up and behaviour of genes", 'Translocations and deficiencies are bound to cause embarrassment later when *synapsis* takes place, because some of the *genes* in the *mitotic* dance become wallflowers without a partner , are some examples of phrases which might have been expressed differently

F W S

The Way of Birds

By R B Talbot Kelly Pp 135 (London Wm Collins, Sons and Co Ltd , 1937) 25*s* net

THIS is a volume of large format, consisting mainly of coloured and other drawings—seventy two in all—with a few lines of text about each It is a book of birds as the artist sees them in life, and not of illustrations in which detail is carefully checked from museum specimens In a short introductory chapter, called 'Feathers , Captain Kelly expounds the difference "I used to think that herons were always blue grey in colour But I have seen a heron look blue, and pale ash grey, and purple grey, and golden buff in different lights at varying times of day The beauty of the feathered coat is that we perceive it as a whole , as a coherent, fluid vestment, not as a collection of separate feathers" On the other hand, "the scientifically accurate map-drawing of a bird's plumage pattern is a specialised form of art, or perhaps craftsmanship" A second chapter, called "Wings ', discusses form and movement—particularly in flight

The reader is thus prepared for generalized representations of colour patterns, and for unfamiliar shades seen in special lights. The test is severe, however, as the bird rendered static on paper becomes too readily comparable with the close-up appearance to which one is accustomed. So, while the method partly succeeds, the effect sometimes seems too strange to be credible. The difficulty is less with the black and white drawings which form the majority as one's attention is focused on the movement which the pose has caught. The result is often beautiful and life-like. Captain Kelly has clearly a real feeling for his subjects. His work is evocative of pleasant memories and stimulating to fresh observation.

Chromosomenbau

Von Prof. Lothar Geitler. (Protoplasma-Monographien, Band 14.) Pp. vii+190. (Berlin: Gebrüder Borntraeger, 1938.) 15 gold marks.

THIS competent and up-to-date monograph on the morphology and behaviour of chromosomes provides an outline of the structure of the chromosome in plants and animals, based on recent work. After describing the external morphology of the chromosome the author discusses euchromatin and heterochromatin, the formation of spirals, chromomeres, the salivary gland chromosomes of Diptera, and the physico-chemical nature of chromatin. A comprehensive bibliography is given while the illustrations are excellent.

This well-illustrated monograph can be highly recommended. F. W. S.

Chemistry

Laboratory Technique in Organic Chemistry

By Prof. Avery Adrian Morton. (International Chemical Series.) Pp. x+261. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15s.

THERE are so many books on this subject that the publication of still another makes the reader wonder whether it should be a welcomed addition to those already in print or whether it should be regarded as redundant.

The answer in this case is clearly the former, because the book is not quite like anything that has appeared hitherto. Few books provide guidance in both the inorganic and the organic laboratories, and if one is asked is it altogether desirable that this should be so, the answer must be that circumstances alone can determine the needs of the moment. Certain it is that if one were to possess and to use all the knowledge in this book, he might be regarded as almost one of the universalists, the days of whom are said to have ceased with Odling. The changes which have taken place during the last forty years are really amazing, for if the number of types of apparatus required for research purposes at the present moment are compared with those needed in 1900, it is clear that in those days the manipulator had to rely mainly on his own skill in order to form the kinds of appliance he required. Now the manufacturers reproduce in a very short time any special form of apparatus details of which may have been provided by an investigator, and it is ready for use at comparatively small cost, by anyone who may wish to adopt it for some purpose of his own. The American practice of using the names of describers to denote any variations in types of apparatus is used freely in this book. It is an open question whether this is desirable or not, but in Great Britain it is generally regarded as invidious, because the work leading to the elaboration of any special type is so often the outcome of team work. Nevertheless, perhaps in several instances cited in this book the inventor's name should be associated with his creation. It will suffice to mention two cases of the kind which stand out from the others, namely, the amazing apparatus of Doran on page 92 and that of Quiggle, Fenske and Tongberg on page 54.

The book is a good one and is to be highly commended to those who want a general treatise on modern chemical technique and all that that implies. J. F. T.

Grundzüge der Theorie ungesättigter und aromatischer Verbindungen

Von Prof. Dr. Erich Hückel. Pp. 160. (Berlin: Verlag Chemie, G.m.b.H., 1938.) 6 gold marks.

THE appearance of pamphlets such as the one under review indicates, if any indication were needed, the necessity for students of chemistry and particularly of organic chemistry, of possessing a working knowledge of German. The Germans write these short monographs so well, and the German publishers seem to like publishing them, although the profit must be small. In Great Britain there is a need for similar publications, but their sale is restricted by the fact that senior students (third year) rely nowadays almost entirely on their lecture notes.

The monographs, therefore, find their greatest use among the lecturers themselves and among the research workers who happen either to be personally interested or among those who wish to be kept fully up to date in the advance of organic chemistry. In these directions the monographs do great good, and in the present example the subject dealt with is one which may be said to be in the forefront of organic chemical discussions at the present time.

The saturated carbon atom, that is to say, one which has all its combining capacity satisfied or practically satisfied, is of less interest that the unsaturated atom in which such combining capacity is not satisfied. The discovery of Thomsen that the double bond in ethylene did not represent two single bonds gave an impetus to research in unsaturated carbon compounds which has led to fruitful work during the twentieth century. The cause of the striking differences shown by unsaturated compounds and those belonging to the 'aromatic' series is still the question of hypothesis and awaits the advent of an all pervading theory. It is this field of organic chemistry that has been chosen to supply the substances used by Nature for the purposes of animal and vegetable metabolism, and there can be no question that the problem of the chemistry of the life processes will be found to be based on them.

A knowledge of German provides, therefore, the student with the key to a door through which he can find much knowledge of the kind contained in this book. He would be wise to acquire it J. F. T.

Handbook of Chemistry

A Reference Volume for all requiring Ready Access to Chemical and Physical Data used in Laboratory Work and Manufacturing Compiled and edited by Dr Norbert Adolph Lange, assisted by Gordon M Forker With an Appendix of Mathematical Tables and Formulas by Prof Richard Stevens Burington Second edition, revised and enlarged Pp xvi + 1501 + 249 (Appendix) + 30 (Index) (Sandusky, Ohio: Handbook Publishers, Inc, 1937) 6 dollars

FIRST published in 1934 (see NATURE, **135**, 978; 1935), this extremely useful handbook has now proceeded to a second and enlarged edition, containing nearly 1,800 pages of valuable and easily accessible information Many of the tables have been revised while, in addition, there are sixteen new ones, the majority of which deal with the refractive indexes of solids and liquids Another useful addition, and one which will prove of considerable aid in the identification of organic compounds, is the listing of the melting points of such compounds in order of ascending values There has also been introduced a section on the numbering of ring systems

Of the parts which have been revised or rewritten, mention may be made of the sections on first-aid, the nomenclature of organic compounds and, particularly, of that dealing with the use of organic reagents in inorganic analysis.

This handbook is handsomely bound and is excellently printed, the matter being clearly set forth without any appearance of overcrowding, there is also a very complete index Altogether the book will prove serviceable to every chemist and be the means of saving much time which would otherwise be spent in a tedious search of the literature

G R D

Engineering

Electrical Measurements

By Frank A. Laws (Electrical Engineering Texts) Second edition. Pp. xiv + 739 (New York and London. McGraw-Hill Book Co., Inc, 1938) 36s.

COLLEAGUES of the late Prof F A Laws have seen the manuscript of the second edition of this text through the press, and have made sure that it contains the latest references and information which it is thought desirable to place before such undergraduate students as are looking forward to a career in electrical engineering. It is also intended to be of use to practising engineers who desire to understand the basis of testing technique which is found in practical work.

There is a great deal which the normal student does not need, and guidance from experienced teachers is therefore essential. There are also more extended references to the relevant literature than is usual; although it would be the teacher's delight if students could be induced to read original literature, it must be confessed that they would not be able to discriminate between various types of work and extract basic principles, for that is all that they have time for, from modern work, which is complex and possesses refinements obscuring the main idea

The newer high-voltage cable tests are included, but there is little that can appeal directly to the electrical engineering student who intends taking up high-frequency communication work The involved shielding of modern high-impedance precision bridges might have been made clearer, with larger scale diagrams

Radio-Frequency Electrical Measurements.

A Guide for Radio Engineering Laboratory Instruction By Prof Hugh A Brown Second edition Pp xvi + 384 (New York and London McGraw-Hill Book Co, Inc, 1938.) 24s

THIS text is intended to be the basis of a fourth-year radio engineering course for telecommunication engineers, and assumes a normal knowledge of electrical engineering and physics It consists of a large number of approaches to specified measurements, in the new edition exact procedures are outlined for the more difficult types of measurement. The cathode ray tube, with linear time-base, is freely used, and measurements of modulation and the frequency drifts of quartz-crystals, when used with valves as frequency controls, are included The standardized methods of ordinary measurements on circuit elements are numerous, and students would require a plan in order to make a useful selection

The course seems more balanced than others recently published, none of the experiments being trivial and none beyond a post-graduate student or a development engineer The art and technique of radio is advancing rapidly, but its advancement depends mainly on precise measurement The present text offers good training in this field.

L. E. C. H.

Geography and Travel

Gales, Ice and Men:

a Biography of the Steam Barkentine *Bear* By Frank Wead Pp xiv + 240 + 13 plates (London. Methuen and Co, Ltd, 1938) 12s 6d net.

"GALES, Ice and Men" is the history of what may be the last of the ice ships, the *Bear*, which had a long and honourable career from 1874, when she was built, to 1935, when she was laid up, perhaps finally. She was Newfoundland sealer, rescue ship (Greely, 1884), U S Revenue Service, with all that that entails in the far north Pacific, U S. Coast Guard and finally, at the age of about sixty years, one of the ships of the Byrd Antarctic Expedition. The *Bear* was built at Dundee and almost certainly in the same yard as the *Discovery*, although Scott writes of "Stevens's" and Mr. Wead of "Alexander Stephen & Sons' The two vessels are about the same size but the *Bear* was a little narrower and had not *Discovery's* stern the former showed perhaps rather better behaviour in dirty weather

It is almost impossible to believe that there is no more scientific work for a ship built to withstand the ice, and it is therefore the more important that there should be preserved records, as minute as possible, dealing with the construction and performance of such vessels If thirty three years ago Scott could write that ' it is all passing away , there is much more reason for apprehension now Mr Wead has written a sound book in a perfectly straightforward manner and is to be complimented on avoiding the dramatic It is rather a pity that in the brief outline of Alaskan history he omits the name of the indomitable Baranov J E H

The Scenery of England and Wales

By Prof A E Trueman Pp 351 (London Victor Gollancz, Ltd , 1938) 7s 6d net

IN his opening sentence, the author points out that 'In England and Wales we are singularly placed to appreciate the relationship of scenery and structure, for few other parts of the earth's surface show in a similar small area so great a diversity of rock types and of landscape features In this attractive little book, addressed to walkers and motorists as well as to students, an easily intelligible and pleasantly written attempt to stimulate that appreciation has been made

Although, as a geologist, Prof Trueman sees scenery from an anatomical point of view, as the external expression of internal structure, he does not omit to mention the softening influences of "waters blown by changing winds to laughter , or to exemplify the harmonious effects of native stone on the domestic architecture of the unspoilt countryside Each chapter deals with one area or type of country, such as the Cotswold Stone Belt the Pennine Moorlands, the Lake District, South Devon and Cornwall, and they are so arranged that the more complex regions come last

The work concludes with A Chronology of the Changing Scene and a brief survey of the geological history of the varied landscapes and seascapes that have culminated in our present day geography In a future edition the very short appendix on maps and books might advantageously be amplified

Geology

Landslides and Related Phenomena

a Study of Mass Movements of Soil and Rock By C F Stewart Sharpe Pp iv + 137 + 9 plates (New York Columbia University Press , London Oxford University Press, 1938) 15s net

IN this excellent and well illustrated book the author covers the whole field of his subject by treating the phenomena, not as isolated processes, but as stages in two continuous series, "in each of which there is every transition from moving masses of dry rock and soil at one extreme to masses of rock and soil abundantly impregnated with water or ice at the opposite end of the sequence" The movements themselves are distinguished as flow (continuous deformation) and slip (mass movement along a plane separating the moving mass from the stable ground), and each type is further subdivided in terms of rate of movement The classification thus arrived at is by far the best yet proposed, and has the great advantage of clearly relating the co operating processes and resulting forms to those of the recognized geomorphic cycles

Though brief, the book has a well selected bibliography and is thoroughly comprehensive Despite its high price, it is an indispensable work of reference that no geologist can afford to ignore

Geologisches Worterbuch, Erklarung der geologischen Fachausdrücke

fur Geologen, Paläontologen, Mineralogen, Bergingenieure, Geographen Bodenkundler, Studierende und alle Freunde der Geologie Von Dr Carl Chr Beringer Pp vii + 126 (Stuttgart Ferdinand Enke 1937) 5 60 gold marks

IN this German handbook of geological terms the definitions, descriptions and explanations are given briefly and in simple language Where it has seemed desirable, illustrations are provided, and certain terms, such as *erzlagerstatten*, *faltungsphase*, *formationskunde*, *orogenese*, *schichtung*, are amplified by means of schemes of classification In German speaking countries, the book will be a useful guide to the hard words and forbidding technicalities of a subject which is much more attractive than its German nomenclature In English speaking countries, students of geology, geography and related subjects will find the book invaluable, whether they are learning to read scientific German or, at a higher level of ambition, attempting to cope with the growing flood of German contributions to geological literature Clear explanations will here be found of many words for which hitherto they may have searched in vain

Mathematics

The Principles of Mathematics

By Bertrand Russell Second edition Pp xxxix + 534 (London George Allen and Unwin, Ltd , 1937) 18s net

MANY thinkers have regretted Bertrand Russell's desertion of the arid beauties of mathematical logic for the alluring dangers of practical ethics and sociology This new edition of the "Principles of Mathematics" will be welcomed by them not only because it makes accessible to all a book which fetched eight guineas when a stray copy could still be found, but also for its preface which many might wish to consider as a 'return to mathematical logic' This preface of ten pages shows, in fact, that Russell has never lost his interest in the subject He tells us that he sees no reason as yet to modify his views on his fundamental thesis of the identity of mathematics and logic, and he supports his opinions by a short discussion of the main contentions of the formalist and of the intuitionist schools.

An interesting admission concerns the status of logical constants, which 'must be treated as part of the language, not as part of what the language speaks about" (p. xi). In this way, Russell believes, logic becomes much more linguistic than he believed it at the time when he first wrote his book. Another reflection concerns the theory of types, which the author still defends in its purpose to establish a set of rules for deciding whether a given series of words is or is not significant. Summing up his estimate of the progress of mathematical logic, Russell is of opinion that the result is an outlook which is less Platonic, or less realist in the medieval sense of the word. "How far it is possible to go in the direction of nominations remains, to my mind, an unsolved question, but one which, whether completely insoluble or not, can only be adequately investigated by means of mathematical logic" (p. xiv). We might point out, however, that this opinion looks rather like an encouragement to his followers, if we take into account two facts: the tendency of logicians to reduce this symbolical apparatus to a minimum, and to return more and more to linguistic explanations of their views; and the tendency of 'logical' mathematicians and of 'mathematical' logicians to consider mathematics and logic as two separate disciplines in spite of their common elements. T. G.

Trigonometry

By Prof. T. M. MacRobert and William Arthur. Part 2: Higher Trigonometry. Pp. ix+203–341+xi–xiii. 4s. 6d. Part 3: Advanced Trigonometry. Pp. viii+343–478+ix–xi. 4s. 6d. Part 4: Spherical Trigonometry. Pp. vii+479–542+ix–x. 3s. (London: Methuen and Co., Ltd., 1937–1938.)

THESE books are companion volumes to Part 1, published earlier and dealing with that portion of the subject usually read by first year students in the universities and by pupils of advanced courses in schools.

Part 2 is designed to provide an introduction to analytic trigonometry and to the theory of logarithmic and exponential functions. The authors have given very lucid discussions on complex numbers, Demoivre's theorem, expansion in infinite series and hyperbolic functions. In the final chapters, the methods of the calculus have been freely used.

Part 3 deals mainly with convergence. There are three chapters, the first of which gives an elementary account of convergence; then follows a chapter on uniform convergence, whilst the final section is concerned with infinite products and with functions of a complex variable. Some interesting applications of the theory of Dirichlet's integrals to trigonometrical series are also included. An appendix is added in which there is a discussion of the length of a circular arc.

Part 4 is devoted entirely to spherical trigonometry and consists only of one chapter. Proofs of all the standard formulæ connected with spherical triangles are given, and the authors have suggested what appears to be quite a good scheme for the systematic solution of spherical triangles.

In each part numerous sets of exercises are provided at the ends of the chapters for the student's practice and, where necessary, answers are given. The four parts together form a thoroughly sound and comprehensive course in trigonometry which should be very useful to students of mathematics.

F. G. W. B.

Medical Studies

A Pocket Medical Dictionary

Compiled by Lois Oakes, assisted by Dr. Thos. B. Davie. Third edition. Pp. xx+397. (Edinburgh: E. and S. Livingstone, 1938.) 3*s*. net.

THE first edition of this useful and handy little work appeared in 1933. It has now been brought up to date by the inclusion of a large number of new words and 120 fresh illustrations. A considerable amount of heterogeneous information has been appended, such as notes on infant feeding, poisons and their antidotes, methods for working out doses, eminent medical men and gas warfare protection.

Climate and Acclimatization

Some Notes and Observations. *By Sir Aldo Castellani.* Second edition. Pp. x+198+4 plates. (London: John Bale, Sons and Curnow, Ltd., 1938.) 10*s*. net.

THIS excellent little book, which is based on the eminent author's prolonged experience of residence in various tropical climates, will prove of value not only to medical practitioners but also to missionaries, nurses and others who propose to take up work in the tropics. The work contains four chapters devoted respectively to introductory remarks on climate, to which the author attributes more importance than some of his immediate predecessors, such as Manson and Gorgas; the effects of climate on various systems of the body; a description of atmospheric pressure, trade winds, sun rays, chemical rays and moon rays; and acclimatization, including an account of the sanitary condition and health of white troops during various tropical wars, and particularly the Italo-Ethiopian War, in which the author was director general of the medical services. A classified international bibliography is appended.

Meteorology

Hurricanes

their Nature and History—particularly those of the West Indies and the Southern Coasts of the United States. By Ivan Ray Tannehill. Pp. x+257. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1938.) 16*s*. net.

THE early part of the book under notice gives a description of hurricanes, the tropical cyclones of the West Indies and the southern coasts of the United States, followed by a discussion of their tracks, the variations of pressure, the distribution of rainfall, the destructive effects of the high winds, and a full description of some historic hurricanes.

Nearly every aspect of the subject is treated, and well treated, and not the least interesting part of the book is the discussion of the relation of their origin to the presence of fronts It provides a much needed account of a subject on which general agreement has not yet been reached

Synoptic and Aeronautical Meteorology

By Dr H R Byers Pp ix+279 (New York and London McGraw Hill Book Co, Inc, 1937) 21s

DR BYERS discusses the subject of meteorology, and in particular the methods now known as air mass analysis from the point of view of the practical forecaster and succeeds in producing a picture of modern meteorology which is at once interesting to read and easy to follow Mathematical methods are avoided, as are the more speculative parts of the subject Special consideration is given to the forecasting of precipitation, fog thunderstorms tornadoes and other aspects of weather, the maps and charts being drawn from American sources This is a useful addition to the library of all who are interested in weather

Miscellany

Scientific Illustration

By John L Ridgway Pp xiv+173+23 plates (Stanford University, Calif Stanford University Press, London Oxford University Press, 1938) 18s net

THE object of this book is to aid students and others engaged in the preparation of manuscripts requiring illustration, which includes the method of assembly and display of illustrations and diagrams designed for scientific publications, and the placing of the matter in a form convenient for reference It ranges over almost every kind of illustration likely to be required by a scientific writer, including such varied subjects as geological specimens and sections, maps, photographs, processes of reproduction suitable for illustrations in colours and half tone, the construction of block drawings, and much else Useful hints are given on retouching specimen photographs and on the grouping of figures so as to make the most effective display

Naturally such a number and variety of subjects cannot be dealt with in much detail, but numerous references, mostly American, are given for fuller information

The author is scientific illustrator and artist, Californian Institute of Technology and Carnegie Institution of Washington, and was formerly chief illustrator, United States Geological Survey The book is very well got up and printed Every illustration and figure, of which there are many, is beautifully clear and well reproduced, in part due to the excellent paper used Judging by the plates and figures drawn by the author himself, he must be a most accomplished artist. We can recommend this work to all interested in illustration It contains many useful practical tips, evidently the result, as one might expect, of considerable experience in this class of work H L C

Business Man's Guide to Management

By G E Milward (Sixth annual edition) Pp. xiv+114 (London Management Library, 1938) 5s

THE sixth annual edition of the "Business Man's Guide to Management" covers all books published up to the end of 1937 In addition to the classified lists of books, with brief descriptive notes on their contents, a subject index, a publisher index, an author index and suggested courses for reading, a numerical and page index is now included Reference to the main divisions—general management, accounting, production, distribution, company secretary, psychology, industrial economics, public administration, and individual trades—is facilitated by use of distinctive paper for each of these divisions The more outstanding books published in 1937 are listed separately in the preface, this enhances the value of this cumulative guide to an important and voluminous section of literature

The Microscope Theory and Practice

By Conrad Beck Pp 264 (London R and J Beck, Ltd, 1938) 7s 6d net

THIS is a new edition combining Mr Conrad Beck's two previous books on the microscope, one elementary, the other more advanced, with the addition of much new matter, but, by judicious elimination, without increase in size The information given is clear and lucid, and can be understood by anyone having but an elementary knowledge of optics and mathematics The beginner will appreciate the directions given for the care of lenses and instrument, and for illumination and technique, the important subject of dark ground illumination being dealt with at some length Chapter iii, on apperture and resolution, gives full details on these important subjects, without a knowledge of which the microscopist cannot hope to obtain the best results, or correctly to interpret his observations Other chapters deal with the photometry of the microscope, microscope stands and accessory apparatus, micro-projection, lens testing and polarized light as applied to the microscope

The volume is profusely illustrated and can be recommended as a relatively simple and yet a comprehensive and trustworthy text book on the microscope and its use as an instrument of research

Philosophy

Einfuhrung in die mathematische Logik · und in die Methodologie der Mathematik

Von Alfred Tarski Pp x+166 (Wien und Berlin Julius Springer, 1937) 7 50 gold marks

THIS is a very useful introduction to mathematical logic, which does full justice to its title, in so far as it really carries the reader into the principles of mathematics interpreted mainly in terms of logical notions Most elementary works on this subject make a mountain of a molehill by confining themselves to the exposition of its purely logical prolegomena and dismissing their application to mathematics with the excuse that they are too difficult for lay readers Dr Tarski rightly thinks otherwise After a restricted account of the leading doctrines of symbolic logic (pp 1–97), he gives a short exposition of the idea of number, of the simple arithmetical operations, followed by a short discussion of the methodology and the axiom system of arithmetic This is an illuminating and sufficient introduction to the analysis of the logical foundations of elementary arithmetic But once the purpose and technique of the method are thoroughly understood, it will be easier for the reader to tackle the more advanced works on the subject Dr Tarski helps him in this connexion by suggesting a number of easy examples after each chapter Controversial questions are carefully avoided, and the technical apparatus is reduced to a minimum, though one may have wished for practice sake more symbolic formulæ and proofs Yet as it is, Dr Tarski s book, with the authority of its author, who is a leading member of the Polish school of mathematical logicians, fulfils a real want and is well worthy of an English translation T G

Explanation and Reality in the Philosophy of Émile Meyerson

By Prof Thomas R Kelly Pp xii + 134 (Princeton, N J Princeton University Press, London Oxford University Press, 1937) 9s net

THE epistemological doctrines of Meyerson have gained a permanent place in contemporary philosophy The influence of this eminent thinker radiates beyond the wide circle of his disciples, and explains the importance of authoritative expositions of his doctrines, such as the one written by Prof Kelly The dramatic conflict between the way followed by explanation and the way followed by reality is the source of Meyerson s system If he began by stressing these differences, however, Meyerson was led, later, to submit that some kind of convergence and identity of structure is necessary in order that the intent of knowledge may be achieved Prof Kelly follows closely the development of these doctrines, and while taking a sympathetic view of them, he does not fail to point out their outstanding deficiencies This work can serve as an introduction not only to the philosophy of Meyerson, but also to the central problems to scientific thought

Examination of McTaggart's Philosophy

By Prof C D Broad Vol 2, Part 1 Pp lxxv + 514 Vol 2, Part 2 Pp 515–796 (Cambridge At the University Press, 1938) 45s net

WITH the publication of these two parts of his "Examination ', the detailed exposition and criticism of "The Nature of Existence" is brought to its completion with that touch of brilliant scholarship which characterizes the works of Prof Broad The profound meaning of McTaggart s philosophy is thus brought to light in a much larger work it could scarcely be otherwise, if a thorough discussion of all the details of that great system was contemplated In comparing "The Nature of Existence" with the "Examination", one cannot help feeling as much admiration for the analytical and critical effort of the second as for the powerful synthetic composition of the first Here we can feel two minds grappling together with the major problems of thought and existence which have been the concern of the great thinkers of all times It is then a kind of anti climax to see Prof Broad write at the end of his inquiry, that he was struck by the thinness" of McTaggart s philosophy, and that he asked himself whether all this speculative effort was worth doing at all But perhaps it is in the very imperfection of all human attempts to solve the riddle of existence and yet in their ineluctable urge of trying to do so, that the eminent critic as well as any modest reader may find a cause for wonder at the achievements of the human intellect

Physics

Electricity and Magnetism for Degree Students

By Sydney G Starling Sixth edition Pp vii + 630 (London, New York and Toronto Longmans, Green and Co, Ltd, 1937) 12s 6d net

THIS well known text book has been extensively revised, and reset in larger type The changes which have been made include the insertion of an account of the Hall and allied effects and the omission of the description of the magnetization of ships The sections on atomic phenomena have been extended considerably and now provide a good introduction to this relatively new work The book, which covers rather more than is needed for a pass degree in physics and provides a sound framework for an honours course remains probably the best treatise of its kind in English on experimental electricity

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Their Role in Physics and Chemistry By Dr E J B Willey Pp viii + 150 + 1 plate (London Edward Arnold and Co, 1937) 10s 6d net

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The subjects covered are diverse, and include the excitation of spectra, inelastic collisions at interfaces, resonance radiation and chemical reactions

The book is the work of an enthusiast, who has himself contributed to the development of the subject Prof Frank is given fitting prominence throughout, and his portrait is included We feel certain that Dr Willey's work will be found helpful by a large number of research workers, to whom primarily it is addressed E A MOELWYN-HUGHES.

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Infra-red and Raman Spectra of Crystalline Hydrochloric Acid

A KNOWLEDGE of the vibration rotation spectra of crystalline hydrochloric acid is of considerable importance in view of the theories of Pauling[1], Fowler[1], and others on rotation in the solid state Although several investigators have taken up this problem, the existing experimental data are confusing and even conflicting Thus Hettner[2] has reported that in infra red absorption a doublet band is found below the transition point (98° K) and a single absorption maximum above it On the other hand, Shearin[3] has reported the existence of thirteen discrete rotation lines at liquid air temperature (that is, around 85° K) and this result has recently been quoted[4] as indicating that rotation exists below the transition point It seemed possible that the discrepancy between those two results might be due to the fact that Shearin had the higher resolving power of a grating at his disposal We have just completed a very careful examination of the absorption near 3 7μ of thin layers of solid hydrochloric acid at the temperature of liquid air, using a grating spectrometer at least equal to that of Shearin s in resolving power

Our observations agree very closely with those of Hettner for this temperature We can find no trace of the individual lines in the positions indicated by Shearin, although there are signs of some further structure in the doublet In addition, we have examined the absorption of layers of solid DCl near 5μ at the same temperature Here we find not two peaks but three distinct maxima with indications of more structure The two extreme maxima appear to correspond to the maxima of the HCl doublet, since their frequencies give the same isotopic ratio As regards the appearance of the third maximum, we might remark that we have had indications of a similar additional peak in HCl when the gas has been condensed on to a surface at a temperature above that of liquid air and afterwards cooled to liquid air temperature The pure doublet is obtained when the hydrochloric acid is condensed immediately on a surface at liquid air temperature

VIBRATION SPECTRA OF CRYSTALLINE HYDROCHLORIC ACID

	Observers initials	Below transition point	At transition point	DCl
Infra red absorption	H	2708(s)2747(w)	2768	—
	L S & W	2704(s)2746(w)		1990(w) 1979(m) 1961(s)
Raman scattering	C & S		2763	
	L S & W	2709(s)2759(w)		

s = strong m = medium w = weak in intensity

The only observations on the Raman spectrum of solid hydrochloric acid are those of Callihan and Salant[5], who found a single broad line extending from 2,743 cm ^{1} to 2,784 cm $^{-1}$. The centre of this line is in good agreement with the centre of the single absorption peak found by Hettner above the transition point at 100° K Since the scattering experiments were done with the crystal only a few degrees below the melting point (presumably about 155° K) this seems quite satisfactory We have now succeeded in observing the Raman spectrum of hydrochloric acid at the temperature of liquid air. We find that it consists of two distinct lines, one of which, lying at 2,709 cm $^{-1}$, is much stronger and broader than the other at 2,759 cm ^{1} The uncertainty in the determination of the Raman frequencies is unlikely to be greater than 5 cm $^{-1}$, and of the infra red ones, 2 cm ^{1}, so there appears to be a small discrepancy between the value of the higher frequency according as it is observed in absorption or in scattering

A full account of these experiments, which are being continued at other temperatures and on methane and germane will appear later elsewhere

E LEE
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Aug 27

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[1] Pauling Phys Rev 48 430 (1930) Fowler R H Proc Roy Soc A 149 1 (1935)

[2] Hettner Z Phys 89 234 (1934)

[3] Shearin Phys Rev 48 299 (1935)

[4] Bartholomé Drikos and Eucken Z phys Chem B 39 371 (1938)

[5] Callihan and Salant J Chem Phys 2 317 (1934)

Predissociation Phenomena in Spectra of some Diatomic Molecules

IN emission at low pressure, the C band (0,0) of strontium hydride is cut off above $R(18) - 26{,}549$ cm $^{-1}$, the upper level of which (C, $v = 0$, J 19) lies 27,776 cm $^{-1}$ above the ground level N, $v = 0$ $J = 0$ In spite of this, Watson and co workers found no traces of the (1, 0) band in emission at low pressure, though the levels C, $v = 1$, J 1 to $J = 6$ lie only 27,620 to 27,770 cm $^{-1}$ above this ground level (cf More and Cornell[1], table 1) Thus the statement of More and Cornell (p 808) that the (1, 0) band lies far beyond the predissociation limit at $K' = 19$ in the (0, 0) band must be incorrect Consequently the predissociation occurs at an energy level at least $\sim$ 150 cm $^{-1}$ lower in C, $v = 1$ than in $v = 0$ Previously Herzberg[2] has found similar cases in the P_2 and N_2 molecules

Now it is very interesting that the C state of barium hydride behaves in quite an opposite way[3] Here in emission the (1, 1) band is clearly present, while only very faint traces can be recovered of the (0, 0) band Apparently we have to deal with two different cases of predissociation in the first case (P_2, N_2, CO, SrH) the cut off appears at lower energy and of course at lower J value, in a higher vibrational level than in a lower , in the second case (BaH), the cut off occurs at lower energy in a lower vibrational level than in a higher

According to Herzberg, the first case of predissociation here mentioned may be explained as an effect of potential barriers at large nuclear distances in the intersecting potential curve (Herzberg, case b) But if the crossing over" occurs above the predissociation limit (Herzberg case c), the transitions between the predissociated and intersecting potential curves take a greater role in the predissociation phenomena than in the first case mentioned According to the Frank Condon principle, the two cases of predissociation then may be explained as an effect of overlapping wave functions In $v = 0$ of the predissociated state, the wave function has one maximum between the turning points In the higher vibrational levels the maxima at the turning points are larger than those between the points Further, the difference $r_{\max} - r_{\min}$ between the turning points is larger at the same energy in a higher vibrational level with a lower J value, than in a lower vibrational level with higher J value If now the intersection takes place at the outer or inner part of the predissociated curve, then, as a result of both circumstances just mentioned, the $U(r) + T(r, J)$ curves belonging to low J values probably will be more influenced than those which belong to higher J values (first case) On the other hand, if the intersecting point lies near r_e and the intersecting curve is then mainly symmetrical between the inner and outer part of the predissociated curve, all the rotational levels in $v = 0$ may be more influenced by the intersecting curves than those of $v - 1$ (second case, BaH, cf Grundström, diss Fig 31)

Thus the position of the intersecting point in relation to the equilibrium distance r_e of the predissociated state seems to be significant for the predissociation phenomena

A fuller account will appear in the *Zeitschrift fur Physik*

BIRGER GRUNDSTRÖM

Department of Physics
University of Stockholm
July 30

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[1] More K R and Cornell S D *Phys Rev* **53** 806 (1938)

[2] Herzberg G *Ann Phys* **15** 677 (1932) Büttenbender G and Herzberg G *Ann Phys* **21** 577 (1934)

[3] Grundström B *Z Phys* **99** 595 (1936) Dissertation Stockholm 1936 Funk G W and Grundström B *Z Phys* **100** 293 (1936)

Atomic Lines in the Auroral Spectrum

IN a letter in NATURE of June 25 R Bernard has published results of auroral spectrograms obtained at the Tromsö Observatory In that connexion, I should like to direct attention to the fact that all the experimental results he derives from his spectrograms are well known and have been described by me and my collaborators

The presence in the auroral spectrum of bands of the ε system, discovered and interpreted by me as due to the forbidden transition $A(^3\Sigma) - X(^1\Sigma)$ of N_2, was found in 1933[1] About fifteen vibrational bands of the ε system (now commonly called Vegard Kaplan bands) including those mentioned by Bernard were observed by me in the auroral spectrum[2]

It is also well known that spectra of diffuse auroras and auroras at great altitudes[2] in many ways differ from those of the distinct forms at low altitudes They differ, for example, in the appearance of a large number of weak lines, many of which are not to be found on spectrograms from distinct forms at low altitudes (cf ref 1, Pl 1 Fig 2)

The line 3470 was obtained by me with a large quartz spectrograph and measured so long ago as 1922[4,5], and on a large number of spectrograms during the following years

From our spectrograms of fairly large dispersion we get the mean wave length 3469 4 In accordance with the observations of Bernard, we find that the intensity of the line 3470 relative to bands of the $2P$ G may differ considerably for different spectrograms (cf ref 5, Table XI and ref 1, Table X) We have regarded the line as the head of a band $2P$ G (3–4) (3469), while Bernard has referred it to the line 3470 recently observed by Kaplan[6] in a nitrogen discharge tube, thought to be due to the forbidden transition from the metastable (^2P) state to the normal (^4S)-state of the neutral nitrogen atom

Our interpretation is supported by the close agreement in wave length and by the fact that a number of other bands of the series $2P$ G (3–n) appears in the auroral spectrum The great variation in intensity relative to other bands of the $2P$ G, however, would be accounted for if we suppose that an atomic line (3470) with varying intensity also appears Also on my spectrograms (cf plates, refs 1 and 2) the line appears sharp, but for small photographic densities the head of a band may also appear quite distinct

Although the present observational data do not settle the question as to the appearance of the NI line, the interpretation suggested by Bernard is of particular interest in relation to certain results obtained by me and my collaborators

Already from the spectrograms obtained in 1922–24 we measured a number of weak lines which were referred to atoms of oxygen and nitrogen in the neutral or ionized state Until recently, these lines had only been measured from spectrograms with small dispersion, so the identification was uncertain During the last two years, with E Tönsberg I obtained two of these lines (4415 1 and 4368 2) with a spectrograph of large dispersion and was able to identify them as O lines Their intensity follows the sunspot frequency, which shows that the concentration of oxygen atoms fluctuates in a similar way to the solar activity

Since these results were obtained, I have made a careful study in order to see which atomic lines might possibly appear in the auroral spectrum

Up to the present I have found that about twenty auroral lines may be referred to atoms of oxygen and nitrogen in the neutral or ionized state Within the limit of error ten of these lines coincide with nebular lines

In addition to the well known green and red OI lines, we find that the following forbidden lines from the atomic ground states may probably be present in the auroral luminescence The OII doublet $(^2D^0_2 - {}^4S_{1,2})$ (λ 3728 6), the OIII lines $(^1S_0 - {}^1D_2)$ (4362) and $(^1D_2 - {}^3P_2)$ (5003), the NII lines $(^1S_0 - {}^1D_2)$ (5751), $(^1D_2 - {}^3P_1)$ (6526) and $(^1D_2 - {}^3P_2)$ (6543) and finally, the NI line $(^2P_{1,2} - {}^4S^0_2)$ (3469 4) as suggested by Bernard

These results indicate that nitrogen and oxygen atoms in different states of ionization are present in the auroral region and that the physical conditions in this region are such that lines corresponding to forbidden transitions from the metastable ground states of OI OII OIII *and* NI *and* NII *appear in the auroral spectrum*

In addition, some auroral lines are observed which correspond to transitions from higher levels of OI, OII NI and NII

L VEGARD

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Aug 25

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[1] Vegard L *Geof Publ* **10** No 4 (1933)

[2] Vegard L *Z Phys* **106** 108 131 (1937)

[3] Vegard L *Phil Mag* **46** 580 (1923)

[4] Vegard L *Phil Mag* **46** 193 (1923)

[5] Vegard L *Geof Publ* **9** No 11 (1932)

[6] Kaplan J NATURE **141** 1139 (1938)

Bode's Law and the Systems of the Planets and Satellites

IN my letter in NATURE of February 5 (**141**, **245**), I pointed out that a slight alteration in the usual form in which Bode's Law is stated leads to some interesting results in Saturn's satellite system As the amended method of stating the law assists in certain conjectures regarding the satellites of Jupiter also, it may be desirable to repeat a few points in my previous letter If we take the distance of Mercury from each planet in turn (not the distance of the sun, as is usually done), it will be found that these distances are approximately in geometrical progression The figures are as follows

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2 Astronomical units
Mercury and Venus	0 33	0 33
Earth	0 61	0 66
Mars	1 13	1 32
Asteroids	—	—
Jupiter	4 8	5 28
Saturn	9 21	10 56
Uranus	18 85	21 12
Neptune	29 74	42 24
Pluto	39 17	84 48

As is well known, Bode's Law breaks down in the case of Neptune and Pluto and the figures are not even approximate for these planets If the satellites of Saturn are dealt with in the same manner, taking the distance between Mimas and Enceladus as the unit, the actual and computed distances are as shown in the table below the geometrical ratio 2 being assumed

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2
Mimas and Enceladus	1 00	1
Tethys	2 13	2
Dione	3 74	4
Rhea	6 69	8
Titan	20 29	16
Hyperion	25 37	32
Iapetus	66 07	64
Missing satellite		128
Phœbe	250 00	256

There appears to be a large discrepancy in the cases of Titan and Hyperion, but it was pointed out in my previous letter that, as these satellites have fairly large eccentricities, there may be certain difficulties in measuring their distances from their primaries with great accuracy It was also suggested that there is a missing satellite between Iapetus and Phœbe

The Jovian system presents certain interesting features which can be dealt with on the same basis—taking the distance from the nearest satellite, V, to satellite I, as the unit The results are as shown below, the ninth satellite being omitted for reasons which will appear later

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2
V and I	1 00	1
II	2 03	2
„ III	3 69	4
IV	7 05	8
„ Missing satellite		16
VI	46 74	32
VII	47 93	64
VIII	96 71	128

There is a very definite gap between IV and VI and some months ago, while discussing the matter with my astronomical friends, I predicted that there was a missing satellite in this region It is possible that this prediction will be fulfilled if one of the two new satellites of Jupiter, recently discovered by Dr S B. Nicholson, is found to be between satellites IV and VI If its motion is direct, as it almost certainly would be in this region, I am of opinion that this completes the number of direct moving satellites of the Jovian system

The retrograde satellites have most probably had an origin different from that of the direct satellites If we consider the system of Uranus, it will be seen that the geometrical progression law is inapplicable, but there is a close approximation to the arithmetical progression rule Thus, if the distance between Ariel, the inner satellite, and Umbriel, the next in order of distance, be taken as the unit, the distances of Titania and Oberon from Ariel are approximately 3 and 5 units Presumably if another satellite of Uranus is ever discovered it will be 7 units from Ariel, or about 460,000 miles from its primary While this rule is purely empirical and only very approximate, it may, nevertheless be used as a criterion with regard to the retrograde satellites of Jupiter The distance between VIII and IX, the two retrograde satellites as known up to the present, is about 400,000 miles, and on the analogy of Uranus, the next retrograde satellite should be 800,000 miles from IX Hence, either satellites X or XI, newly discovered, should be at a mean distance from Jupiter of nearly 16 million miles How far the above figures will conform to those which will be computed when further observations have been made of the two new satellites remains to be seen If it is found that they both lie outside IX, there is still a missing satellite between IV and VI

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Sept 26

Composition of the Earth at a Depth of 500–700 km

Price and Lahiri[1] announce interesting results of their study of the electrical conductivity, κ, of the earth from terrestrial magnetic variations They confirm the finding of Chapman and Price that there is a considerable increase in κ with increasing depth beyond 150 km below the earth's surface, and further, express the view that the really important increase in κ occurs at a depth of about 700 km , and they accordingly suggest a change in the composition of the earth in the vicinity of this depth This result is specially interesting in view of recent progress in other branches of geophysics, and the purpose of this note is to direct attention to the extent of agreement indicated

Seismological evidence has of course for some time made it clear that the major discontinuity within the earth occurs at the boundary of the dense central core, 2,900 km below the surface But more recently the work of Byerly[2], Jeffreys and Bullen[3] and Lehmann[4] on seismic waves has indicated a further change in elastic properties at a much smaller depth On the assumption of a sudden change, Jeffreys[5] placed the corresponding depth at 474 ± 20 km If the change is gradual, it may well be incomplete until a depth approaching 700 km is reached The corresponding main alteration in electrical conductivity might, on account of the existence of impurities in this case, not occur until the change was nearly complete This would agree very well with the result of Price and Lahiri , in any event it is significant that terrestrial magnetism and seismology both indicate changes at several hundred kilometres below the earth's surface

Another interesting point is that the value 700 km gives the limit of the focal depth of any recorded earthquake As pointed out by Gutenberg and Richter[6], 'this result is all the more striking in view of the fact that some of the deepest shocks are among the largest recorded"

Further evidence arises from a study of the density variation within the earth I have shown[7] that unless there is a change of material at a depth of the order of several hundred kilometres, the deduced moment of inertia of the central core would involve a most improbable distribution of matter Jeffreys[5] put forward the suggestion that the corresponding density jump found by me might be associated with a high pressure modification of olivine Bernal[8], arguing by analogy from known properties of magnesium germanate, pointed out that such a modification might take the form of a complete change in the crystal type of olivine to a cubic form The results of Price and Lahiri indicate a change in the value of χ from about 10^{15} to at least 10^{11} electromagnetic units It does not seem unreasonable to suppose that this figure may fit the postulated cubic form of olivine at the temperature and pressure reached

It appears thus that a number of distinct lines of evidence are in good accord in suggesting a change in properties at a depth of order 500–700 km below the earth s surface

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July 22

Price and Lahiri *Proc Roy Soc* A **165** S 55 (1938)

[2] Byerly *Bull Seismol Soc Amer* **16** 209 (1926)

[3] Jeffreys and Bullen Nature **131** 97 (1933) *Bur Cent Séism Trav Scient* 11 (1935)

[4] Lehmann *Geod Inst Copenhagen* 5 (1934)

[5] Jeffreys *Mon Not Roy Astro Soc Geophys Suppl* **4** 57 (1937)

[6] Gutenberg and Richter *Bull Geol Soc Amer* **49** 285 (1937)

[7] Bullen *Mon Not Roy Astro Soc Geophys Suppl* **3** 395 (1936) *Trans Roy Soc N Z* **67** 121 (1937)

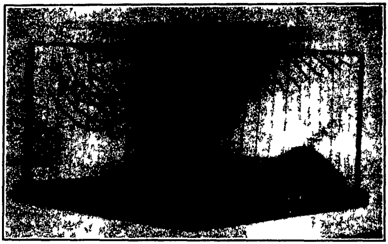
[8] Bernal *Observatory* **59** 268 (1936)

Transparent Models to Illustrate Geological Structures

Large transparent models to show the structures of particular areas have been used for some years So far as I am aware they are less common in Britain than on the Continent, for example, at Lille, large models of this type have been made to show the structure of French coalfields These models have been built up by drawing numerous accurate sections to scale each on a separate glass sheet and arranging these vertically at proper intervals

Such models are invaluable to indicate underground structures to those not familiar with geological maps and sections and they are also helpful as a check on suggested interpretations of complicated areas Recently similar but smaller models of much simpler construction have been made As they appear to be useful in the teaching of elementary geology and are quite inexpensive a description may be useful to others Similar models may also be employed for demonstrating other structural relations

The model illustrated consists of a glass box, 6 in × 7 in × 3½ in, formed by four glass sheets fastened with Seccotine and fitted into slots in a wooden base Over the top is a sheet of 'Cellophane' fastened along the edges by 'Durofix' This upper sheet on which the geological map may be drawn, is cut by thirteen narrow slits, each vertically above a V shaped groove in the wooden base Thirteen sheets of celluloid with successive sections across the structure represented are thus kept vertically in their positions and can readily be taken out to demonstrate the section along any line Viewed from the side a model of this size is sufficiently transparent for the whole structure to be seen in three dimensions, about a dozen sheets of celluloid seems to be the maximum number which can suitably be employed but this depends on the amount of detail to be shown



Transparent model to show pitching folds

A E Trueman

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Sept 8

Antiquity of the Modern Type of Man

Mr Marston s discovery of parts of a human skull deep in the gravel of the 100 ft terrace of the Lower Thames at Swanscombe is of great importance and significance Thanks to the careful and scientific manner in which this discovery was treated by him there can remain no doubt that these human bones were indeed *in situ* in the gravel and formed an integral part of it

The Swanscombe skull according to the expert anatomists who have studied it, would appear to be of the modern type, while on archæological and geological grounds, the specimen is to be referred to the Acheulean period Thus, it now seems established that as certain students of ancient humanity have held for many years the primitive Neanderthal Mousterian man was preceded in time by people closely akin in their bodily form to ourselves The discovery of the Swanscombe skull therefore once more opens up, and in a decisive manner, the question of the antiquity of the modern type of man Mr Marston s discovery is, however, not the only example of human bones of this general type claimed to have been found in Acheulean and earlier deposits But it has been the custom to regard it as necessary that any human bones claimed as of great antiquity must, in order to be accepted, and in addition to the geological data supporting this claim, exhibit definite primitive and simian characteristics

The reason for this would appear to be the belief that man is evolved from an anthropoid stock and, in consequence, any really ancient human bones would show evidence of this ancestry Various fossil remains of man do, of course, exhibit such characteristics, but there are others which do not, and the question arises as to whether *Homo sapiens* has evolved to his present state via the anthropoids Upon this important matter I am not entitled to express an opinion, but from my archæological researches, I am compelled to believe that intelligent beings—shall we call them—were in existence certainly a long way back in Pliocene time, and probably in that of the Upper Miocene

As things stand at present, however, I am confronted by the anatomists who tell me that no known anthropoid ape was sufficiently evolved at such epochs to make it possible for any flint flaking being to have been in existence, and the *impasse* is complete I have therefore read with great interest a remarkable article by Prof H H Woollard, F R S, in the current number of *Science Progress* In this article, Prof Woollard suggests that man arose from the primitive primate stem in very remote times, and long prior to the branching off of the anthropoids He states "If man has avoided many of the anthropoid specialisations it is logical to expect that he might retain many of the early primitive characters which the great apes have modified or lost" He then, having enumerated the various anatomical features which modern man possesses and shown that these are derived from the pre anthropoid primate stem, continues 'Those who have these characters could not be derived from those who have lost them A recrudescence of them by a subsequent mutation seems incredible

Now it seems to me that these are very formidable arguments, not lightly to be put aside, and I should much like to know what other anatomists have got to say about them If they are correct, then the great antiquity of the modern type of man and of intelligent beings capable of implement making becomes increasingly probable

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Sept 18

Prof. Buckland and Oxford

The verses which follow are printed by permission of Sir Edmund Phipps, K C B, who found them among the papers of his great grandfather William Foskett of Bath (1763–1843), who was accustomed to preserve current songs, verses and anecdotes, communicated to him in various handwritings

William Buckland (1784–1856) was one of the founders of scientific geology He began to lecture at Oxford in 1813, and a special readership in geology was founded for him in 1819 He was elected fellow of the Royal Society in 1818, president of the Geological Society of London in 1824 and 1840, president of the British Association at Oxford in 1832, and Dean of Westminster in 1845 His best known work, "Reliquiae Diluvianae", was published in 1823; his Bridgewater Treatise on "Geology and Mineralogy" in 1836

John L. Myres

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An Intended Epitaph on P[rofessor] Buckland at Oxford

Mourn, Ammonites, mourn, o'er his funeral urn,
Whose neck ye must grace no more
Gniss, Granite, and Slate, he settled your date
And his, ye must now deplore

Weep, caverns, weep, with filtering drip,
Your recesses he'll cease to explore,
For mineral veins and organic remains
No stratum again will he bore

Oh, his wit shone like chrystal ! his knowledge pro
From Granite and Gravel descended, [found
No trap could deceive him, no slip c^{d} confound
Nor specimen true or pretended —
He knew the birth place of each pebble so round
And how far its tour had extended —

Though eloquence roll'd, like the deluge retiring
In which many carcases floated,
To a subject obscure he gave charms so inspiring
Young and old on geology doted
He stood like an out lier his hearers admiring
In pencil each anecdote noted

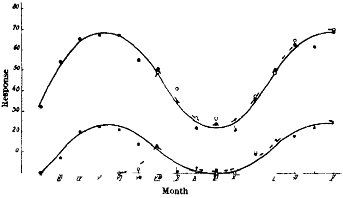
Where shall we our great Professor *inter*
That in peace may rest his bones ?
If we hew him a rocky sepulchre
He'll rise to break the stones
And examine each stratum that lies around,
For he s quite in his element under ground —

If with mattock and spade his body we lay
In the common alluvial soil
He ll start and snatch those tools away
Of his own geological toil
In a stratum so young the Professor disclaims
That imbedded sh^{d} lie his organic remains

Then exposed to the drip of some case hardening
His carcase let Stalactite cover, [spring
And to Oxford the petrified Sage let us bring
When he is incrusted all over
There with mammoths and crocodiles high on a shelf
Let him stand as a monument raised to *himself*

Annual Cycle of Responsivity of Castrated Albino Mice to Œstrone Injection

Laqueur, at the sixteenth International Congress of Physiologists held at Zurich in August last reported that the response given by capons to a given dose of androgen varies according to the time of year being lowest in winter and highest in summer An analogous rhythm in the responsivity of castrated albino mice to monthly injections of 1 I U of œstrone has been found to exist the response being more than three times as great in May as in November The upper full line curve in the accompanying figure represents the response given according to the State Hygiene Institute's method of evaluating vaginal smear tests in a group of 60 mice In this method (not yet published), points are awarded to each smear (cornified epithelial cells only 5, sporadic nucleated cells 4, cornified and nucleated cells in approximately equal number 3, sporadic cornified cells 2, nucleated cells only 1, and absence of epithelial cells 0 points), maximum response in a group of 20 mice is thus 100 points The lower curve represents the percentage of mice developing full oestrus after each injection A second group of mice was castrated in May 1937 and injections were commenced in June It will be seen (broken line curves) that the responsiveness attains that of the former group (castrated in January 1937) in August, and that the curves thereafter closely follow the earlier ones



Certain important conclusions may be drawn from our results First, it may be said that the results of work on the oestrogen content of biological material and based on vaginal smear methods not involving comparison with standard preparations, are highly inaccurate Secondly, the existence of an extraneous factor modifying responsivity to oestrogens is indicated Thirdly, should a similar rhythm exist in the human, the desirability arises of varying the dosage of oestrogens in replacement therapy, according to the season Finally, in animals exhibiting seasonal sexual activity, variations in this activity may be due not necessarily to increased hormone production, but also to increase in responsivity

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Decarboxylation of Aspartic and Glutamic Acids

ACCORDING to our earlier reports[1], the legume bacteria split off quantitatively one of the carboxyl groups from *l* aspartic acid forming β alanine,

$$HO_2C\,CH_2\,CH(NH_2)\,CO_2H \rightarrow HO_2C\,CH_2\,CH_2NH_2 + CO_2$$

The reaction was at first accomplished only with living bacteria We have now succeeded in observing it also *in the presence of toluene* with the same bacteria The bacterial suspension, which had been kept 24 hours under toluene, split off carbon dioxide forming β alanine in an aspartic acid solution (pH 7) in the presence of toluene

In addition to aspartic acid, the legume bacteria split off the carboxyl group also from the *l* glutamic acid forming γ amino butyric acid,

$$HO_2C\,CH_2\,CH_2\,CH(NH_2)\,CO_2H \rightarrow HO_2C\,CH_2\,CH_2\,CH_2NH_2 + CO_2$$

This compound has been isolated as the gold salt The reaction is quantitative like that with aspartic acid The pH optimum is likewise the same (pH 7) The rate of the decomposition of glutamic acid is somewhat higher than that of aspartic acid Legume bacteria do not decarboxylate any other amino acids except aspartic and glutamic acids Thus it may be assumed that the same enzyme is acting in the decarboxylation of both these amino acids Since, however, Okunuki[2] has recently succeeded in decarboxylating glutamic acid with plant material, for example, dried beet powder, while aspartic acid does not react at all, it is likely that the legume bacteria contain two different amino acid decarboxylases, one decarboxylating glutamic acid (glutamic decarboxylase) and the other aspartic acid (aspartic decarboxylase)

As shown earlier by us[1,3], the coli bacteria split off the carboxyl group from lysine forming cadaverine almost quantitatively We suggest the name lysine decarboxylase for this enzyme

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P RINTALA
T LAINE

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Aug 31

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[1] Virtanen and Laine *Suomen Kemistilehti* B **10** 2 (1937) *Enzymologia* **3** 266 (1937)

[2] Okunuki *Bot Mag* (*Tokyo*) **51** 270 (1937)

[3] Virtanen and Laine *Suomen Kemistilehti* B **9** 17 (1936)

Segmental Interchange Lines in *Pisum sativum*

IN a former communication[1], a list was given of seven lines of *Pisum sativum* with different arrangements of their chromosome segments Four new types (structural types 8–11) have since been tested The chromosome relationships now recognized are summarized in the following table

			Chromosomes interchanged
Structural type	1	The normal or standard type (1 2 3 4 5 6, 7)	—
	2	Hammarlund's *K* lin	1 and 2
	3	The Thibet interchanged lin	1 and 3
	4	Extra Rapid	3 and 5
	5	An interchanged type from Miss de Winton's material	4 and 5
	6	An interchanged type from Prof Winge	1 and 4
	7	The doubly interchanged type from Structural type 2 × Str type 3	2 with 1 and 3
	8	*M*₁ a new type originating at Merton	3 and 4
	9	E Gt R, a new type originating at Merton in Early Giant Rogue stock	1 and 2
	10	The *G* line from Dr E Nilsson	6 and 7
	11	The *F* line from Dr E Nilsson	5 and 6

These interchanges have all been found in untreated material Each of the seven chromosomes has been found to be involved in one or more interchanges

The crosses structural type 1 × structural type 2, structural type 1 × structural type 9 and structural type 2 × structural type 9 all have a ring of four chromosomes at meiosis It is therefore clear that, although the chromosomes concerned in the two interchange types 2 and 9 are the same, a different combination of segments is involved Moreover, since neither of these lines has a dicentric (double attachment) chromosome, the break must have taken place on different sides of the centromere, in one and one only, of the chromosomes concerned in the two interchanges

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Sept 7

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[1] Sansome E Nature 139 113 (1937)

Dosage and Response in Vitamin E Treatment

For the last two years in this laboratory we have been working to establish the relationship between dosage and response to vitamin E treatment Some discussion of the experimental conditions that we consider necessary for this work has already been published[1, 2] We have now completed a detailed account, which we hope to publish elsewhere, of the construction of a response curve, this is of the sigmoid type, owing to the quantal nature of the response in question

With the kind collaboration of Dr J O Irwin, it has been possible to calculate the equation to the regression line that relates the probits of the responses to the logarithm of the doses Between 200 and 250 animals were used in the construction of this curve, and the error of the mean fertility dose calculated from this curve was found to be, for $P - 0\ 99$, 71 141 per cent and for $P \quad 0\ 95$, 77–129 per cent Naturally, in individual tests where 10, or at most 20, animals are used, the error will be very much higher In one instance examined, where 10 animals formed the test group the limits of error were for $P \quad 0\ 99$, 48–209 per cent

In spite of the large inherent error, which appears to be unavoidable in this type of test, it is thought that the relationship established between dosage and response may be of use to others besides ourselves It makes possible calculation of the mean fertility dose of a source of vitamin E when the percentage fertility from a known dose has been established, the nearer the found fertility is to 50 per cent fertility the greater will be the accuracy of the value assigned to the mean fertility dose

We find that, if D_M and D_T are the mean fertility and the test doses respectively and if y_T is the probit of the percentage fertility found, then

$$\log D_M \quad \log D_T \quad 0\ 35y_T + 1\ 74$$

A L Bacharach

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Sept 23

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[1] Bacharach, A L Allchorne E and Glynn H F *Biochem J* 31 2287 (1937)

[2] Bacharach A L and Allchorne E *Biochem J* 32 1298 (1938)

Points from Foregoing Letters

Further observations on the flow of liquid helium II are reported by Dr J F Allen and A D Misener showing that the velocity increases very rapidly between 2 177° and 1 15° K, and becomes independent of pressure as the area of the capillary is reduced In no case was a purely linear flow observed, and the correction due to surface flow was found to be small

Dr D H Menzel states that the usual assumption that an appreciable intensity of the forbidden spectrum lines only occurs at high electron density is not valid From mathematical considerations he deduces that the opposite is the case, and considers that the predominance of the forbidden lines in nebular spectra is attributable not to the effect of collisions in de exciting an atom before it has a chance to radiate, but to the weakness of the permitted lines

The absorption spectra at liquid air temperatures, of a thin layer of solid hydrochloric acid in the infra red region near 3 7μ and of the heavy variety, DCl, near 5μ, have been determined by E Lee, Dr G B B M Sutherland and C K Wu The authors find that the Raman spectrum of hydrochloric acid at the same temperature consists of two lines at 2,709 and 2,759 cm^{1}

The difference in the band spectrum of barium hydride, as compared with strontium hydride and other diatomic molecules, is discussed by Dr B Grundström, who points out that two different types of predissociation are involved

Following upon R Bernard s referring the auroral line 3470 to a forbidden transition of the neutral nitrogen atom, Prof L Vegard, after a further study of the auroral spectra, considers that a number of other lines may be due to nitrogen and oxygen atoms in different states of ionization in the auroral region

By applying to Jupiter s satellites the slightly modified Bode s law which was found to fit roughly in the case of those of Saturn J Miller infers that there is a missing satellite (after satellite No 4) and suggests that one of the two bodies recently discovered by Dr S B Nicholson may possibly fill that gap

Dr K E Bullen directs attention to the lines of evidence from different branches of geophysics, which all suggest that a change in the properties of the earth occurs at a depth of order 500–700 km below the surface

In view of the discovery of the Swanscombe skull, of Acheulean period but having characteristics of modern man, J Reid Moir inquires whether it is not justifiable to assume, as Prof Woollard does that man was derived from an earlier stock, prior to the branching off of the anthropoids

A seasonal rhythm in the response of castrated albino mice to injections of œstrone similar to that reported in the case of the action of androgen upon capons, is described by Dr J Duszyńska The response is greater in spring than in autumn, being more than three times as great in May as in November This variation affects the conclusions arrived at from biological assays by the vaginal smear methods unless carried out in comparison with standard preparations

A L Bacharach has studied the relationship of response to dosage of vitamin E An equation is given showing the relation between the response to an experimental dose and the dose that will give 50 per cent fertility in a group of animals

Research Items

Iron Age Poland

FOR four years, excavation has been proceeding on a six acre iron age village site at Biskupin in the northern part of Great Poland under the Poznan University Archæological Expedition This is a prehistoric stronghold which was built on a peninsula jutting into the lake of Biskupin on the surface of a former peat bog, in the Early Iron Age between 700 B C and 400 B C An account of the results is given by Prof J Kostrewski in *Antiquity* of September During the Bronze and Early Iron Ages a great part of Poland, as well as eastern Germany, was inhabited by an agricultural people known as the Urnfield people of Lusatian type, who are considered by nearly all Polish prehistorians to be ancient Slavonic Under pressure from a people probably of Baltic stock, they took refuge in forts of wood and earth in inaccessible spots, a number of which have been identified Nothing but the necessity of defence could have induced the inhabitants of Biskupin to occupy so unhealthy and unsuitable a site for building The peninsula, surrounded on three sides by the lake and cut off on the land side by marshy ground, was in addition strongly fortified by a wooden rampart filled with beaten earth carried round the whole site This rampart was built three times each time nearer the centre of the peninsula The rebuilding was evidently due to a rising in the water level The area was occupied by a populous settlement, composed of 80–100 huts, built on layers of birch fascines resting on the surface of the peat bog The ground plan was laid out in a masterly fashion, which would do credit to a modern town planner So far, eight perfectly parallel roads or lanes have been laid bare, in which rows of wooden huts stand side by side even touching The lanes are corduroy of oak logs The huts, about ten yards square, contain two rooms The floors are of beams covered with clay, and stone hearths were also covered with clay The antiquities recovered afford evidence of the continuity of Lusatian and later Slav culture

Artificial Incubation of Game Birds

THE demand for game birds in the United States has led to the development by private and commercial breeders of methods of producing game by incubator brooder methods Artificial incubation has given rise to many difficulties, and in an effort to solve these, Cornell University Agricultural Experiment Station has conducted, under the direction of Alexis L Romanoff, a series of experiments over a period of five years The results of the first two years work dealing with temperature and humidity requirements of pheasant and quail eggs were published some time ago, and now the results of the final three years appears from the Station as *Bull* 687 (March 1938) It concerns the effect of air movement and the role of the interrelation of temperature, air movement and humidity, in the incubation of pheasant and quail eggs Although each species has its own needs there is a definite relationship between these three factors, so that a proper adjustment of temperature and humidity must be made according to the rate of air movement Such adjustment permits the more extensive use of agitated air type incubators for greater efficiency in hatching Pheasants eggs incubated for the first 20 days in such an incubator may thereafter be hatched most successfully in a still air incubator under proper conditions But quail s eggs may be incubated and hatched most successfully in an agitated air incubator provided that with increase in air movement there is a corresponding increase in both temperature and relative humidity

An Indian Mosquito destroying Fish

THERE has been some doubt about the value of *Panchax panchax* as a mosquito destroyer, since F Sen found from an examination of the food under natural conditions that the fish showed no selective food habit It appeared to swallow any small moving object, animal or vegetable, which came within its range of vision , and the result was that only about 10 per cent of the fish examined contained mosquito larvæ Dr S L Hora and K K Nair point out however, that the waters in which the fish lives are as a rule free from mosquito larvæ, and therefore offer no assistance in deciding its mosquito control value They have therefore tested this value by two sets of experiments by introducing the fish into pits in which mosquito larvæ were living and observing their food from day to day, and by providing the fish with a mixed food supply in laboratory tanks and studying the food consumed, at intervals of 30 minutes (*Proc Nat Inst Sci India*, 4, 245 1938) In the first case, the observations showed that *Panchax* preferred mosquito larvæ, and only when they were absent or scarce did it turn to other insects, mostly ants Normally vegetation does not form any part of the regular diet In the second experiment, the fish also seemed to select the mosquito larvæ from amongst a miscellaneous diet But these experiments show the same fallacy as Sen's did , until we know the relative proportions of different sorts of food in the pools and tanks *before the experiment has begun*, we cannot decide from food eaten whether there has been selectivity or simply non selective swallowing of the food present

Boron Treatment of *Citrus*

DEFICIENCY of boron has been shown to be the cause of a widespread disease of *Citrus* trees in Southern Rhodesia The disease, known as hard fruit , is associated with spotting of the leaves, thick fruit rind, low juice content, absence of seeds, gumming and discoloration A A Morris (*J Pom and Hort Sci* , 16, 167 , 1938), analysing 21 random leaf samples, has shown that varying boron status is correlated with varying severity of 'hard fruit' incidence Applications of powdered borax to the soil at rates of 100–500 gm per tree resulted in rapid increases in the boron content of the leaves, and boron accumulated in the leaves with increasing age Leaves and fruit from 'hard fruit' trees were found to be low in boron With the possible exception of nitrogen, it was shown that the intake of the more common nutrient elements by the young citrus fruit does not appear to be influenced by boron treatment On the other hand, sugars and pectins were lower in boron deficient fruits than in fruits from trees under relatively low boron treatment High boron treatment, however, seems to retard rather than assist the translocation of sugars to the fruit A comparison of treated and control trees shows that severe losses of fruit are occasioned by deficiency of boron, not only during the growing season but also afterwards in the pack house In a particular area the number of fruits from treated trees was 10 411, whereas the controls yielded only 4 627 The disease, which occurs in areas where the soil is very shallow and subject to marked erosion, is now being controlled on a commercial scale by the application of borax

Gas Possibilities in New York State

THE discovery in 1930 of the Wayne Dundee gas field in Steuben, Yates and Schuyler Counties New York, and the more recent discovery of large quantities of gas in the Oriskany sandstone at Greenwood Steuben County, have awakened widespread interest in the search for other similarly favourable structures in the neighbourhood In 1934 and 1935, an allocation of funds was made by the United States Public Works Administration to enable a survey to be made, and since that date the United States Geological Survey has financed exploratory work W H Bradley organized the survey, and he has since, with the help of J F Pepper, recorded the results obtained in a detailed bulletin (*U S Geol Surv* 899 A) The area covered by the report includes more than 3,000 square miles of Steuben and Yates Counties south west New York, and parts of the six adjacent counties The main purpose of the survey was to determine the regional structure with the view of correlating it with sub surface structure How far this purpose was achieved is clearly revealed in the map showing areal distribution of key horizons and geological structure contours published with the report Ten domes which warranted test drilling have been mapped Moreover, during the course of construction of the map at least three potentially productive synclines were discovered It is, in fact possible from a study of this report to gain a clear indication of oil and gas possibilities throughout the area, and to supplement this by reference to the records of wells in the Oriskany sandstone and in the Wayne Dundee gas field included in the text

Energy Balance Sheet of the Gas Engine

UNDER this title a series of articles was contributed to *Engineering* by Dr F W Lanchester and these have now been reprinted in pamphlet form The author has preferred to use the term gas engine' rather than the more cumbersome internal combustion engine' for, whether the fuel be liquid or gaseous, the engine is a gas engine An especial value s attached to this very practical exposition of the author's method of accounting for the heat available and its disposition, as it represents the fruit of many years of study of the problems involved In discussing the debit side of the account, he claims that he lower calorific value of the fuel should be taken and also that a further initial deduction is due on account of the energy radiated by the flaming mixture to the cylinder walls As the engine is only capable of dealing with heat, this radiant energy, which never appears as heat and is shown to be about 7 per cent of the total heat of combustion, should be initially excluded Emphasis is laid on the advantages of conformal plotting on logarithmic paper By this method, when absolute pressure and volume are plotted, any expression of the form pv^{γ} = constant is represented by a straight line the slope of which is γ so that for example the diagram of the Carnot cycle for a perfect gas becomes a parallelogram easily plotted and readily interpreted Another simplification is introduced by expressing the relation of energy to temperature in terms of degrees of heat The basis of the analysis is that the heat apparent and the heat latent are separately accounted The former is the heat appearing in the indicator diagram, the latter is estimated from the difference deg H – deg T at the extreme peak of the diagram, and their sum is assumed, provisionally, to constitute the total heat supplied The jacket loss is reckoned as that taking place prior to the instant of exhaust release, and the exhaust energy is calculated as that existing at that instant Using deg H as a basis the energy balance sheet is drawn up the estimated jacket energy being divided between flame radiation and convection loss Referring to his method of dealing with inherent change of volume Dr Lanchester points out that when applied to engines using liquid fuel it properly points to an expansion and an increase of efficiency

Origin of Satellites

IN his paper entitled On the Origin of Binary Stars Dr R A Lyttleton considered the rotational instability of a single body, and showed that fission takes the form of the radial ejection of a portion of the mass, the two bodies having sufficient energy to escape from each other The principle is applied to a discussion of the satellites of the solar system (the origin of which has always been difficult to explain) in a recent paper (*Mon Not Roy Astro Soc*, 98, 8, June 1938) A brief mathematical investigation shows that the terrestrial planets and the satellites assuming the temperature of the material ejected by the sun to be about 10^6 10^7 degrees C, could not have condensed, as the material would have dissipated into space He conjectures that Jupiter and Saturn are the masses resulting from the catastrophic disruption of a single primitive planet, and as a filament of material would stream out between the components, the end portions would be captured and give rise to satellites The other portions of the material would be able to escape from both bodies and would give rise to the terrestrial planets When fission took place in the primitive planet, the layer of cleavage must have been as deep as the outer part of the heavy core of the planet and this affords an opportunity for the small planets to have a difference of composition and density from those possessed by larger planets The earth and moon came out of the catastrophe as separate bodies, and although our satellite may have been close to the earth, it never came within the Roche limit, for which reason the initial rotation period of the system could never have been less than 7 2 hours Dealing with Uranus and Neptune, Dr Lyttleton shows that if the fission which produced Jupiter and Saturn occurred at the distance of Uranus, escape from the system would occur The absence of companion planets to Uranus and Neptune is, therefore, explicable on account of their great distances from the sun, and, in addition, it is suggested that these two planets represent the more massive portions of their respective primaries.

International Federation for Documentation

Conference at Oxford and London

'Documenter c est reunir classer et distribuer des documents de tout genre dans tous les domaines de l'activité humaine"

THE fourteenth International Conference for Documentation, which has just been held at Lady Margaret Hall, Oxford, and the Science Museum, London, under the patronage of the British Government and the presidency of Sir William Bragg, has provided a demonstration of the increasing realization of the fundamental importance of documentation in intellectual and material progress The three hundred and fifty members of the Conference included delegates of thirty Governments and a hundred and fifty leading scientific and learned societies, research institutions, and international associations The growing interest in the work of the Federation was reflected in the aggregate of 106 papers communicated, an increase of 150 per cent on the number presented to the Jubilee Conference of the Federation at Copenhagen three years ago Above all, the spirit of international collaboration which inspires the Federation, made itself felt, not only in the study of the means of co operation in the task of making more fully available the records of human progress, but also in a remarkable feeling of international friendship and good will, which has pervaded the atmosphere of the Conference throughout its proceedings

The Conference has demonstrated, in no uncertain manner, the intense desire of thinking men and women all over the world to collaborate in the solution of international problems, including among them the co ordination of documentary work, as one of the most powerful means of promoting the happiness and material progress of mankind

As Lord Stanhope remarked, in proposing the toast of the International Federation for Documentation at the Government banquet, "that is not knowledge, which we do not know where to find" Buried in books, journals, monographs, reports, patent specifications and archives, to which continual additions are being made, lie masses of invaluable data and records of advances in every field of knowledge These facts lie hidden and inaccessible for want of a comprehensive index whereby to make them available as the basis of further progress In the absence of such an index, incalculable time, money and labour are being wasted every day in the repetition of investigations already completed To prevent this unnecessary delay, effort and expense is the object of the International Federation for Documentation, which seeks to unite all those engaged in the collection, classification and distribution of information, as well as everyone seriously concerned with the progress of knowledge, in the study and solution of this economic problem The importance of such work was pointed out by Sir William Bragg in his presidential address on "The Historical Papers of the Royal Institution"

The subjects discussed in papers by leading authorities from all countries might be said to cover almost the whole field of documentation The sessions were devoted to symposia on such subjects as the making of abstracts from periodical literature, applications of indexing systems, the practical application and use of bibliographies, the teaching of documentation, theories of cataloguing and classification, the organization of information services, and tools for library co operation

Two sessions, allotted to the discussion of photographic and other technical methods in their application to bibliographical problems, and apparatus for photographic reproduction of documents, were particularly valuable, as providing the most fully representative descriptions of the latest apparatus and authoritative opinion of all countries The exhibition arranged in the Science Museum, through the kindness of Colonel E F B Mackintosh, illustrating the most up to date apparatus, material and methods available for the purpose, is now open to the public and should certainly be visited

In accordance with a suggestion made at the World Congress on Documentation, held in Paris last year, that, in the past, the Federation had concentrated too exclusively on the scientific field, a special attempt was made at this Conference to include authoritative reports on the present state of bibliographical work in such fields of learning as archæology, archive work, economics, finance, history, law and painting This led to one of the most important sessions of the Conference Another session was devoted to a paper by Prof A F C Pollard, president of the British National Section of the Federation, on the mobilization of knowledge and the Permanent World Encyclopædia" of Mr H G Wells Assuming that the need for such an encyclopædia has been demonstrated conclusively, Prof Pollard gave an able survey of the reasons that have prevented the realization of this undertaking in the past, and indicated the mechanism by which these difficulties may surely and efficiently be overcome This is a paper the value of which is likely to be more greatly appreciated with lapse of time Mr H G Wells, who was present at this sitting, made a stimulating contribution to the discussion

The address of the president of the International Federation, Dr Alingh Prins, on problems of international documentation, was given during the week end, when the members of the Association of Special Libraries and Information Bureaux also were present for their annual conference and the full attendance was reached As a clear, comprehensive and concise synopsis of the problems involved, and the simple and completely effective methods available for their solution, this paper was certainly one of the most important contributions to the Conference Also during the joint sessions with ASLIB, Mr E Lancaster Jones read a useful paper on the evaluation of scientific and technical periodicals This included suggestions of methods utilizable by libraries in choosing periodicals to take.

From the above, it will be seen that the *Transactions* of the fourteenth Conference of the International Federation for Documentation contain perhaps the most comprehensive collection of original authoritative papers within its field, and should be studied by everyone who has at heart the mobilization of recorded information. The first issue has already been sold out. But, by the time these notes are in print, a new issue will be available at the moderate price of £1 net for the three volumes. These will be obtainable directly from the International Federation for Documentation, Willem Witzenplein 6, The Hague, or from its British National Section, British Society for International Bibliography, at the Science Library, Science Museum, South Kensington, S.W.7.

Those who are seriously interested in the task of making recorded information more fully available should put themselves in touch with Miss M. Gosset, the honorary secretary of the British Section at the above address.

Sir William Bragg's presidential address, as well as Dr. Alingh Prins' lecture as president of the Federation, together with the discussions of the papers will be printed in the *Communicationes* published quarterly by the Federation.

Space will not permit to describe the Government banquet in the beautiful Hall of Christchurch presided over by Lord Stanhope, the reception by the Vice-Chancellor in the Ashmolean Museum, the hospitality of the Mayor in the Town Hall, the garden party given by Dr. and Mrs. Priestley at their beautiful manor house at March Baldon, the interesting visit to Messrs. Morris Motors Ltd., the tea provided by Messrs. Kodak Ltd., and the various other visits and excursions which did so much to create the prevailing atmosphere of friendship and provided those opportunities of social contact that constituted such a valuable part of the proceedings of the Conference.

S. C. BRADFORD

Association of Special Libraries and Information Bureaux

Annual Conference

THE fifteenth annual conference of the Association of Special Libraries and Information Bureaux, held at Lady Margaret Hall, Oxford, on September 23–26, was somewhat overshadowed by the anxiety of the political situation, and also by the Conference of the International Federation for Documentation, which held its fourteenth annual conference simultaneously. If the joint sessions with the latter Federation unfortunately suffered from the depressing effect of an excessive number of papers which characterized the sessions of the International Federation, the remaining meetings at the ASLIB Conference had their characteristic spontaneity, and the discussion on the work of the Association at the annual meeting in particular indicated a lively interest on the part of members in its continued progress.

The president-elect, Sir William Beveridge, was unfortunately prevented by illness from giving his address on "The Use of Books in Social Science". Mr. E. W. Wignall's paper on "Museums and Research: Some Facilities in London", gave an indication of the extent to which museum officers carry out research, not only for their own departments but also for Government departments, universities and scientific institutions of different kinds all over the world. Facilities for workers not on the staff of a museum are often limited by the space available or the demands made on the time of the museum staff, and Mr. Wignall urged that in any new museum it is of the utmost importance that adequate study rooms should be provided. He also stressed the question of acknowledgment, very considerable help being sometimes given to a student which receives no acknowledgment in his subsequent papers. A brief subject list of museums in London was included in the paper.

At the annual general meeting of the Association, the honorary treasurer, Mr. A. F. Ridley, submitted accounts showing a slight balance of income over expenditure as compared with the deficit of the previous year. Although the membership of the Association has also increased from 308 to 325, the report of the Council once more emphasizes the necessity for a much larger membership if the Association is to fulfil the functions which belong to it. The report also refers to the increased circulation of the ASLIB Book List and to the issue in May of a second edition of the Select List of Standard British Scientific and Technical Books. Increasing use is being made of the inquiry bureau and the panel of expert translators has been reorganized, a new register having been established under new regulations. Eighty-six members have now been enrolled under the modified scheme.

In the absence of Sir William Beveridge, Mr. B. M. Headicar presided over the evening session on September 24, when Mr. Frederick Brown, lecturer in statistics at the London School of Economics, read a paper on "The Compilation of Statistics by Trade Associations", in which his felicity and liveliness of exposition drew the warm appreciation of a large audience. Mr. Brown referred to the difficulty of generalizing about the statistics compiled or issued by trade associations owing to the wide variations in practice both in compilation and in objective or use. Terminology is also important, as frequently trade statistics cannot be interpreted without knowledge of special terms used or of the way in which they are compiled. Among the services which trade associations can render to their members in this way is the reproduction of market prices of special interest to them in the calculation of special index numbers.

While most trade associations base their statistical work on data collected and compiled outside, some few associations are breaking fresh ground, and Mr. Brown emphasized the opportunities which await trade associations in the field of statistical research, in such matters as the compilation of figures of consumption and production by members, stocks and plant capacity and operating or production costs. In this connexion Mr. Brown pointed out that if such work is to have any value, membership of the association must be representative of the trade or industry as a whole, or comprise such a majority of the trade that firms who are not members are too insignificant to affect the returns

Such statistical research could take two main forms that of the descriptive study as seen in the survey of milk consumption in England and Wales undertaken by the Milk Board or of the investigation type as in the survey of nutrition effects of milk also undertaken by the Milk Board , or the investigation into the causes of the marked fluctuations in retail trade about Easter and Whitsuntide undertaken by the retail distributors associations Mr Brown pleaded for greater participation in such research by the universities and for greater readiness to place statistical information at the disposal of the community for the advancement of knowledge He referred to examples of co operation in this respect between the Retail Distributors Association the Bank of England and the London School of Economics, which while securing a check on possibilities of error and safeguarding the disclosure of individual sources of information, has made the collective returns accessible for research or public purposes

At the final session on Sunday evening Mr Max Nicholson, secretary of Political and Economic Planning (PEP), gave an interesting account of how material for the PEP Press Report was compiled, which is of some interest to scientific workers as an example of the possibilities of the group method of inquiry and research into subjects in which very little published information is available, and especially in making available neglected experience and buried sources of information Mr Nicholson also stressed the value of PEP anonymity

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Society of Chemical Industry

Autumn Meeting

THE autumn meeting of the Society of Chemical Industry held in Glasgow on September 16–20 was notable for a symposium of papers on the trend of progress The opening paper presented for the Food Group by Dr L H Lampitt, referred to the part played by chemists in the effort of nations to secure self sufficiency and particularly to the issues involved in the storage and preservation of food Dr Lampitt asserted that although internationalism in the scientific world is less pronounced we are heading towards international agreement in certain aspects of dietetics as well as towards increased Government control of the efforts of chemists in the field of food science

On behalf of the Road and Buildings Materials Group two papers were presented In the first of these, Mr R Fitzmaurice discussed the question how far standardization and how far freedom of design are to predominate in the building industry Referring to the accumulation of the scientific knowledge necessary to replace tradition, Mr Fitzmaurice indicated some of the possibilities which standardization offers, given close co operation between the architect and engineer as in the 'Mapin' system of instruction He referred also to the question of building regulations and the obstacles they sometimes present to progress whether in the introduction of new materials or new methods Mr Fitzmaurice referred also to the large number of British standard specifications now in existence for building materials Many of these should provide a valuable safeguard for the purchaser in respect of particular properties of materials which constitute a source of difficulty in practice, but many architects appear to be unaware of their existence This position, however, may slowly change through the use of these specifications in official specifications for Government or local authorities works

The second paper, by Mr J O Willis, dealing with road design, urged a trunk road policy in the construction of which full advantage could be taken of modern practice of alignment, and all interruption of the main streams of traffic obviated by overbridges and properly laid out junctions He stressed the importance of standards of riding quality and the improvement of surface quality particularly of the need for the introduction of new methods of laying bituminous roads Resistance to skidding is of vital importance, and Mr Willis considers that asphalt surfacings finished with precoated chippings, are only a palliative The ideal he suggested is a fine textured bituminous carpet impervious to water and presenting a uniform texture throughout its life In the light of work in Great Britain and in Holland rubber might play an important part in solving the problem

The paper presented by Dr V E Yarsley on behalf of the Plastics Group referred to the fact that, in the plastics industry, only rarely has one material dominated another This position is likely to continue, although with the balance of power inclining in favour of the thermoplastics group The current trend is towards improved tensile properties and greater stability to heat, making possible the use of higher temperatures and the production of larger moulded units In the field of cellulose plastics, the development of quick growing celluloses which can be produced within Great Britain or the Empire is an obvious gain in a national emergency Cellulose triacetate is now a commercial possibility, and ethyl cellulose is promising for coating and impregnating compositions The attention now being devoted to the production of shock resisting phenolic plastics should ultimately provide an entirely new field for exploitation, while extended phenols should also do much to emphasize the possibilities of plastics as "the fourth material of construction" Amino plastics are also promising for transparent plastics, and other possibilities lie in laminated plastics and for creaseless fabrics The increased use of plastics for the production of high-duty wheels, gears and bearings, and also for airscrews, struts and construction parts in aircraft is only one of the developments to be expected

In the final paper of the symposium, Prof W M Cumming and Mr F Rumford reviewed tendencies in chemical engineering both in regard to materials and to unit operations In regard to the former they referred to the development of new alloys but stressed the importance of scientific comparison and selection They referred also to the use of special steels for high temperature and high pressure reactions in view of the importance of creep at elevated temperatures as well as to the efforts being made to replace nickel at least in part by other metals in a number of special cast irons, and to the attention devoted to the technique of welding and the interest in organic materials such as rubber Similarly, the authors briefly reviewed developments in heat transfer, filtration, size reduction, distillation, including the use of a true counter current system throughout the column, evaporation, drying, dust removal and other unit operations while in conclusion the question of education was discussed and the importance of avoiding uniformity of training was stressed

Appropriately enough, a paper by Dr R Gilmour at a joint meeting with the Institution of Chemical Engineers on "Chemical Engineering in the Fermentation and Distilling Industries" had much to say about the place of art and science in the distillation of whisky, including the effect of air, water, malt and peat on the production of a high class whisky

Diffraction and Refraction of Radio Waves

THE increasing application to various radio purposes of ultra short electric waves of less than 10 m in wave length has given a new stimulus to the problem of calculating the field strength at distances from the transmitter such that the ionosphere is of negligible influence The solution of the problem of the diffraction of electric waves around the earth was first given on a sound basis by G N Watson in 1918, but this analysis involved assumptions which, while perfectly valid for the long and medium waves then in use for radio communication, are not justifiable for the ultra short waves now being considered For example, at long wave lengths, the conductivity of the earth may be assumed to be infinitely great for analytical purposes, but as the wave-length is reduced through and below 10 m, the actual value of the conductivity and also the dielectric constant of the soil over which the waves are propagated has an important influence on the field strength at a distance from the source Furthermore, the height of the receiver above the earth's surface may no longer be assumed to be a negligibly small fraction of a wave length, when the latter is only a metre or two

In a recent paper published by T L Eckersley and G Millington (*Phil Trans Roy Soc*, A, **237**, 273–309; 1938), a phase integral method has been applied to the problem of obtaining a formula for calculating the electric field at a distance from a wireless transmitter This method agrees with Watson's theory in the case already considered by him, but it has the advantage that it more readily permits of extension to the case of finite earth conductivity and of an elevated transmitter and receiver The authors claim that the phase integral method has a certain generality in exhibiting the solution as one of a general class appropriate to problems of this kind, this feature encourages the hope that other problems of the type may be solved by similar methods The application of this analysis to the wave propagation problem has also afforded a solution to the case not considered in the original problem, but of considerable practical importance, where there is a gradient of refractive index in the atmosphere above the earth

The paper to which reference is made above presents the detailed analysis involved in this work in a form which exhibits clearly the physical nature of the problem Formulæ are derived from which the field strength may be obtained for any wave length, distance from the transmitter and conductivity of the ground over which the waves travel Furthermore, the increase of field as the receiving post is raised above the earth's surface is obtained, and by using the reciprocal theorem, the analysis applies as well to the case when the receiver is on the ground and the transmitter is elevated By combining both cases the effect of having both the transmitter and receiver can be calculated

A very satisfactory feature of this investigation, which will be much appreciated by those engaged in practical radio communication, is that the various formulæ have already been reduced to the computation of numerical values A paper by T L Eckersley (*J Inst Elec Eng*, **80**, 286–304, 1937) gave a complete set of field strength/distance curves for wave lengths between 2 and 10 m and for conductivities corresponding to land and sea Other curves provide the relationship between field strength and height, while a simple means of extending the curves to take account of refraction through the atmosphere is explained for application when the vertical gradient of refractive index of the air is known or can be estimated While these theoretical results await adequate experimental confirmation, they are already of considerable value as a general guide to the radio engineer, and in this case the graphs referred to above were utilized by the recent International Telecommunications Conference in Cairo in considering a preliminary allocation of bands of ultra short waves to various classes of radio communication

R L S R

University Events

GLASGOW —On September 29, the Gardiner Institute in Medicine, attached to the Western Infirmary, Glasgow, was opened by Lady Gardiner The Institute is under the direction of the regius professor of medicine in the University, and will be devoted to clinical research At the opening ceremony, Prof T R Elliott delivered an address in which he stressed the great advantage to be derived from the establishment of such an institute, and emphasized the necessity of a closer co operation between the science and practice of medicine

The following appointments have recently been made in the University Dr O Löwenstein to be lecturer in zoology in succession to Dr H B Cott, newly appointed lecturer in vertebrate zoology, Cambridge, Mr Vernon D van Someren to be temporary assistant in zoology in succession to Dr Margaret W Jepps, who has been awarded a Leverhulme fellowship for one year

Science News a Century Ago

The Zoological Society

AT a meeting of the Zoological Society on October 9, 1838 Richard Owen began the reading of a paper on the osteology of the Marsupialia He remarked upon the great value of an acquaintance with the structure of the skeleton in determining the genera and species of this group of animals and proposed a new genus *Thylacomys*, for certain species presenting a peculiar conformation of the cranium In treating the maxillary bones, Owen said that he was induced to enter more largely into details, from the great interest attached to the fossil jaw found in the oolitic strata at Stonesfield and the doubts which had lately been expressed by M de Blainville as to its true mammiferous character The author had examined four specimens of which one was in the museum at York, another was in the collection of Mr Broderip and the other two were in the possession of Dr Buckland The double fangs to the molar teeth, and the ramus of the jaw being formed of a single bone he thought sufficiently attested the mammiferous nature of these remains , while minor anatomical characters led him to regard them as belonging to a marsupial genus

Meteorological Science in Germany

WRITING from Carlsruhe a correspondent of the *Athenæum* said The attention of scientific men is just now directed to a curious discovery of Professor Stiefel—well known throughout Germany for his researches in Natural Science—the result of which has been the attainment of a more accurate knowledge of those changes to which the atmosphere is subjected than was possible by the old methods The instruments hitherto in use have been the thermometer and the barometer, but an unerring standard has been considered a desideratum that is said to have been at last supplied in the shape of geranium fruit, the awns of which are *in* and *e*volved by the dryness or humidity of the atmosphere in obedience to laws so regular and unvarying, that being fixed upon a dial plate properly graduated, the change from one part of a room to another may be noted with the greatest accuracy A paper on the subject was to be read at the meeting of German naturalists, held this year at Freyburg Professor Stiefel is the greatest weather doctor in southern Germany, and has for many years tabulated all changes in the atmosphere, according to a plan suggested by Goethe, but he does not venture to predict for more than twenty four hours at a time and laughs at our weather prophets (*Athenæum*, Oct 13, 1838)

New Botanic Gardens in Regent's Park

"THE interior portion of the Regent's park, ' said the *Mechanic's Magazine* of October 13, 1838, 'will shortly be laid out as botanical gardens, the Commissioner of Woods and Forests having granted a lease to a society newly formed under the title of the Royal Botanic Society of London, at the head of which is the Duke of Richmond as president The object of this society is the formation of an extensive botanic garden, with a library, museum, and conservatories, so that medical and scientific as well as merely ornamental botany will respectively receive the attention commensurate with their importance '

Societies and Academies

Paris

Academy of Sciences (*C R*, 207 353–384 August 8 1938)

K **KITAGAWA** Dispersion of a turbulent current of air and the flow of subterranean waters

G **BERTRAND** Principle of a method for obtaining rapidly a relative value of *g*

G **WATAGHIN** Indeterminism in the space of moments and the origin of explosion showers

MME G CHAUVENET State of surface and oxidizability of cobalt A fresh surface at high temperature is very vulnerable , gradually it becomes covered at lower temperatures with a thin film of unknown nature

Y **DOUCET** Electrolytic dissociation of cadmium iodide

D **BODROUX** and A **CHATENET** Paracyclohexylphenoxyacetic acid and some of its derivatives

M **MOUSSERON** and R **GRANGER** Some active cyclohexane compounds

C **KILIAN** and X **LANGLOIS** Discovery of fresh water mussels of middle carboniferous age near the watering place Nord de Chelemma, in the northern Touareg Tebou region of the French Sahara

E **DE CHETELAT** Extension of the Gothlandian in French Guinea

R **GUIZONNIER** Study of the diurnal component of the terrestrial electric field

P L **MERCANTON** The new Kreis Wanner seism graph of the Swiss seismological service

H **PARENT** An important bed of Bathonian ammonites in the north of the Departement of Var

G **BOURGUIGNON** and **MLLE** R **DEJEAN** 'Tim characteristic of excitability of the vestibular system by mono auricular excitation, in various disturbances of central origin

L **LAPICQUE** Observations on the preceding communication

F **HOLWECK** Measurement of the elementary dimensions of viruses by the method of statistical ultra micrometry The virus is diluted until a critical concentration, which ceases to be constantly infective, is reached and the amount of X ray irradiation required to match this effect is determined

A **BESREDKA** Test of local cutaneous bacteri therapy

Geneva

Physical and Natural History (July 7)

E A H **FRIEDHEIM** Relation between chemical constitution and trypanocidal effect of 4 (4 arson anilino) 1, 2 naphthoquinone 8 sulphonic acid Th naphthoquinone group is essential for therapeuti action The presence of free hydroxyl in position 2 is important, but not essential Sulphonation at position 8 gives a more active product than sulphonation at 7 or 6 The anilino arsonic residue at position 4 of the acid is essential

L W **COLLET** Discovery of a fragment of th San Colombano nappe under the miocene of Saint Florent (Corsica) and its consequences The Sa Colombano nappe, which is the highest in Corsica would appear to extend into the upper tecton element of the island with rock of a deeper facies It is equivalent to the Ligurie nappe of the Apennines

A **LOMBARD** and W **SCHROEDER** . New observations on the miocene of Saint Florent (Corsica) Th fauna and lithological composition of the calcareous miocene forming the beach of Saint-Florent are described The uniformity of composition of the fauna suggests stratigraphic unity, disturbed at times by submarine currents

Moscow

Academy of Sciences (*C R*, 19, No 5, 1938)

I M **Vinogradow** Some new estimations of the analytical theory of numbers

J **Lieberman** Some characteristic properties of convex bodies

D **Koliankowsky** A theorem of O Schmidt

M **Rebuton** A theorem on the complexes

S **Rossinski** Deformation of a rectilineal congruence with preservation of the distributive surfaces

S **Michlin** The extension of singular integration to the space α_2

I **Natanson** Some theorems on singular integrals

L **Pontryagin** A classification of continuous transformations of a complex into a sphere (2)

A **Donoff** Pressures dependent upon vortex formation caused by a sudden increase in the density of the stream

V **Boolinsky** Conical motion of an ideal gas in the case of a sudden increase in its density (Boosemann's problem)

P A **Walther** and W A **Stefanowski** Influence of the number of scoops in an axial pump on its work

A **Alichanian**, A **Alichanov** and B **Dželepov** Form of the β spectrum of radium E in the vicinity of the upper limit, and the mass of the neutrino

A **Alichanian** and S **Nikitin** Form of the β spectrum of thorium C in the vicinity of the limit, and the mass of the neutrino

A **Alichanian**, B **Dželepov** and P **Spivak** The angles between the components of a pair

J **Dorfman** and S **Sidorov** State of the nickel atom in the gamma phase of the Ni Zn system

B **Kolomiez** The new 'positive' barrier plane photo electric effect and the new barrier plane photo cell

V **Fabrikant** Excitation of metastable atoms in a gas discharge (2) Excitation of radiating atoms in a gas discharge

V **Fabrikant** and G **Rokhlin** Effect of magnetic field upon mercury discharge radiation

E **Kondorsky** The magnetic anisotropy of ferromagnetic crystals (3) Reversible susceptibility of iron crystals in various crystallographic directions

N **Wassmuth**, V **Werzner**, S **Tibilov** and S **Freivert** Observation on the varying intensity of the green ray in the luminosity of the night sky

J **Olenov** and I **Kharmac** Dynamics of the genic composition in a wild *Drosophila melanogaster* population

G **Zabluda** Beheading of sunflower as a means of increasing the yield of its vegetative mass

N **Gortikova** Effect of preliminary treatment with coloured light on the development of pea nut (*Arachis hypogaea* L)

R **Hecker** · New data on *Rhipidocystis* Jkl (order Digitata, class Carpoidea) and on a new genus *Bockia* (sub-class Eocrinoidea, class Crinoidea) from the Ordovician of Leningrad province, U S.S R, and from Estonia.

R **Hecker**: A new member of the class Ophiocistia Sollas (*Volchovia* n g) from the Ordovician of the Leningrad province, and changes in the diagnosis of this class

S **Semichatova** Contribution to the problem of evolution of Carboniferous (Baskirian) *Choristites*

(*C R*, 19 No 6–7)

S **Rossinski** Deformation of rectilineal congruences with preservation of their distributive surfaces

W **Dubrovski** A generalization of W Feller's theory of a pure discontinuous process

B **Lewitan** Mean values of measurable functions

B **Fessenkoff** Role of the Milky Way matter in the phenomenon of the zodiacal light

I **Tcharnyi** Calculation of chambers used for reducing pressure oscillations in the case of unsteady flow in pipes

I **Koukles** On the centres and the foci

F S **Baryšanskaja** Study of fluorescence in a layer of thickness comparable to the length of the wave (2) Polarization of the fluorescence

I I **Zelmanov** Some peculiarities observed in the liquefaction of helium

B **Klarfeld** Influence of the Ramsauer effect on the potential gradient in a positive column

I **Tamm** The penetrating cosmic ray particle, and nuclear forces

V **Veksler** and N **Dobrotin** Heavy electrons in cosmic rays

D I **Mirlis** Kinetics of wetting and selective linear corrosion of metals in polyphase systems metal liquid liquid and metal liquid gas (5)

V **Čelinzev** Structure of associated molecules of organic acids on the basis of Raman spectra

P **Petrenko Kiritschenko** and J **Ekster** The law of periodicity

K **Topchiev** Mechanism of the formation of γ acetopropyl alcohol during hydrogenation hydration of α methyl furane and consecutive hydrogenation of the double bonds in α methyl furane

G V **Gorškov**, N M **Ljatkovskaja**, A G **Grammakov** and V S **Žadin** Neutrons of rocks.

V P **Baturin** Fluorite in the Kungurian limestones and dolomites of the Ural Emba region

S I **Yarjemsky** The rate of soil tillage

G **Markov** Survival of the tapeworm plerocercoids (*Diphyllobothrium latum* L) in artificial media

V I **Kudryavtzev** Experimental change in the physiological properties of yeast

V S **Lukjanova** Velocity of movement of certain plankton and its dependence upon external conditions

S **Muraveisky** and I **Chertok** Carotinoids in lacustrine silts

G D **Pratassenja** Studies on polyploid plants Parallel variation

G D **Pratassenja** and E M **Trubitzina** Production of polyploid plants A triploid in *Prunus persica*

M R **Cheulishvili** Short tailedness (brachyury) in Georgian dogs and its inheritance

V A **Novikov** Endemic conditions of growth of *Gossypium Kirkii* Mart

N S **Petinov** and G A **Zak** Effect of hardening upon structure of the plant

G M **Ivanov** After effect strain and the limit of plastic flow of wood

A A **Woitkewitch** Role of thyroid hormone in formation of feathers in fowls and pigeons

N N **Sinakevitch** Bits of liver and lung restored to life under the skin of an axolotl.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, October 10

University College London at 5—Dr Phyllis Tookey Kerridge The Physiology of Hearing and Speech (succeeding lectures on October 17 24 and 31) *

Warburg Institute (at the Royal Society Burlington House W 1) at 5 30 Prof V Gordon Childe India and the West before Darius *

Royal Veterinary College London at 5 30 Prof T W M Cameron Principles of Parasite Control (succeeding lectures on October 11 and 13) *

Tuesday October 11

Royal Society of Medicine (Section of Therapeutics and Pharmacology) at 5—Sir Frederick Banting F R S The Immunity Aspect of the Tumour Problem (W E Dixon Memorial Lecture)

Institution of Electronics (at King s College Strand London W C 2) at 7 30 Dr J A Darbyshire Applications of X Ray Diffraction and Electron Diffraction Methods to Industrial Research *

Thursday October 13

Institute of Fuel (at the Institution of Mechanical Engineers Storey s Gate London S W 1) at 2 30 Lieut Colonel J H M Greenly Presidential Address At 3 Prof R W Wheeler Destructive Distillation (Melchett Lecture)

University College London at 5—Dr R J Lythgoe The Physiology of Vision (succeeding lectures on October 18 20 25 and 27) *

Friday October 14

School Nature Study Union (in the Conference Hall County Hall Westminster Bridge London) at 6—Autumn Meeting

Sommerville Hastings The Plants of Rocks and Mountains *

North East Coast Institution of Engineers and Shipbuilders at 6 Annual General Meeting

Major T Russell Cairns Presidential Address

Cinematograph Films Modern Steelcraft

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Junior Scientific Officers at the Ditton Laboratory Maidstone and the Low Temperature Research Station Cambridge—The Establishment Officer, D S I R 16 Old Queen Street Westminster S W 1 (Quote ref J 38/12 October 12)

Chemists and **Assistant Chemists** (grades II and III) under the War Department Chemist Woolwich—The Under Secretary of State (C 5), War Office Whitehall London S W 1 (Quote appts /101 October 22)

Head of the Junior Technical School of the Royal Technical College Salford—The Director of Education Education Office Salford 3

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Mazoe Citrus Experimental Station Report for the Year ending 31 December 1936 (British South Africa Company, Publication No 6) Pp xiii+210 (London and Salisbury S Rhodesia British South Africa Co Mazoe S Rhodesia Mazoe Citrus Estate) [209

City of Birmingham Annual Report of the Mental Hospitals Committee April 1st 1937, to March 31st 1938 Pp ii+35 (Birmingham Birmingham Mental Hospital) [269

The Vitamin Requirements of Pigs with Special Reference to Vitamin A and to certain Components of the Vitamin B Complex By A S Foot, J Golding and S K Kon with the collaboration of J Campion, K M Henry and S L Huthnance (N I R D Publication No 462.) Pp 68+10 plates (Shinfield Reading National Institute for Research in Dairying) 1*s* 6*d* [269

Proceedings of the Royal Irish Academy Vol 44 Section B No 11 Salmon of the River Shannon By Arthur E J Went Pp 261 322 (Dublin Hodges Figgis and Co, Ltd London Williams and Norgate Ltd) 5*s* [269

Hannah Dairy Research Institute Annual Report for the Year ending 31st March 1938 Pp 28+4 plates (Kirkhill Hannah Dairy Research Institute) [269

Other Countries

Conseil Permanent International pour l Exploration de la Mer Rapports et procès verbaux des réunions Vol 107 1ère partie Procès verbaux (Mai 1937) Pp 62 3 00 kr Vol 107, 2ème partie Rapport administratif (1937 1938) Pp 88 3 00 kr Vol 107 3èm partie Appendices (1937 1938) Pp 79 3 00 kr (Copenhague Andr Fred Høst et fils) [199

Gold Coast Colony Report on the Gold Coast Colony for the Year April 1937 to March 1938 Pp 17 (Accra Government Printing Department London Crown Agents for the Colonies) 1*s* [199

Ceylon Part 4 Education Science and Art (F) Administration Report of the Acting Director of the Colombo Museum for 1937 By P E P Deraniyagala Pp F 32 (Colombo Government Record Office) 35 cents [199

Palæontologia Sinica New Series D No 3 (Whole Series No [illegible] The Ramification of the Middle Meningeal Artery in Fossil Hominid and its Bearing upon Phylogenetic Problems By Franz Weidenreich Pp 16+6 plates (Peiping National Geological Survey of China) [199

University of Illinois Engineering Experiment Station Circular No 32 Two Investigations on Transit Instruments By Prof W H Rogers Pp 17 25 cents Circular No 33 Papers presented at the Twenty fifth Annual Conference on Highway Engineering held at the University of Illinois March 2 4 1938 Pp 162 50 cents Circular No 35 Factors Involved in Plate Efficiencies for Fractionating Columns By Prof Donald B Keyes Pp 14 20 cents Bulletin No 303 Solutions for Certain Rectangular Slabs continuous over Flexible Supports A Report of an Investigation conducted by the Engineering Experiment Station University of Illinois in coöperation with the U S Bureau of Public Roads and the Illinois Division of Highways By Prof Vernon P Jensen Pp 98 1 dollar Bulletin No 304 A Distribution Procedure for the Analysis of Slabs continuous over Flexible Beams A Report of an Investigation conducted by the Engineering Experiment Station University of Illinois in coöperation with the U S Bureau of Public Roads and the Illinois Division of Highways By Prof Nathan M Newmark Pp 118 1 dollar (Urbana Ill University of Illinois) [209

Annual Report for the Year 1937 of the South African Institute for Medical Research Johannesburg Pp 88 (Johannesburg South African Institute for Medical Research) [209

Nyasaland Protectorate Annual Report of the Geological Survey Department for the Year 1937 Pp 29+6 plates (Zomba Government Printer) 2*s* 6*d* [2[illegible]

Third Report of the Royal Institute of Science Bombay (1934 1937) Pp iii+66 (Bombay Royal Institute of Science) [219

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verhandelingen No 28 Sea Surface Temperatures on some Steamer Routes in Netherlands India Third Series 1933 1937 By Dr M W F Schregardus Pp 36 (Batavia Koninklijk Magnetisch en Meteorologisch Observatorium) [229

An Ecological Survey of the Mountain Area of Basutoland By R R Staples and W K Hudson Pp iii+68+12 plates (Maseru Basutoland Comptroller of Stores London Crown Agents for the Colonies) 10*s* 6*d* [269

Proceedings of the United States National Museum Vol 85 No 3035 A Miocene Dog from Maryland By Charles T Berry Pp 159–162 (Washington D C Government Printing Office) [269

U S Department of the Interior Office of Education Bulletin 1938 No 7 Curriculum Laboratories and Divisions their Organization and Functions in State Departments of Education City School Systems, and Institutions of Higher Education By Bernice E Leary Pp v+33 (Washington D C Government Printing Office) 1 cents [269

Memoirs of the Royal Asiatic Society of Bengal Vol 9 No 9 Geographic and Oceanographic Research in Indian Waters By Lieut Col R B Seymour Sewell Pp 541 550 (Calcutta Royal Asiatic Society of Bengal) 9 annas [269

Catalogues, etc

Ultra Rapid Processing Pp 4 (London Kodak Ltd)

R M B Miniature Ball Bearings (Catalogue No 2) Pp 16+13 (London Miniature Bearings Ltd)

Rotary Compressors and Vacuum Pumps (ROT 2) Pp 4 (London W Edwards and Co)

Die Askania Warte Nr 13 Pp 24 (Berlin Friedenau Askania Werke A G)

Catalogue of Optical Projection Apparatus Part 1 Optical Lanterns etc Pp 32 (London Newton and Co)

The Use of the B D H Gonadotropic Hormones in the Male Vol 1 No 2 Pp 12 (London The British Drug Houses Ltd)

A Catalogue of Scientific Works, including Books in Natural History Zoology Geology, Ornithology Agriculture Botany and Gardening also Books and Periodicals on Mathematics and Physics from the Library of the late Dr J R Airey (No 489) Pp 40 (Cambridge Bowes and Bowes)

Spectrographic Outfits for Metallurgical and General Chemical Analyses (S B 107/9) Ninth edition completely revised Pp 64 Outfits for Absorption Spectrophotometry (S B 156/6) Sixth edition Pp 64 (London Adam Hilger Ltd)

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Science and National Service

IT was apparent during the recent critical weeks that, though the problem of the utilization of science in war-time had been under consideration, no comprehensive scheme for this purpose was in existence The immediate danger is now past, but there are clear signs that the peace obtained by consultation is not of a character which will permit of any relaxation of military preparations The problem thus still remains an urgent one, though we may hope for the time to work out a reasonable rather than improvised scheme If this is to be done in a way that is not likely to waste the capacities of scientific workers, or to damage the structure of scientific knowledge and research, scientific men will need to take the matter in hand

In the first place, it must be emphasized that no scheme for the utilization of science can be satisfactory to citizens and men of science unless its ultimate aim—the utilization of science for human welfare in times of peace—is kept steadily in view The idea which appears to be prevalent in certain countries, that the main activity of human communities is the waging of war and that peace is merely an armistice for future war preparations, is not one which is compatible with the maintenance of civilization or of science Consequently, the organization of scientific workers for war must be conceived in such a way that the minimum damage is done to the possible beneficial utilization of science. This involves the safeguarding of fundamental scientific research and of the main lines of its application, so that once the danger of war is definitely removed, science can advance as rapidly as possible in carrying out its true purpose. It involves, further, the protection of the life and efficiency of a sufficient number of key scientific workers, and the maintenance of a continuity of scientific teaching and training It would be found that such provision would not, in fact, be detrimental from the strictly military point of view, and that the effective utilization of science for war purposes requires, to be fully effective, a proper balance between civil and military uses for science, even in war-time

If we are to face in a realistic way the possibility of war, certain steps should be taken immediately in the organization and the use of science, while others of more drastic character will be needed only if and when war breaks out Scientific war preparations in peace-time involve two types of activity The first is the organization and development of basic and applied scientific research in such a way that it may be of value for war without losing its actual or potential peace-time value The second is the training of a certain number of scientific men, and the preparation of many more, for possible war-time activities

It is clear that measures that were adequate for the Great War are unlikely to prove so in a future war waged under conditions which will probably be even more severe and prolonged. Preparation for such a war requires not only a much more thorough organization of science, but also a much closer integration between scientific research and the other activities of the community, particularly those of industrial production, agriculture and health

When we review the potential needs of the British Isles, or the British Commonwealth, in war-time, we see that they are primarily those of maintaining a human community at full effectiveness under conditions of shortage of supplies, shortage of men and of general disorganization due to enemy attack Most of these are simply the problems of normal civilized life raised to a much higher degree of urgency consequently development of scientific research to cope with these problems is bound to follow in the main the same lines as those required for the proper utilization of science in peace

The five principal needs of a modern community under war conditions are (1) maintenance of the military and civil populations (2) maintenance of war production (3) defence against aerial attack (4) the carrying on of military naval and air operations (5) care of casualties Each of these problems makes special demands on certain of the sciences and requires peace time development of research on certain specific points The strain of war conditions is not uniformly felt it bears particularly hard on certain sectors in which there are deficiencies not perceptible in peace time These weak points are those most likely to break and the breaking of any one of them may entail military defeat or what is more likely under modern conditions economic collapse

It is impossible to itemize all these weak places but there are at least six which are of cardinal importance food non ferrous metals rubber motor fuel optical instruments and medical supplies For all of these we are dependent to a large degree on imports which may be restricted or cut off altogether At the same time they are all products in which an application of science can provide either alternative sources or effective substitutes If this is to be done however it is not only necessary to provide as at present for applied research in these fields fundamental research is just as necessary provided it is well linked with practice In the case of food for example the work of geneticists plant physiologists biochemists and nutrition experts is no less important than that of agriculturists

Similar considerations apply to the more purely military aspects of war The defence of the civil population against aerial attack has created entirely new problems Protection against the effects of high explosives will necessitate a combination of evacuation and construction of shelters which will involve research in population distribution and in building

The carrying on of military operations is itself a large scale industrial undertaking The question of fuel may be a crucial one Already a great deal of fundamental and applied research has been done on the problem of artificial fuels but it is still open to doubt whether a more direct attack on the problem free from the confusion of rival interests might not yield more economical production of motor fuel from coal than at present obtains Another characteristic of modern warfare is the dependence it places on scientific means of detection and communication An adequate supply of optical instruments of the highest precision is needed and this requires a development of the optical industry and of optical research on a scale that has not yet been attempted

With the new weapons of destruction which have been developed since the last war and particularly with the bombing of cities casualties are likely to be heavy and serious The medical profession will have to face a heavier task than in any previous war It is difficult to improve technique in dealing with casualties under war conditions and therefore special efforts in medical research are required in order to prepare new and improved methods of treatment and rehabilitation Much greater quantities of medical supplies will be required particularly of drugs for there is reason to believe that the home production is inadequate even for peace time We need at once to develop drug production and research on drugs comparable to that already existing in Germany and on a far larger scale than the £30 000 provided by the Medical Research Council for chemotherapy allows

These are some of the more obvious needs that war would bring for applied and fundamental science There are many others which will be apparent to those working in different fields But if these needs at least are not dealt with now by provision and adequate facilities for research on both laboratory and factory scale the effect of this neglect in war time will be disastrous Further it will be necessary to secure that men trained in the different scientific techniques are reserved for scientific service in war time and that the best use is made of the registers now being compiled by the universities possibly through the collaboration of the learned societies

The problems which war raises for scientific research are however not independent and demands made for one or another of them would in the absence of co ordination merely increase the existing confusion and inefficiency of research If science is to be used to some extent for the protection of humanity in war it needs to be organized more comprehensively than it is at present This is not to criticize the existing organization of science but to point out that it requires to be extended and more closely knit We need a National Research Council covering the whole of science and relating it to the running of the community both in peace and in war The French Government has just set up such a council which is linked with all the defence Ministries as well as with that of national education This is not the place to discuss precisely how such a council should be formed or how it would group existing organizations but certain requirements must be satisfied if it is to succeed in its main purpose of utilizing science for national service In the first place it will need to command the active loyalty of a great majority of the scientific workers in Great Britain They will best collaborate with a body which they feel represents the most effective scientific workers and not simply those chosen on a basis of seniority or official position Further at any rate the younger among them will not work wholeheartedly if at all to organize science for a possible war unless they see evidence that the intention of political policy in general is to prevent war Lastly if the war should come their attitude towards it will largely depend on whether it is a war for or against the principles of democracy and civilization

There are two ways in which the scientific man can be used under war conditions One is by putting him in the position of a military subordinate whose business is to obey orders and not to think The other is to give him a chance to use his imagination and knowledge co ordinated with that of his fellow scientific workers and technicians to criticize and direct in so far as he is competent the character of operations In the first way it is impossible to get the best out of scientific men even if they are willing to comply with the conditions Any adequate organization of science cannot relinquish the fundamental scientific right of criticism Stifling of criticism led to great losses in 1914–18 it might have an even more disastrous result in a future war The full utilization of scientific workers requires the use of their ingenuity far more than of their routine service and this can only be secured by giving them opportunities and liberty of initiative The degree to which this is done may be a decisive factor and its neglect might mean defeat in which the prospects of reconstruction afterwards would be irretrievably damaged It is for the citizens and scientific men in the democratic States to see that this does not happen on their side

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Foundations of Human Inequality

The Origin of the Inequality of the Social Classes

By Prof Gunnar Landtman Pp xvi + 444 (London Kegan Paul and Co Ltd 1938) 21*s* net

PROF LANDTMAN S book in spite of certain shortcomings will obtain a permanent place in anthropological literature as an encyclopædia of fact and theory on such subjects as the earliest differentiation of society according to age sex and personality the role of wealth manual skill and commercial efficiency in creating primitive stratification the question of early phases of priesthood in its dogmatic social and ritual aspects The chapters on slavery are valuable as a summary of older work supplemented by recent evidence The book deals somewhat briefly in the last two divisions with the genesis of nobility and with the origins of government

Inspired though it is by the classical tradition of British anthropology the book lacks the charm and the intuitive genius of Frazer it falls short of the standard set by Westermarck in his almost uncanny creative acumen in the analysis of fact and its relevance it has not the flashes of inspiration characteristic of the work of Crawley At the same time the sincerity the thoroughness and the complete impartiality in dealing with facts and theories will allow the reader to draw his own conclusions from the material conscientiously and skilfully accumulated by the author

The very quality of the book and its high standard of scholarship invite criticism on one or two points In his treatment of the origins of government for example the author fails in my opinion to recognize some of the relevant aspects of the problem It is of course necessary to discuss whether in certain primitive communities power is vested in a council or a monarch in a male chief or a queen mother handed down by a hierarchy or distributed through a confederacy Another important question however still remains In what way do the rulers of primitive peoples carry out their work ? And indeed in what does this work consist ? Do they ever take any legislative initiative or is custom regarded as unalterable ? In what way are their administrative functions carried out—through specific executive organs, a tribal police, the chief's henchmen, or by magic and sorcery ? An analysis of primitive government might have considered such aspects as legislation, jurisdiction and administration, as well as its fiscal, magical and military functions

This substantial side of the problem is scarcely touched upon Prof Landtman gives us almost exclusively the structure, or the form, of early government The question of its scope and functions is interesting for here we have apparently considerable differences according to area In Melanesia, where I studied it at first hand, the actual sphere of activity of chiefs, councillors and officials is very limited They do not act as rulers, but rather as political masters of ceremonies The actual rule is exercised by custom The chief acts as mouthpiece of the traditional routine in war and in economic activities , in the interpretation of legal rules and their application In Africa, on the other hand, the initiative and executive power of the rulers is apparently much wider and more substantial In a comparative study like the present one, it would have been of great value if the author had revealed the common measure as well as the variations in the actual work of early government The problem is not merely theoretically important, but also has actual practical relevancy under systems of indirect rule, and, indeed, in all cases where colonial policies are being framed or overhauled

Again, the practice of starting with a definition instead of letting it grow out of the material collected, might be questioned Thus when, after a very useful review of older theories and definitions of slavery, the author tells us that slaves are "an unfree class which, occupying the lowest rank in human communities, are more or less entirely subject to the power of their masters" (p 229), it seems that from the substance of his subsequent analysis a much better definition could have been framed For it might have been given not only in the somewhat general terms quoted, but also in summing up the main characteristics of slave labour , of the position of slaves in their freedom to marry and reproduce in terms of legal status and political disabilities

As a follower of Rousseau, Prof Landtman endorses A R Wallace's opinion that "among people in a very low state of civilization, we find some approach to such a perfect social state" *Perfect* here seems synonymous with *equality, homogeneity, lack of oppression* and *plenty of food and simple commodities* For Prof Landtman tells us that "Not only the non-existence of social ranks but certain other features of the life of undeveloped native tribes undoubtedly suggest attributes of the utopian social state of philosophy Such is the high moral standard of some of these tribes and, above all, such the seemingly happy and untroubled life some of them lead surrounded by a luxurious tropical nature No wonder that they have acquired the admiration of so many enthusiastic travellers" (p 4) As a corrective to the constantly reiterated statements describing the primitive as "fear ridden", "witch haunted", "paralysed by anxiety neurosis", or "living in debauchery and sexual promiscuity", such a view is a welcome exaggeration of the opposite aspect of primitive life

As a matter of balanced fact, however, the stone age man of to-day fits neither into the pages of Rousseau nor into those of Hobbes He is neither primarily happy nor panic-ridden , neither virtuous nor infected with vice and cruelty In extremely small groups, with a limited range of interests and activities, we cannot look for cultural phenomena, fully fledged, formalized, and with a strongly pronounced moral physiognomy Under such conditions, it depends very largely upon the subjective stress given by ethnographer or scholar in one direction or the other, upon some minute touching up, whether the Bushman, the Negrito or the Australian aborigine emerges as a happy child of Nature or a miserable savage witch haunted, starved and bloodthirsty

The simple *yea* or *nay* approach is not sufficient We have to search in the confused and uncrystallized beginnings of social and mental life, and look for the manner in which law and order, rank and class differentiation, though but partly formed, yet do their work and achieve their results We have to establish the early forces and foundations of such permanent aspects as economics political rule administrative and legal order, education and religion

As regards all such problems within the sphere of early social differentiation, the present book will prove an excellent compendium of fact and information In his actual handling of most problems, Prof Landtman writes not as a follower of Rousseau, nor of the doctrines of Marx, Durkheim or Hegel, but as an impartial man of science, one of the world's foremost field-workers, and with a sound theoretical outlook derived from the unimpeachable teachings of Westermarck

The greatest merit of all original contributions to a new subject-matter is to provoke thought and even criticism, as well as to provide the material with which this can be substantiated Thus even my critical remarks are a tribute to the value of the book It will remain a standard treatise on the somewhat neglected, and nowadays perhaps most important, problem—that of human inequality, of the possibilities of a 'classless society', and the organization of rank and power

B MALINOWSKI

Periodicity of Earthquakes

Studies on the Periodicity of Earthquakes
By Dr Charles Davison Pp ix+107 (London Thomas Murby and Co 1938) 13s 6d net

> When the earth s crust or a portion of it is on the point of making one of those sudden movements that result in earthquakes a very slight force acting in the same direction may precipitate the movement On the other hand the same type of force acting in the opposite direction may be sufficient to delay its occurrence If the magnitude of the force in whichever direction it acts is subject to a periodic variation as in annual or diurnal changes of barometric pressure the same or a contrary periodic variation may thus be impressed on the frequency of earthquakes in any district The study of the periodicity of earthquakes may therefore throw light on both small and great movements of the crust

THESE opening words from the preface of Dr C Davison s new book clearly indicate the motive that prompted this veteran worker on earthquakes to undertake one branch of his extensive seismic studies Much might be written on the mechanical questions involved in these prefatory remarks without invalidating the legitimacy in our present state of ignorance of inquiry into the periodicity of earthquakes Such an inquiry forms a natural complement to the author s long and valuable work in collecting and cataloguing particulars of the earthquakes that occur both in the British Isles and throughout the world as a whole His book summarizes and extensively revises (with the aid of many new catalogues) the conclusions on earthquake periodicity that he has published in many articles during the past forty years and more

The periods Dr Davison has been led to consider range from forty two minutes through diurnal and annual intervals to eleven and nineteen years a chapter is devoted to each supposed period The brief opening chapter describes the method employed and the test of reality adopted which is one given by Schuster the author states that the test may be and often has been misapplied but is himself convinced that as he applies it it establishes the reality of the periods studied in each of his chapters In his concluding chapter he discusses how the results he obtains throw light on the movements of the earth s crust

Those who know most about the pitfalls that beset statistical studies not least in geophysics will probably feel that Dr Davison s conclusions should be taken as a new starting point rather than as the end of this line of investigation Not the least valuable feature of his book is the long list of (131) catalogues of earthquakes on which his studies have been based and which will facilitate new studies of the same data as for example by the methods that Bartels has developed wherein in particular quasi persistence is taken into account

S C

Electronic Theory and Organic Reactions

Modern Theories of Organic Chemistry
By Dr H B Watson Pp viii+218 (Oxford Clarendon Press London Oxford University Press 1937) 15s net

A BOOK such as that under review was certainly wanted in order to co ordinate the various modern theories applied mainly to organic chemical reactions Thus after a general article on theories of chemical combination—a theme which has occupied the minds of chemists from the earliest days and will do so for many years to come—the author passes on to deal with the new physical methods of investigation and devotes many pages thereafter to a general discussion of the subject, mainly of the electronic theory as applied to organic reactions Although Robert Robinson gave a very concise and clear account of this theory in his lectures at the Institute of Chemistry in 1932 the work which has been done since needed the hand of a ready writer in order to co ordinate the details in a manner capable of being understood by those who are not physically minded The desired co ordination is provided in this book and the author is to be congratulated on the way in which he has achieved a most necessary task

Nevertheless it must be admitted that except in the instance which may be termed The Royal Institution Case the theory has not yet proved sufficiently quantitative to enable it to predict It still relies too much on what is known and on what indeed has been recognized and provided with other forms of nomenclature, in the past The positive negative cause of all chemical reactions has been the basis of discussions of interacting molecules for generations past What we require of the new theory, and what it has not yet developed to the full, is a quantitative aspect which will give direction and not merely offer an explanation of what is known No doubt, however, this development is only a question of time, and the research worker will at some future date be able to tell with certainty whether an organic reaction will 'go' or not Then, and then only, will the investigator save the time and expense caused by the 'cut and try' method of research a method which is perhaps more common than many purists will admit

The chapter on Free Radicals" is also one of considerable interest That the combination of organic residues to form more complex molecules occurs is clear but what is lacking in this method is direction When the simplest cases are investigated, that is, for example, those cases in which only two free radicals are concerned, all is clear It is only when several such free radicals are involved that the issue seems to be entirely adventitious and may be likened to a dog fight It is foolish to dogmatize in these matters, but it seems unlikely that, except in specific cases, this method of research can lead to any form of prediction open to serve any useful purpose

The article on tautomeric change is admirable, and will repay reading, as will also the chapter on "The Beckmann Rearrangement" and those on several other topics of the day

The book is well presented and well written throughout, and contains just those matters which the chemist as such, apart from the specialist, wishes to know To the specialist himself it will act as a stimulant and an incentive J F T.

Scientific Pursuit and Personality

Scientists are Human

By David Lindsay Watson (The Library of Science and Culture) Pp xx +249 (London Watts and Co , 1938) 7s 6d net

IN his foreword, Prof Dewey says that Dr Watson is concerned to show that the pursuit of science and the products of science are relative to the mental world of the scientist, to the organization of his personality in all its phases, and that this in turn is relative to the social organization that subsists" That is surely a commonplace nowadays , the only dispute left is that between liberals and communists concerning the relative importance of personality and social organization

Dr Watson is very definitely liberal , indeed, he scarcely seems aware that the communist view is held seriously The first part of his book is directed to an inquiry whether the social organization that subsists in the United States is favourable to the personality of those possessed of true scientific originality He concludes that it is not I am quite incapable of offering any opinion concerning the matter, because the conditions he takes for granted in America do not prevail in Great Britain We doubtless suffer from our own evils , but our universities do not, I think, over value "drawing-room standards" , nor would eccentric genius find its spiritual home here in an industrial rather than in an academic institution

But even an American reader might criticize Dr Watson's analysis He seems to assume that scientific genius is always associated with the same kind of personality and that conditions adverse to one genius must be adverse to all This is by no means obviously true , it is difficult to imagine a state of society that would be congenial both to a Cavendish and to a Rutherford , it is equally possible that almost any state of society will encourage some type of scientific genius Moreover, Dr Watson's arguments are difficult to follow He is obsessed with neglected geniuses , but whatever were the reasons why Fresnel and Mendel did not receive their full recognition, they were certainly not the machinations of the ' good executive" to which (I understand) all American evils are due Again, the fact that Dr Watson thinks that certain of his contemporaries are neglected surely does not prove that they are geniuses , the judgment of contemporaries is *sometimes* right It is all very puzzling

The rest of the book is concerned with the denunciation of certain fallacies that, according to Dr Watson, vitiate much of modern science (Whether they too are due to the "good executive" is not clear) The difficulty here is to discover who entertains these fallacious doctrines , for whenever Dr Watson quotes a scientist (even myself !), he does so with approval Moreover, the true gospel, as he expounds it, does not seem to be very novel , it appears to be made up of selections, not always self-consistent, from all the chief writers on scientific principles and methods I am sorry to be so disparaging, for Dr Watson's theme is interesting , but his personal grievances appear to have got the better of his judgment

NORMAN R CAMPBELL.

The Doctor's View of War

Edited by Dr H Joules Pp 123 (London George Allen and Unwin, Ltd , 1938) 3*s* 6*d* net

THIS admirable little volume has the strongest claims on the attention of all scientific workers Dr Joules and his colleagues give a concise but lucid account of the service which the doctor can render in time of war, and the problems he has to face, as well as of the effect of the disregard of the Red Cross emblem in recent years Much more than this is, however provided An ably written chapter deals succinctly with the biological effects of war, and argues that it is doubtful whether a differential mortality between different groups would be great enough to have any evolutionary significance within a short time It is considered rather that modern war would wreck the present structure of society without any permanent biological damage having been inflicted

It is however, for the stimulating and highly suggestive chapters which deal with the professional responsibilities of the doctor towards the State and in the defence of the civilian population that scientific workers should be most grateful What is written here of the medical profession is equally true of scientific workers of other groups, and the problems which face a professional association in relation to the State and the responsibility that such associations must bear for independent investigation and criticism are admirably presented If the volume did no more than arouse scientific workers to the responsibility that they must bear in this way for conserving the fragile life of our democratic institutions it would be welcome It issues, however, a call to wider action on an international scale to eliminate the causes of war, and the responsibility of the doctor or other scientific worker as a private citizen for supporting a foreign policy which insists on such preventive measures is firmly urged Equally it is urged in conclusion that the medical associations of different countries should take their own collective action to assure ordered scientific progress, nationally and internationally conceived and practised, and that the relations of the profession to the State should be based upon a series of well defined principles

These Amazing Electrons

By Raymond F Yates Pp xiii + 326 + 46 plates (New York The Macmillan Co , 1937) 16*s* net

THIS volume merits serious consideration as an attempt to popularize science, with proper emphasis on its social significance It is not a mere book of wonders (although they are in it), but an accurate and well illustrated account of the principles and applications of electronics The development is not superficial, but it should be possible for anyone to follow it easily who has no more initial knowledge of electricity than is required for the use of ordinary domestic electrical apparatus Mr Yates's style is vivid, almost racy, and will probably irritate an academically trained physicist , but it is unlikely to disturb the average lay reader

Advanced Algebra

By Clement V Durell and A Robson Vols 2 and 3 Pp xi + 195–510 + xxiii–xlvi + 4 (London G Bell and Sons, Ltd , 1937) 12*s* 6*d*

THIS book, comprising vols 2 and 3, is intended to complete the school course and to provide a suitable introduction to higher work for those who are proceeding to the universities Attention has rightly been concentrated upon fundamental principles and methods which are essential to a more advanced study of modern mathematics Vol 2 deals with finite series, difference equations, complex algebra, partial fractions, theory of equations, sequences and convergency In vol 3, the student is introduced to those parts of the subject which are of special significance in the modern developments of mathematics—inequalities determinants, matrices elementary probability and the theory of numbers

Throughout, the text has been prepared with much skill, thoroughness and clarity , the methods are up to date and admirably adapted to lay a sound foundation for further study There is also an abundance of exercises for the student and these are roughly divided into two groups, the first consisting of straightforward applications of the bookwork, and the second of carefully graded sets of more difficult problems The book should be very useful and especially to those who intend to specialize in mathematics

Engineering Electronics

By Donald G Fink Pp xiii + 358 (New York and London McGraw Hill Publishing Co , Ltd , 1938) 21*s*

THE author, who is managing editor of the well known journal *Electronics*, is in an ideal position for observing the continuous and successful application of electronic devices to industry Without the subtlety associated with the specialist and research worker, or even a professor, and taking a robust point of view, he has produced a well balanced text covering ground which has indeed been covered before, but not in a way that a practising engineer can, and ought to, understand Sufficient theory of electrons in vacuum and gas tubes is included to make the internal and external circuit phenomena of these intelligible A large number of electronic problems serve to illustrate magnitudes and the possibility of practical use of controls

L E C H

The Climates of the Continents

By W G Kendrew Third edition Pp xii + 473 (London Oxford University Press, 1937) 21*s* net

THE third edition of Mr Kendrew s book does not bear any striking outward marks of differing from the earlier editions, but many minor emendations have been made, both in the text and in the tables The book remains, as before, the most useful and convenient collection of climatic data available in the English language, and not the least of its virtues is that it gives data for the whole world in one set of units

High Altitude Cosmic Radiation*

By Prof P M S Blackett, F R S

VERY great advances have been made during the last year in the understanding of the complicated phenomena of cosmic radiation One of the most important steps has been the experimental verification of the validity of the predictions of the quantum theory of radiation up to very high energies The application by Heitler of the quantum theory to the collisions of energetic electrons with atoms and also the semi classical treatment of the same problem by Williams and by Weizsacker show that energetic electrons are rapidly absorbed in matter by the emission of energetic photons and further that the photons are equally rapidly absorbed by the production of pairs of positive and negative electrons The combination of these two processes leads to the cascade theory of showers which was developed independently by Bhabha and Heitler and by Carlson and Oppenheimer When an energetic electron traverses an absorber it gives rise by successive acts of photon emission and pair production to a large number and for very energetic electrons to a very large number of positive and negative electrons and photons Eventually the loss of energy by ionization brings this process to an end leading after the first building up of a shower to its eventual absorption

This cascade theory of showers was found to explain in a very satisfactory manner the behaviour of the soft component of the cosmic rays in the atmosphere in particular the measurements at high altitudes by Regener and by Millikan and their co workers The theory was also able to explain many of the features of the much studied transition curves of showers and bursts in dense materials which were first investigated by Rossi and Hoffmann respectively The details of the building up of cascade showers can be seen in cloud photographs some taken by Street and Stevenson are especially notable in this respect

Once the validity of the quantum theory for electrons with energies of 10^{10}–10^{11} electron volts had been established it became certain that the penetrating rays which are in the great majority at sea level must consist of a new type of particle with a mass intermediate between that of an electron and that of a proton The possibility that the penetrating component might consist of a new type of particle had been discussed by Auger in the course of a detailed discussion of the widely different properties of the hard and soft components

Neddermeyer and Anderson[1] first put forward strong evidence that the penetrating rays consisted of particles which had a mass intermediate between that of electrons and protons Cloud photographs taken by Anderson Street Williams Brode Ehrenfest and others have shown that the mass of the new particle is probably of the order of 150 times the mass m_e of an electron

Once the experimental existence of the new particle had been established great interest was aroused in a theory of nuclear forces put forward in 1935 by Yukawa[2] in which he had postulated the existence of particles with a mass of about 100 times the electronic mass in order to explain the short range nuclear forces by assuming that this field was related to the emission and absorption of such hypothetical new particles in a similar way to that in which the coulomb forces between electrons and nuclei are related to the emission and absorption of photons On this view the range of the nuclear forces which is of the order of the classical radius r_0 of the electron and so the size of the fundamental heavy particles is essentially related to the mass of the new particle through the relation $\lambda = \hbar/\mu c$ where λ is its Compton wave length and μ is its mass If $\mu \sim 137\, m_0$ then $\lambda \sim r_0$

In order to explain β decay Yukawa assumed further that the new particle interacted with electrons and neutrinos It followed that the new particle if it existed in the free state must be itself β active that is it must disintegrate spontaneously into an electron and a neutrino with such a probability that its mean time of life when at rest is given by

$$T_0 = 3\hbar^2/g^2 \mu c$$

where g is Fermi s constant of β decay Taking $g \doteqdot 4\times10^{-1}$ and $\mu = 200\, m_e$ we get $T_0 \doteqdot \frac{1}{2}\times 10^{-6}$ sec When moving very rapidly the particle will live longer owing to the relativity change of time scale as pointed out by Bhabha[3] and so will have a mean time of life $T = \gamma T_0$ where $\gamma \gg 1$ and is the ratio of the total energy of the particle to its rest energy

The predicted instability of these particles provides an immediate explanation of the curious fact that had been deduced from the observations by several workers, that there are apparently no penetrating particles incident as primaries on the top of the atmosphere on the new theory they would, of course have disintegrated in space before reaching the earth Recently, Heisenberg and Euler[4] have shown how the spontaneous decay of the new particle can explain the striking, but hitherto inexplicable failure of the mass absorption law for the penetrating rays in air and in dense materials

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*Introductory address at a symposium in Section A (Mathematical and Physical Science) of the British Association on August 20

By observations at ground level and in the tube station at Holborn Follett and Crawshaw[5] found that the intensity of the rays under a large thickness of air was about one half that found under the same mass of clay Ehrmert[6] found a similar discrepancy between the absorption by air and by water The effect was studied in considerable detail by Auger[7] and his co workers who obtained results which can be interpreted as showing the greater absorption of air at low pressure compared with air at normal pressure

Heisenberg and Euler show how such observations can be explained quantitatively by the spontaneous decay of the new particle This follows from the fact that in air the distance travelled by the particle during its mean time of life is rather less than its range as defined by its ionization loss, whereas in dense materials the latter range is very much the smaller Thus in air the decay increases the apparent absorption while in dense materials it has little or no effect

A simplified form of the calculations of Heisenberg and Euler shows clearly how the order of magnitude of the time of decay can be obtained from the observations For example, from the measurements of Follett or of Ehrmert it can be seen that the intensity under 60 m water equivalent of air is about a half that under the equivalent thickness of clay or water We conclude, therefore that one half the rays decay spontaneously in the time required to traverse 60 m water equivalent of air that is a distance of about 60 000 m The mean time of life T is therefore of the order of $6 \times 10^4/3 \times 10^{10} \simeq 2 \times 10^{-6}$ sec Since the value of γ for the rays assuming a mean energy of 10^{10} e volts and a mass of 200 m_0, is about 100 we get $T_0 = 2 \times 10^{-8}$ sec Though this value is about four times that predicted by Yukawa the agreement must be considered as most satisfactory in view of the early stage of the theory and of the crudeness of the deductions from the experiments

There seems therefore to exist definite experimental evidence for the spontaneous decay of the new particle The accurate determination of this time of decay and of the mass of the particle is now one of the outstanding problems of cosmic ray research It is possible of course that there are other methods than that of spontaneous decay by which the new particles may disappear but further experimental results are needed before any certainty can be attained on this point Since there can be no particles of this type incident on the atmosphere they must all be produced in the atmosphere as secondaries to the incident electrons No evidence as to how this occurs has yet been found

Neddermeyer and Anderson *Phys R* 51 884 (193

[2] Yukawa *Pr Phys Math Soc Japan* 19 1084 (193) Yukawa and Sakata *ibid* 20 (1938

[3] Bhabha NATURE 141 117 (1938)

[4] Heisenberg and Euler in the Press (I am greatly indebted to Prof Heisenberg and Dr Euler for communicating these new results to me)

[5] Follett and Crawshaw *Proc Roy Soc* A 155 546 (1936)

[6] Ehrmert *Z Phys* 106 751 (1937)

[7] Auger Ehrenfest Fréon and Fournier *C R* 204 257 (93

The Old Stone Age in European Russia*

ARCHÆOLOGISTS are generally agreed as to the importance of obtaining more precise and detailed information about the actual conditions of the cultural stages of eastern Europe, of which the greatest part is European Russia At the same time, the total of information relating to the palæolithic period in that region, which has appeared in English, French and German, is negligible, and knowledge of the period is far from satisfactory Dr Golomshtok, accordingly, at the suggestion of Mr H H F Jayne director of the University Museum of Pennsylvania, with the assistance of the Board of Managers of the Museum and a grant from the National Research Council has brought together all the data available, regardless of the language of publication, but so far as possible endeavouring to present the first hand evidence of the excavator Some idea of the importance and magnitude of his undertaking will be gathered from the fact that while Burkitt lists nine sites, MacCurdy fourteen, and Ebert and Menghin six and seven respectively the present survey, which it is pointed out, is not to be regarded as final, covers no fewer than 105 sites to which must be added eight sites on which human remains have been found, without artefacts, but in association with a fossil fauna, or otherwise dated

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* The Old Stone Age in European Russia By Eugene A Golomshtok *Trans Amer Phil Soc* N S 29 2, March 1938 Pp v+191–468+xxxvii plates

In the history of palæolithic studies in Russia up to 1917 the first site discovered was Gontzi in the Poltava region, where fossil bones in association with a flint implement attracted the attention of Kaminsky a local teacher, in 1874 Three years later Count U S Uvarov, the father of Russian prehistoric archæology, established the existence of a palæolithic site on his estates near the village of Karacharovo and in 1879 his collaborator, Poliakov, discovered Kostenki I one of the most important sites in Russia The visit of K S Merezkovski a botanist, to the Crimea resulted in the discovery of a number of cave sites Suren I Cherkess Kermen etc , while from 1880 onward palæolithic cultures were determined in the Dnieper region (Antonovitch) Nova Alexandria (Kristaphovitch) Tomsk (Kaschenko) Cyrill St , Kiev (Khvoiko) and Ilskaya in the Caucasus (Baron de Baye) Uvarov and Volkov, by their summaries of existing knowledge, and the latter also by training young archæologists in his excavations at Mezine (1908) placed palæolithic researches in Russia on a truly scientific basis Among Volkov's pupils, P P Ephimenko is the most distinguished archæologist in Russia of to day

Under the Soviets, archæological studies have received a tremendous impetus, and the interest of the general public has been much enhanced Old sites have been re examined and new sites opened In 1922, Zamiatnin discovered and examined Borshevo near Kostenki where also he excavated new sites Important investigations have been carried out by G A Bonch Osmolovsky among others in the Crimea In Siberia, extensive studies have been made in the Yenisei district and in the region of Irkutsk , while archæology has been supplemented by a more detailed study of quaternary geology and palæontology by Pavlov, Gromov and others The only survey of this work hitherto in a language other than Russian is by L Sawicki , but it is in Polish

The materialistic interpretation of history now followed under the Soviets requiring the investigation of every factor that influenced culture, expeditions have studied, alongside the archæological and ethnological data, local geology, fauna, flora and climate Microscopic examination of charcoals have afforded much information as to flora and climatic conditions

Russian students of the development of culture, being firm believers in the evolutionary materialistic explanation of cultural changes, are strongly opposed to the theories of cultural borrowings and migrations of Western archæologists, as well as to the antiquarian attitude of interest in antiquities *per se*, which forgets the people who made them Again, Russian archæologists claim that their statistical and functional methods of study have, on one side, saved them from laying undue stress on 'leading' types, which give a distorted view of the culture, and on the other they have been led to such discoveries as those of underground dwellings of palæolithic man which have been overlooked in the West

Before turning to archæological discovery the conclusions of recent geological and palæontological investigations may be summarized as follows The existence of three and only three definitely traceable glaciations has been established These are Mindel Riss and Wurm The Gunz was very weak and either its traces were obliterated by subsequent advances of the ice or it was not effective The other three glaciations appear to correspond in time and in general characteristics with those of western Europe The fauna which accompanied the various climatic changes generally corresponds to that of western Europe but on the whole has a colder character The extremely warm species are few and not abundant The Crimea and Caucasus show local variation

The discovery which has probably attracted most attention among Western archæologists in the post War years is that of the human skeletal remains, generally known as the Podkumok skull from the Caucasus These remains were found in the autumn of 1918 in the course of excavations for a sewer in the town of Piatigorsk They were below a pottery vessel and a polished stone perforated disk , but owing to political conditions no observations of the exact position of the human remains was possible Later the remains were dated on the basis of general geological conditions resulting from a survey by P V Rengarten According to this, the find was in the fifteen metre terrace of boulder clay deposits on the left bank of the Podkumok River General conditions for the North Caucasus show three terraces at 15 m , 60 m and 120 m respectively, all belonging to the Quaternary Age On this showing the Podkumok find belongs definitely to the Würm glaciation

The Podkumok remains are part of a cranium consisting of almost the whole of the frontal bone, the front parts of both temporal bones and a small part of the nasal bone, a fragment of the right side of the lower jaw with five teeth, and some other fragments of the skull and skeleton The bones are thin and small and the muscular attachments weak Gremiatsky identifies the remains as those of a female of from fifty five to sixty years of age of the Neanderthal group, but showing an approach to *H sapiens*, which would place it between Neanderthal and 'modern man'

While Gremiatsky holds that this find definitely establishes the existence of Neanderthal man in the Caucasus in conditions very similar to those of the diluvial period of western Europe, there has been a disposition recently in Russia to question the Neanderthal affinities of Podkumok, while Sir Arthur Keith, it is noted, has expressed the opinion that it is altogether of the neanthropic species.

In this connexion, it is to be remarked that the biological conception of the development of man favoured by Soviet archæologists pictures that development as one uninterrupted chain of evolution, and the view of Western archæology that the Neanderthal race died out and was replaced by a new Cro-Magnon race is vigorously denied. Cro-Magnon is considered to be a direct descendant of Neanderthal man, and it is held to be even possible that this transformation may have taken place in Europe.

A number of human cranial fragments have been found with fossil bones of an extinct fauna at several sites on the Lower Volga. Of these the most considerable are known as Undora I and Undora II, from the island of that name on which they were found. The skulls have been reconstructed by A. P. Pavlov, and classified by him as belonging to a group which includes Galley Hill, Brunn and Canstatt, of early post-glacial date.

The dating and interpretation of cultural finds by Soviet prehistorians are often founded on certain basic assertions, which lead to important divergences from the views held by Western archæologists. The acceptance of the universal evolutionary scheme of cultural development with the material basis as the main determinant, results in a fairly well outlined succession of the phases of social structure, corresponding to the different stages of industrial development. The centre of gravity lies in the method of production, and strenuous objection is taken to 'migrations', 'borrowing' and 'superior races'. This view, however, leads to certain difficulties and inconsistencies. Ephimenko, for example, when faced by certain very primitive characters in Neanderthal man, attributes them to the degeneration which arose from close interbreeding in the small Neanderthal group. Yet on the other hand, the relatively poor industry of the Mousterian group is taken as a proof of the tenacity and ingenuity of Neanderthal man.

To account for the superior physical characters and industry of Cro-Magnon man, it is argued that new conditions of existence changed the character of the social structure, creating, in place of the closed primitive horde, more complex groups of intercommunicating hordes. Hence arose rapid cultural growth and the formation of a new physical type, which entered the history of Europe during the Upper Palæolithic period as the Cro-Magnon race. This view, it is only fair to say, is not accepted by all Soviet archæologists. Bonch-Osmolovsky maintains that while Neanderthal man differed physically from modern man, these differences were such as to limit his functional possibilities. Thus the structure of his hands prevented him from making long knife-like blades which required a very accurate blow for their detachment. Hence Neanderthal man and Cro-Magnon man represent stages in the process of perfection, which are the result of physical changes dictated by the gradual development of social life.

On summarizing the material from the one hundred and thirteen localities listed, certain generalizations are seen to emerge. European Russia would appear to be very poor in remains of Lower and Middle Palæolithic cultures. No true Chellean and Acheulean sites are found. Two accidental finds of *coups de poing* are doubtful, but a series of Acheulean sites reported in the Caucasus by Zamiatnin may change these conclusions when data are available. The so-called 'pre-Mousterian' cultures, such as are found in the lower layer of La Micoque and La Ferrassie, are represented by the lower layer of Kiik Koba. The dating of this site, however, is far from settled. The upper layer is regarded as pre-Mousterian or archaic Mousterian. Transitional between Middle and Upper Palæolithic, corresponding to Abri Audi, is Shaitan Koba. These sites are dated by Gromov as from Riss-Wurm to the maximum of Würm.

In the Upper Palæolithic there is an absence of stratigraphical evidence of distinctly different cultural layers. In the cave sites of the Crimea and the Caucasus where geological evidence is lacking, it is frequently necessary to rely on analysis of the faunal complex. The bulk of Upper Palæolithic sites are open camp sites of hunting peoples. In these two cultural complexes can be distinguished. The first of these complexes consists of large accumulations of animal bones, very much like the well-known bone piles from Předmost, Moravia. As a rule they contain very few stone implements. The second complex, according to most Russian archæologists, represents the place of more or less permanent habitation of these hunting groups. It is characterized by red pigmentation of the ground, due to the presence of ochre, the remains of open fires, filled with ashes and charred bones, and usually by large quantities of stone and bone tools. In several cases, definite traces of permanent habitations were found, sometimes with stone slab foundations, well-preserved fireplaces, copings, niches in which objects were kept, and caches of flint and bone tools. Nearby were storage pits and primitive 'ovens'.

The flint industry of the Russian Upper Palæolithic presents almost every variety of form known to western Europe except the very specialized classical 'Solutrean The 'leading' bone forms, such as the Aurignacian cleft base and harpoons, are totally absent Consequently an entirely new set of criteria for dating is necessitated, and the subdivisions of Upper Palæolithic industries are employed with different implications Aurignacian Proto Solutrean Solutrean and Magdalenian are used to designate stages in the development of culture, rather than specific cultures Thus bifacial flaking and the *point à cran*, even in its most atypical form, are taken as indicating Solutrean temporal affinities Taking this as the middle point, industries where these characteristics are less prominent are taken as older, that is as Aurignacian others which show a general decadence of technique are said to be younger, that is, Magdalenian Hence Ephimenko finds true Aurignacian in one site only, Suren I The rest of the Upper Palæolithic sites, excluding the transitional with microlithic industries he classifies as Aurignacian Solutrean and Solutrean Magdalenian, affirming that no true Solutrean sites are known in Russia

Basically, we seem to have in European Russia the Early, Middle and Late Upper Palæolithic industries all characterized by the blade technique, which starts very much like the Aurignacian in western Europe, develops, acquires some peculiar traits, suggesting Solutrean influence, and then slowly degenerates, finally reaching the stages of a microlithic industry

Hugh Miller, 1802-56

Commemoration at Cromarty

THE rise of geological knowledge in the first half of last century was marked by the appearance of innumerable books dealing with the rich mass of observations which could be made by even superficially interested persons Most of these books are wisely forgotten, but in the residue there are some of the strongest foundations of the present science One stands out among the greatest, both in content and in its influence on others "The Old Red Sandstone or New Walks in an Old Field" by a man who was proud to be a journeyman mason Buckland said that "geologists were amazed and delighted" by this book, and his phrase must be echoed to day, almost a century later

Hugh Miller wrote other books, many of them dealing with geological topics, but "The Old Red Sandstone" seized popular imagination and made this perhaps the most widely known geological formation He had a few comments on the geology of his native Cromarty in "Scenes and Legends of the North of Scotland", which was appreciated by distinguished critics for its literary qualities "The Old Red Sandstone" was published serially in 1840 in the *Witness* newspaper, of which Miller was editor, it appeared as a book in 1841 "Footprints of the Creator, or the Asterolepis of Stromness", followed in 1847 as a reply to the "Vestiges of Creation", in which Chambers had published anonymously an evolutionary theory Miller's answer was, in its time, a remarkable and able contribution to Christian apologetics He dealt further with the hotly debated frontier-territories of science and religion, in "The Testimony of the Rocks" (1857), which received its final corrections on the day of its author's death, and in the same year was published "Voices from the Rocks, or Proofs of the Existence of Man during the Lower Palæozoic Period", which is now best forgotten Posthumously, in 1858 Symonds edited the manuscript of "The Cruise of the Betsey, with Rambles of a Geologist", which, in my opinion, contains the most delightful prose of all Miller's output Other less important geological books and papers, besides other works, came from his pen

To Hugh Miller geology was an incident in the revelation of religion, but he was usually a shrewd and accurate observer who faced the deductions which he could make from the facts of his observations In the dedication to "Footprints of the Creator" he wrote "The ingenious and popular author [Chambers] whose views on Creation I attempt controverting, virtually carries his appeal from science to the want of it I would fain adopt an opposite course" He was a strong believer in the notion of successive creations, and the great profusion of fossil fishes in the nodule-beds which occur at certain levels in the Middle Old Red Sandstone of the Moray Firth led him to describe these horizons as "platforms of death" For some time his efforts were directed to reconciling Biblical and geological knowledge, and in the atmosphere of nearly a century later it is not always easy to estimate the influence of these attempts

His indignation was powerfully aroused by two things—the clearings in the Highlands, during which large sections of the crofter population were packed off to the colonies, and the system of patronage then prevalent in the Church of Scotland Some tracts published in 1839 made a very deep impression, and in 1840 he was persuaded to become editor of the *Witness*, the organ of the non intrusionist party His energies had found a congenial outlet, and his conduct of the newspaper played a great part in the events which led to the formation of the Free Church

The scientific content of Miller's geological work is perhaps magnified by his literary qualities, but it can stand on its own merits It must be remembered that very little was known at that time of the comparative anatomy of *living* fishes, and it is not at all remarkable that Miller made several mistakes in his accounts and reconstructions of the curious fishes of the Old Red But these were mistakes in the interpretation and synthesis of a great number of new, accurate observations which he made on the actual fossils Sir Archibald Geikie wrote "He was not in any sense a trained geologist He lacked the habit of patient and detailed investigation in departments of the science that did not specially interest him, but which were essential as a basis of accurate induction and successful speculation", though perhaps T H Huxley's was a fairer appreciation 'The more I study the fishes of the 'Old Red' the more I am struck with the patience and sagacity manifested in Hugh Miller's researches, and by the natural instinct, which in his case seems to have supplied the place of special knowledge "

It is often assumed that because men like Hugh Miller and Robert Burns were of humble birth and were manual workers that they were without education, but the Scottish parish school system was proof against that Miller himself said that his want of the more orthodox learning was largely his own fault As for Latin he wrote at thirty six years of age I abominate it and ever did since I burned my *Rudiments*" and Latin was a hall mark It is recorded that his uncles were prepared to assist him to King's College at Aberdeen, but he became a stonemason against family advice From his work he contracted silicosis, which ruined his health, and in later years his mind became affected and he shot himself in 1856

Though Miller wrote much on other geological topics (for example, the shelly boulder clays of Scotland), it is particularly with the Old Red Sandstone and its fossils that he is associated He came early under the influence of Dr John Malcolmson and Prof Fleming, and later corresponded with Agassiz and with Murchison (who was also a native of the Black Isle) On the other hand he was regarded by many geologists in north east Scotland as their mouthpiece, and such men as Robert Dick of Thurso kept him informed of their new discoveries and sent him specimens without which much of his work would never have been written

Miller was born of mixed Scandinavian Scottish and Celtic stock at Cromarty in 1802 and the cottage in which he was born was handed over to the National Trust for Scotland on September 26, 1938

T S W

News and Views

Dr C. G Darwin, F R S

THE Lord President of the Council has appointed Dr C G Darwin, master of Christ's College, Cambridge, to the directorship of the National Physical Laboratory, rendered vacant through the ill health of Prof R H Fowler, who is unable to take up the post The name of Darwin is so completely identified in popular speech with the author of "The Origin of Species that it is not always easy to give due credit to the work of his illustrious descendants Dr Darwin is a grandson of Charles Darwin, and a son of the late Sir George Howard Darwin, formerly professor of astronomy at Cambridge He is distinguished for his work in mathematical physics, especially for his researches in collaboration with R H Fowler on statistical mechanics (1922) and on the quantum theory of the electron and the atom (1927) He described the electron as a vector wave having two independent components analogous to the polarized components in a wave of light Much of this later work was done while Darwin occupied the Tait chair of natural philosophy in the University of Edinburgh There, as a colleague of Prof E T Whittaker, he did much to strengthen the mathematical school in the University and at the same time his influence was exerted on the council of the Royal Society of Edinburgh The striking address which he delivered at Cambridge this year as president of Section A (Mathematical and Physical Sciences) of the British Association has been described as a model which other sections might study

Dr. Alexander Scott, F R S.

THE announcement of the retirement of Dr Alexander Scott from the honorary directorship of research at the British Museum Laboratory brings to mind that he was a pioneer in a field of applied science which, largely through his initiative and vision, has developed beyond all expectations The idea of having a scientific laboratory in an archæological museum was entirely novel, when, in 1919, the trustees of the British Museum sent a request to the Advisory Council for Scientific and Industrial Research for assistance in connexion with problems of cleaning, restoring and preserving antiquities That Dr Scott was called in to advise was singularly fortunate His wide knowledge of chemistry coupled with his interest in antiquities fitted him peculiarly for the work Within seven years the original inquiry had been satisfied and the results published in three reports which aroused widespread interest Early experiences were of incalculable value when he visited Luxor and co-operated with Dr Howard Carter in preserving many valuable objects from the tomb of Tut ankh Amun As experience accumulated, the fact emerged that scientific assistance could be of much greater value to archæology and the British Museum in general than had been at first supposed There were questions of authenticity, of the composition of materials, of ancient technique, of classification, and of general diagnosis that could be answered only with the help of qualified scientific staff having the necessary facilities Dr Scott has had the satisfaction of founding and controlling the development of a research laboratory which from small beginnings became at length (in 1931) incorporated as a department of the British Museum, and is recognized to day as being of the first importance by archæologists and museums the world over

Rejoinder of an Egg Collector

To Mr Edgar P Chance all credit is due for his film of cuckoo life, which thrilled every ornithologist who saw it and made a distinct contribution to scientific knowledge This achievement, however, does not necessarily justify all his other activities, and for his egg collecting he has been severely criticized His rejoinder appears as an eight page pamphlet entitled An Egg Collector Replies to his Critics" (Sept 1938) In our view, an appropriate reply would be to show that the amount of disturbance caused to wild birds was justified by the amount and value of the scientific knowledge gained from the collections and published for the information of other scientific workers Unfortunately, this reply makes no attempt at such justification, and is marred by expressions which cannot further the case of the egg collector The author s ethics are hinted at in a paragraph which states that ' Bird Protection laws are proverbially stupid [we have not heard any proverb on the subject] When a law is not worthy of respect it ceases to be law to those who know better" That is a position which cannot be defended, any more than can be the allegation that the bird protection laws are framed "by those who do not understand their subject" Clearly, however, the collector is himself convinced that his collection, which "is complete and only the abnormal can now find a place there", has been brought together without any unwonted disturbance of the numbers or distribution of wild birds

Accessions to the British Museum (Bloomsbury)

AMONG the accessions to the British Museum (Bloomsbury) reported at the meeting of the trustees on October 8 (the first meeting to be held after the recess) were a number of antiquities from Central America, part of the collection made by the late Mr T W Gann, and bequeathed by him to the Museum They were accepted by the trustees in May last, but this selection has been received at the Museum only recently The more important specimens are a number of carved jades, including figures of men and animals, coming mostly from Copan in Honduras The best example is a magnificent green jade plaque with figures carved in relief It is said to be the finest known example of carved jade from Central America It was found at Teotihuacan in Mexico, but is thought to have come originally from Quiriqua in Honduras By its style it is assigned to the Old Empire of the Maya, and dates probably from the fifth century A D In addition the bequest includes a number of fantastically shaped flints of unusual size Some of these range up to seventeen inches long There are also a number of painted stucco heads, with elaborate headdresses and some beautiful examples of the Mayan painted pottery Another accession to the American collections obtained by purchase is an archæological collection from Esmeraldas Province, Ecuador, while an anonymous loan consists of a notable series of antiquities from mexico, which includes a remarkable series of funerary urns in human shape from Oaxaca The Museum has now received its share of the antiquities found by Sir Leonard Woolley and Mr M E L Mallowan on their respective expeditions in Northern Syria, which were conducted under the auspices of the Museum jointly with the School of Archæology in Iraq Grants have been allocated for the renewal of both these expeditions in 1938–39

Excavations in Northern Syria

MR M E L MALLOWAN's expedition to the Habur region of Northern Syria in the spring of 1938, from which came the finds to which reference is made above, excavated four areas, which in conjunction yielded evidence covering a period extending from 3100 B C down to 1500 B C The remains latest in date were Hurrian houses of mud brick in three successive levels, ranging in date from 1800 B C to 1500 B C These yielded a quantity of pottery of white design on black Some private houses, Mesopotamian in plan, were contemporary with the third dynasty of Ur, but the most important evidence was obtained from the Sargonid level with its Akkadian palace, and the ziggurat, or tower, of Jemdet Nasr date, of which the remains were found beneath the Palace The Palace, of which a complete ground plan was recovered, is a huge building, 90 metres by 90 metres, ranged about a great courtyard It was built, as is shown by an inscription, by Naram Sin, son of Sargon, about 2500 B C It was destroyed by fire approximately at the end of the Sargonid period and rebuilt under the third dynasty of Ur Below the south west corner of the Palace were the ruins of a great tower, which was built about 3100 B C Its dimensions were about 60 metres by 60 metres, and its walls still stand about 10 metres high It rests on a clay platform, and was found to be packed with votive offerings, among which were about 40,000 beads in a variety of material, though mostly of faience There were also a large number of amulets, which are beautiful specimens of animal carving and not all paralleled at Ur and Uruk A collection of alabaster idols consisted of about 200 complete figures, with some thousands of fragments

Excursion of the Geological Society of France

A R LILLIE writes The *réunion extraordinaire* of the Société Géologique de France was held this year on September 10–17 in the southern French Alps There was an attendance of ninety four members, who came from the following countries France, Belgium, Britain, Czechoslovakia, India, Poland, Spain and Switzerland The excursion, under the guidance of Profs Gignoux, Lory, Moret, Raguin and Schneegans was well organized and was a useful introduction to a territory of fascinating tectonic problems The party met at Grenoble, where M Gignoux outlined the objects of the meeting, and then went by motor car to the Dévoluy M Lory there demonstrated the considerable extent of the pre Senonian folding which he has elucidated during many years work From Gap as centre, during the following three days, the excursion was conducted in localities situated in the ultra Dauphinois zone and the sub-Briançonnais zone at Ancelle and in the Ubaye valley The recent work done in this region, particularly that of Schneegans in the massif of the Grand Morgon, is very impressive in view of the complicated tectonics and the mountainous nature of the ground Moving on to Briançon for the last three days of the excursion, the party had the opportunity of seeing something of the tectonics in the Briançonnais zone The final day was spent at the col du Galibier, where all the tectonic elements are to be seen continued northwards into Savoie An excellent memoire with numerous plates had been prepared by MM Gignoux and Moret in collaboration with Lory and Schneegans, and a copy was presented to each participant This memoire, entitled 'Description Géologique du Bassin Supérieur de la Durance", appears to include much hitherto unpublished work, and should prove a valuable summary for geologists interested in Alpine tectonics

The Mellon Institute

THE annual report of the Director of the Mellon Institute for the year March 1, 1937, to March 1, 1938, refers to the interest aroused in hydroxyethylapocupreine, a contribution of the Institute's department of research in pure chemistry Semi plant scale operations have been undertaken to provide material for more extensive clinical trials, and other new drugs prepared in the Institute have received clinical trials in cases of pneumonia and pneumococcic empyema Research on alkyl, hydroxyalkyl and other derivatives of apocupreine is being actively pursued with the object of finding more efficient antipneumococcic drugs Studies in the treatment of streptococcal and pneumococcal infections have been continued, and research on the variability of the tubercle bacillus has reached a point where it appears to be of some importance in diagnosing anomalous aspects of lung tuberculosis in the benign stages, an advance which may make it possible to use preventive and hygienic measures in time to stop development into the classical and more fatal forms Seventy two applied science programmes or fellowships were in operation in 1937–38, new fellowships on amines, anthracite industries, chemical hygiene, cotton, dielectrics, proteins and tar properties commencing operation in the year Valuable contributions to the improvement of industrial health have been made by the attention given to the medical, engineering and legal aspects of the problems involved A multiple fellowship on commodity standards has a programme directed to establishing standards for nearly 300 items of staple merchandise so as to provide known values for the consumer The Cotton Research Foundation is investigating the chemical and physical properties and uses of the whole cotton plant A new blue print paper has been developed, and a new resin, Raolin, is also under development A multiple fellowship on organic synthesis has been concerned with the preparation, properties and uses of a wide range of amines, solvents, intermediates and resins, including various alkylene alkylol and heterocyclic amines, propylene glycol derivatives, silicon and titanium esters of higher alcohols and vinyl resins for protective coatings

Industrial Development in 1937

A SURVEY of Industrial Development for 1937 recently issued by the Board of Trade includes particulars of factories opened, extended and closed in 1937 with some figures for 1936, and indicates the extent to which industrial development in the form of new factories and factory extensions took place in Great Britain in 1937, together with the areas in which it occurred and the nature of the trades contributing to such development (H M Stationery Offices 9d net) The survey is limited to factories where 25 or more persons are to be or have been employed, and Government establishments set up in pursuance of the rearmament programme are excluded The Survey shows that 541 new factories, employing 46,700 people, were established in 1937, as against 542 in 1936, employing 49,500 people The number of factory extensions, however, increased from 185 to 237 and the number of factories closed decreased from 394 to 361 94 of the new factories represent transfers from other areas and 66 of these are in Greater London An attempt was made to ascertain the reasons for the location of the new factories Convenience of premises was the reason given in 212 of the 416 cases for which particulars were obtained, suitability of labour coming next (67), proximity to other factories in the same industry (41), proximity to markets (34), cheap land, low rent or low rates (34), accessibility of raw materials (26), being the other reasons assigned in the relative order indicated

Greenkeeping Research

The report of the Board of Greenkeeping Research for 1937 (from the Board's Research Station St Ives, Bingley, Yorks 2*s* July 1938) shows an increasing amount of advisory work and original investigation at the St Ives Research Station and at other centres The Station lives within its income, but research work cannot be greatly extended with the present financial arrangements, as advisory work makes the first claim upon revenue More advisory work was, moreover accomplished in 1937 than in any previous year The volume of research papers does not appear to reflect this policy, however and a general account of work in progress will be found in the report and also in a paper by the Station's director, Mr R B Dawson (*J Roy Hort Soc*, **63**, 8, August 1938) A promising line of investigation concerns the use of potassium permanganate on lawns, to destroy moss and expel earthworms, further developments will be awaited with interest Supplies of seed of St Ives creeping red fescue, the first of a series of improved strains of lawn grasses, are now available to greenkeepers This strain has greater leafiness and density of growth than the existing varieties, it has good winter colour, and reasonable resistance to fungal disease Successful courses of instruction in the science and practice of greenkeeping have been prosecuted at the Station, and practical demonstration has been greatly improved by the establishment of a permanent exhibition of implements for the treatment of lawns

Timber Resources of the World

The small handbook entitled The Rationalization and Conservation of the Timber Resources of the World (The Technical Press, Ltd, London 2*s* 6*d* net), by Dr A Harold Unwin, is written mainly with reference to the amelioration of the Special Areas and general improvement of woodlands Dr Unwin puts forward a series of proposals and suggestions of a somewhat varying nature In the short period since the Great War, a number of organizations have come into being in connexion with forestry and timber utilization in Great Britain and the Empire To mention but three, the Forestry Commission, the Forest Products Research Laboratory at Princes Risborough and the Imperial Forestry Institute at Oxford The timber trade has also a considerable organization Dr Unwin wishes for a more rational care of trees and woodlands, especially in Great Britain, and for a better and organized utilization of the world's timber resources Until recently, Dr Unwin was conservator and head of the Forest Service in Cyprus, having previously served in Nigeria Although there is much in the handbook of interest the same cannot be said of the practicability of some of the proposals The list of trees given at the end requires considerable revision, and would have been more serviceable had it included the botanical names

Racial Studies in Italy

It is announced in the *Corriere della, Sera* of October 5 that racial doctrine is to be made part of the curriculum of Italian universities It is to be taught to students of natural science, medicine, and biology, as well as to students of philosophy, educational theory and literature This innovation is made under a decree of the Minister of Education, Signor Bottai A second course is to be devoted to study of the demographic problem Italy has been slow in following Germany in the adoption of racial doctrine, nor, as was shown by the report of the Italian men of science on the racial question, has the doctrine been adopted entirely in the form, nor with the enthusiasm, which it has aroused in the country of its origin The physical characters of the main element in the Italian population would naturally call for some modification, and account for the stress, which in Italy is laid on continuity of cultural history

Preservation of the Fauna of the Empire

The Society for the Preservation of the Fauna of the Empire has been accused (according to an editorial note, in the August number of its *Journal*) of talking and doing nothing, while game throughout the Empire is being ruthlessly destroyed The accusation is unjust The powers of a private society are in any event strictly limited, since game preservation lies with the official Government of the territory in question Nevertheless, the Society has investigated conditions in various parts of the Empire and has reported upon the steps which might usefully be taken for the safety of threatened members of the fauna always keeping in mind that it is no part of its aim to preserve animal life to the detriment of human industry or the natural development of mankind The Society does encourage talk about animal preservation, but surely one of the secrets of the success of any great cause is the efficient propaganda which spreads information and may eventually make the cause part of the nation's will

Agricultural Education in Jamaica

A pamphlet of 86 pages (*Bulletin* No 14, New Series, 1938) issued by the Department of Science and Agriculture of Jamaica indicates the thoroughness with which that Government Department organizes agricultural education in the Colony It summarizes the series of addresses, lectures and demonstrations given by experts during a special refresher course devised for the staff of instructors of the Jamaica Agricultural Society, and held throughout a week in January The course was a varied one dealing with aspects of farming which included insects of economic importance to stock maintenance, sugar production, tobacco growing, afforestation, exporting and marketing of produce, banking in relation to agriculture and other subjects The pamphlet shows that these aspects were treated with thoroughness from the Jamaican point of view, and the appreciation with which the course was received was indicated by an audience of as many as 150 at some of the sessions

(*Continued on p* 713)

NATURE

SUPPLEMENT

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BRITISH ASSOCIATION DISCUSSIONS

Soil Fertility and Agricultural Policy

SPEAKERS in the discussion in Section M (Agriculture) following the presidential address to the Section at Cambridge agreed that agriculture in Great Britain is declining and the land suffering The only possible approach to a stable and long term agricultural policy must be a national one directed not merely to the production of commodities but also to the maintenance and enhancement of soil fertility

In his presidential address on Ley Farming and a Long term Agricultural Policy Prof R G Stapledon stressed the need for maintaining a large and contented rural population with the greatest possible acreage of fertile and ploughable land managed so as to allow the utmost flexibility of production The vital need of Great Britain for an abundant supply of fresh food is threatened not merely by war danger but also by the effects of soil erosion and soil depletion in the countries on which we have come to rely for cheap food The possibility of producing sufficient amounts of fresh food ourselves is not compatible with our present superabundance of permanent grass We need a survey on the land to map the main types of farming and the facilities of individual farms in order to determine both our potential food production and the way our schemes for subsidizing commodities and planning marketing are affecting the fertility of the land

Prof Stapledon gave the following outline classification of farming systems (*a*) arable farming including a one year ley for hay and for maintaining soil fertility (*b*) alternate husbandry or ley farming with arable cropping alternating with leys of either two or three or four to eight years duration (*c*) nondescript farming in which the arable land and the grassland occupy separate parts of the farm and (*d*) permanent grass He criticized the last system on both general and technical grounds Even the poorest permanent grass retains some earning capacity but it does so at the cost of a low standard of management complete dependence on imported foodstuffs and great wastage of both manurial residues and potential fertility Again as a later speaker said Permanent pastures perpetuate parasites

The best grassland holds within itself an immense store of fertility which can be cashed only by ploughing and cropping and thereby preparing the land for still better grass The urgent need for lime which has been emphasized by increased milk production and by the slaughter of young animals can best be met by applying the lime when the land is under the plough On the poorest soils there is nothing to equal continued ploughing down of sod accompanied by lime and phosphate to build up fertility Prof Stapledon particularly recommended the use of contrasted types of ley in rotations—one or two years ley for hay and deep rooting residues, and four- to six years' ley for grazing leaving shallow rooting residues rich in clover Experimental work is needed to discover the best rotations for individual districts and especially to find means of establishing leys without undue risk on the heaviest soils and in the driest regions These problems and many others in agriculture are more likely to be solved by agronomical investigations than by scientific research Facilities for conducting field experiments should be enormously increased

The only solution for our derelict areas is to determine by a survey which fields must be ploughed up and then to devise means of supplying working capital and ensuring its correct expenditure From his experience in North Wales, Prof Stapledon favours the idea of loans with a working plan through a master borrower' with the necessary tractor and other equipment or through scheduling districts for a rehabilitation loan on an agreed plan He believes, too, that the advantages of a more balanced specialization would be secured by a system of 'share farming by which, for example, a mechanized wheat grower and a poultry farmer might operate over a number of neighbouring ley farms devoted mainly to milk

Dr W G Ogg stressed the necessity for checking the drift of poor arable land through inferior pasture to rough grazings and wastes which would ultimately require very difficult and costly reclamation He doubted whether private individuals, even with cheap long term credits, could undertake the reconditioning, and suggested that it would have to be done by the State or by some State aided corporation, working in much the same way as the Forestry Commission does on land which the private owner is unable to afforest When the land has been reconditioned, and buildings, fences and water supplies made satisfactory, the farms could be rented with a clause in the lease to require suitable manuring and cultivation Dr Ogg showed by films some of the work of the Macaulay Institute for Soil Research in the reclamation of peat in Lewis and in Lanarkshire Satisfactory hay, pasture and silage have been secured by installing long wooden box drains leading to open collecting ditches and by using a rotary cultivator drawn by a caterpillar tractor, and supplying a cheap source of lime and the necessary fertilizers The spongy fibrous peat from *Sphagnum* in the Lanarkshire experiment has proved more amenable to treatment than the slimy *Scirpus* peat of Lewis, though in the drier parts of Lewis pasture has been established without cultivation and with very little drainage by using fertilizer, grass seeds and clover cleanings The Lanarkshire experiment was undertaken for the Commissioner for Special Areas in Scotland, and it was estimated that full reclamation would cost about £20 per acre

In analysing the basis of soil fertility and crop rotation, Dr E M Crowther emphasized the importance of soil structure and plant cover The essential contrast is between periods of cultivation with rapid oxidation, leaching and degradation of structure, and restorative periods under a vegetational cover leading to granulation of the soil, the return of nutrients to the surface and the production of active colloidal organic matter Under extreme conditions it has generally been found necessary to restrict, either by prohibition or by compensation, the amount of grazing or the proportion of the land occupied by the most wasteful crops, notably the widely spaced row crops with frequent cultivations Under our more temperate conditions there is a need, especially at college farms, for long range experiments along the lines of recent Rothamsted and Woburn experiments on crop rotations, testing the restorative value of leys, lucerne and green manures and the residual value of straw used directly and in farmyard manure and composts The use of fertilizers could be made far more efficient by combining a co-ordinated series of field experiments with soil surveys and soil analyses Such series of experiments are carried out annually in their thousands in most of the other countries of northern Europe whilst soil analyses have been used by the million in mapping for advisory purposes

Introducing the discussion on the papers, Sir Daniel Hall said that extra livestock cannot compensate for decreasing crop production since they are merely the manufactured products of imported foodstuffs Remedial measures costing some £40,000,000 annually were intended to maintain the *status quo* of our farming, but are not succeeding Better farming needs a measure of control through the landowner and cannot come through financial stimulus alone The landowners of Great Britain are so hampered by legislation and the immediate returns are so problematical that the landowners have ceased to have much influence on the farming of their land Even though land nationalization may not become a matter of practical politics for decades he suggested that a body should be set up and subsidized by the State to purchase the second class and poorer land, and get it into order and farmed properly Such a form of State activity is as necessary to-day as the production of shells and aeroplanes for defence The State is constantly acquiring large quantities of land for these and similar purposes and 'it should also busy itself similarly for the purposes of peace and for improving its own personal estate If not, what is the alternative ?"

E M CROWTHER

Ecology and Afforestation

THE symposium at Cambridge on The Cultivation of British Hardwoods (Department of Forestry K*) and the papers on The Ecological Aspects of Afforestation (Section K (Botany) and Department of Forestry K*) brought out clearly one point of great practical and scientific importance. It is the need for distinguishing between woodland and non woodland environments.

Since it is the policy of the Government to add to the existing area of woodlands it follows that most of the new planting is carried out on soils which bear a kind of vegetation other than woodland and it is just on this class of soil and under the conditions associated with it that difficulties are experienced in the establishment of hardwoods. Many if not all the soils of Great Britain presumably once carried some kind of woodland but the land has been cleared and put to various uses or misuses. Most of it has been farmed and still is but at various times some of it has been allowed to run wild. This marginal land is commonly heavy clay or light sand and its abandonment is usually attributed to falling prices of major farm produce. Doubtless this is a main cause but it may well be questioned whether modern farming methods by destroying the physical and biological regime of the woodland soil have not been a potent contributory cause. Besides the farm land carved from the original forest there are the wide open spaces of heather peat or poor grassland to which the forest failed to return because of regeneration difficulties due in the main to grazing burning or the lack of parent trees. Under these conditions too the forest soil has been altered in fact the set of conditions associated with a complex biological unit and built up slowly by Nature has been destroyed or degraded from its woodland status.

The problem stated affords an excellent illustration how the larger light emanating from the study of plant communities in general can be usefully focused upon the practical problems of the forester. For to the ecologist the forest is not merely a collection of trees with a certain density and rate of growth it is also a community of organisms living together in a more or less intimate and intricate relationship. This forest biological unit is achieved only after much preparation in Nature during the sequence of changes separating the early stages of the plant succession from the later culminating generally, in the climate of Great Britain, in woodland. It thus becomes easier to understand why trees like oak and beech which normally appear late in the succession are difficult to establish on new ground for the conditions of microclimate and soil (including microflora and microfauna) under which they become established in Nature are widely different from those offered by marginal and waste land. Further it is well for the forester to realize that in planting he is not only planting to produce timber but he is also setting in train a whole series of processes culminating in the formation of a complex biological unit.

Conifers are less exacting than hardwoods and can be more readily established on land available for planting and Prof H M Steven in his paper on The Ecological Aspects of Afforestation in Hill Country touched on their use as pioneer crops. He said that although vegetation may be a safe guide in the selection of species which will readily become established it need not necessarily be correlated with the subsequent growth of the trees after they have formed canopy. Here one can assume that the forest so to speak takes charge and changes the environment so that the coniferous crops now being established may be looked on as catch crops ameliorating the conditions for more exacting species to follow. The same points emerged in Mr R Ross s account of the colonization by hawthorn of abandoned arable land in the heavy chalky boulder clay district of west Cambridgeshire under the hawthorn scrub the soil changes in the direction of a woodland soil in acquiring more humus and an open crumb structure.

A pioneer coniferous crop mostly of pines has been successfully established by the Forestry Commission in Breckland an area with climate transitional between oceanic and continental and much subject to spring frosts with open permeable soils incapable of holding much water against shortage during drought and with a chalk content which varies from soils with much through soils deficient in it to those completely devoid of it. The last type is extremely infertile. Dr A S Watt gave a summary of his work on the area and concluded that liability to frost shortage of water and plant nutrients are the critical factors capable of amelioration at least in part through normal sylvicultural procedure. By controlling the canopy the internal climate of the woodland is ameliorated and the less hardy species can be successfully reared by careful choice of species and by planting them in suitable proportions the water holding and base holding capacities of the soil can be appreciably altered through the control of the amount and more important still the kind of humus produced

In the subsequent discussion Sir Roy Robinson explained that the exigencies of the moment had largely determined the selection of conifers for planting and that it was likely that the next generation of the forest would in certain parts of Great Britain at least differ markedly in com position particularly by the use of more hardwoods This is welcome news and more followed For Sir Roy announced on behalf of the Forestry Commission the initiation of a programme of closer co operation between the forester and the scientific worker particularly the ecologist and offered to set aside quite considerable areas in selected forests for purposes of scientific study primarily for a periodic record of the changes in the vegetation But many scientific interests are involved and one may look for results fruitful to science generally as well as to the forester from this opportunity to study a forest in the making

Limestones as Eruptive Rocks

THE carbonate rocks especially limestones and dolomites are so well known as sedimentary or metamorphosed sedimentary rocks that there may be some surprise that petrologists of Section C (Geology) of the British Association spent the greater part of a day during the recent Cambridge meeting in discussing the origin of carbonate rocks associated with alkali rich intrusions

The occurrence of limestones in close association with alkali rich rocks such as nepheline syenites phonolites and related types has been observed with great frequency and it has commonly been assumed that the limestones where not clearly belonging to a sedimentary formation were relics of sedimentary limestones assimilated in depth by the igneous magmas

According to a widely accepted theory proposed by R A Daly in 1910 such assimilation of lime stone by sub alkaline magmas is the cause of the formation of the alkali rich igneous rocks

However so early as 1892 some limestones occurring in the form of dykes and cutting the volcanic rocks of the Kaiserstuhl in Baden were described by A Knop and three years later A G Hogböm described limestone dykes in a region of alkali rich intrusives on the island of Alno in Sweden Hogbòm also recorded calcite as a primary mineral in some rocks at Alno and there were other descriptions of primary calcite in alkali eruptive rocks from Canada and India In view of the readiness with which calcite dissociates on heating geologists were reluctant to accept it as a primary mineral or to believe in limestone intrusions, but during the last few years much fresh evidence of apparently intrusive carbonate rocks has been obtained

The most convincing new evidence comes again from Alnò where the rocks are now far better exposed than they were at the time of Hogbom s visits forty three years ago They have been studied thoroughly by Dr Harry von Eckermann, of Stockholm who opened the discussion at Cambridge A large area of alkali intrusives—nepheline syenites and ijolites—cuts the Pre cambrian gneisses and is probably late Jotnian in age Around the contact with the gneiss (which is altered) crystalline limestones appear and out side the neck of intrusive rocks there are calcitic and dolomitic dykes which are shown to be cone sheets dipping towards two deep central foci From the inclination of the cone sheets the focus of the calcite dykes can be shown to be at 1 2 km below the present surface and that for the dolo mitic sheets at 6–7 km The geology of the country near Alno is well known and von Eckermann regards it as certain that for hundreds of miles around and to great depths there is no trace of sedimentary limestone in the Archæan rocks of earlier age than the alkali intrusives All the evidence points to a magmatic origin for these limestones at Alno

Magmatic origin is also claimed by Dr F Dixey for the crystalline limestone associated with breccias filling remarkable vents of post Karroo age in Southern Nyasaland At one of the largest of these vents Chilwa Island limestone and orthoclase breccias occupy a roughly circular area 1½ miles across and form steep cliffs rising 1 400 ft above the level of Chilwa Lake Nine larger and seven smaller vents are known and at most of them the limestones are cut by small bodies or dykes of alkali rich rocks nepheline syenite ijolite phonolite or nephelinite The rocks surrounding the vents are altered and there are many resem blances with the rocks of Alnö As for the source of the limestone Dr Dixey finds that the small lenticles of limestone known to occur in the Base ment Complex of the district are altogether too small and infrequent to have supplied the lime stone for the great masses of the Chilwa vents and the conclusion that they are in some way magmatic seems unavoidable

Mr S I Tomkeieff had visited Fen in Norway where the rocks closely comparable with those at Alnö were described in a classic paper by W C Brögger in 1921 He has no doubt about the magmatic origin of the carbonate rocks in that district

Prof S J Shand claimed that the limestones at Alnö and Fen and at eight other localities which he listed had been or ultimately would be proved to be derived from sedimentary or metamorphosed sedimentary limestones He described two areas of alkali rich rocks—Haliburton Ontario and Sekukuniland Transvaal—where he regards it as demonstrable that carbonate rocks associated with nepheline syenite have been derived by the incorporation of sedimentary or metamorphic limestones by igneous magma

Prof C E Tilley admitted that the limestone syntexis theory is applicable in certain places to a limited extent and he believes that the limestone intrusions in the Haliburton and Bancroft areas present certain peculiarities differentiating them from the other occurrences but he claimed magmatic origin for every other example of limestone associated with alkali rich rocks in Prof Shand's list He mentioned especially Magnet Cove Arkansas and Palabora Transvaal and he added two new examples Iron Hill Colorado and Kabossero at the head of the White Sea

The claim for magmatic origin of some of these limestones seems to rest on good field evidence but it needs to be supported by a credible explanation of how magmatic limestones can be formed and why they are associated with alkali rich intrusions To this task Dr von Eckermann devoted the last half of his address He outlined the possible processes which might have effected the formation at the base of the Jotnian sheet intrusions of a nepheline syenite magma rich in potash carbon dioxide fluorine and chlorine and he traced the possible history of such a magma as it stoped its way upwards to a point at which the concentrated volatiles shattered the roof and more or less pure carbonates filled the conical fractures in the surrounding rock Mr Tomkeieff also was able to suggest a possible petrogenetic scheme for the rocks of Fen He regards carbon dioxide as probably originally present in many rock magmas but lost by most during consolidation Where it is retained it must have a profound effect on the course of differentiation While Dr Eckermann made no claim that the explanation he had put forward applied outside Fennoscandia Mr Campbell Smith referring to the rocks of the Chilwa Series of Southern Nyasaland said that there are so many resemblances between them and the rocks at Alno and Fen that processes which were active in Fennoscandia in the Archæan must have been operative at the Chilwa vents in post Karroo times He said that in Nyasaland the problem is to explain the close connexion between the formation of pure orthoclase rocks (remarkably rich in potash) their brecciation the alteration of the country rocks the supply of material for and the emplacement of the crystalline limestone and the subsequent intrusion of alkali rich rocks

When the results of Dr von Eckermann's work are published it may be found that all these closely related events will find their places in the scheme of differentiation of which during the discussion he gave a brief description but which lack of space here compels us to omit

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Vibration in Engineering

FOR the past few years the council of the British Association in co operation with the various sections has selected a number of scientific topics which are of direct interest to the general public and by means of symposia or otherwise to which workers in the particular fields concerned have contributed general reviews of our present knowledge and the problems still to be solved have been arranged Among the subjects chosen for the Cambridge meeting was vibration a phenomenon which in this mechanical age is in daily evidence to every one of us and the importance of which is very great The engineer is concerned with its results upon the structure in which it occurs which in an aeroplane for example may be disastrous and in any event will have a deteriorating effect The ordinary person be he traveller in motor car train ship or aeroplane is more concerned with the discomfort (and even maybe injury to health) which accompanies continuous vibration From whichever point of view it is regarded therefore vibration is a phenomenon which everyone desires to see eliminated or reduced to a minimum

Any elastic structure when disturbed from rest and released will vibrate freely for some time in one of a number of possible modes the particular one resulting depending upon the restraints imposed on the structure and upon the method of disturbance The frequencies of these modes are called the natural frequencies of the system When a bridge or ship for example is subjected to a sudden load, it will vibrate in one of these natural modes, but the vibration will be rapidly damped out When a periodic disturbing force is applied to such a structure vibration will ensue of the same frequency as the disturbing force, the amplitude depending upon the magnitude of the force This type is termed 'forced' vibration When the frequency of the disturbing force is equal to that of one of the natural modes of vibration of the structure a state of resonance occurs, and, theoretically, for a completely undamped structure, the amplitude will become infinite Actually, the movement is restricted by the damping of the supports and in the material and by the fact that the restraints alter completely when the amplitude becomes large but nevertheless, very serious vibration may and does result in all types of engineering structures under such resonant conditions

In any motor car ship aeroplane or other self-propelled vehicle, there are several sources in the machinery from which periodic disturbing forces may arise, and therefore very few such structures are free from forced vibration of one form or another In order that the amplitude of this should be so small as to be unimportant to passengers, the engineer must do everything possible to balance the machinery so that the magnitude of the out of balance forces may be small If this cannot be achieved by such means a vibration damper may be used Such a device was described and shown in action at Cambridge by Prof C E Inglis in introducing the symposium on the subject in Section G (Engineering) It consists of a small spring supported mass, of about one per cent of the weight of the structure and attached to it, and tuned to vibrate at the same frequency Under such conditions it is capable of reducing the vibration of the main structure to very small amounts indeed Similar devices have been developed for eliminating torsional vibrations in engine shafts

The most serious cases of vibration whether considered from a structural or a comfort point of view, are those in which resonance occurs Under such conditions even a very small residual disturbing force may cause large amplitudes of vibration, and in a completed structure suffering from this type it is usually necessary to alter the frequency of the disturbing force and so destroy the resonance This however, cannot always be done without sacrifices in other directions As Dr F H Todd pointed out, when dealing with ship vibration, if the revolutions of the main engines have to be reduced by ten per cent to avoid resonance with a natural frequency of the hull, this entails, if no other changes are made, a loss of speed of ship of the same order To recover this loss, a new set of propellers will be necessary, and it is not then always a practical solution, since in certain types of engines, particularly oil engines, it is not permissible to increase the pressures in the cylinders in order to develop the original power at the lower revolutions One cannot usually destroy resonance in a ship by going to higher revolutions, since within the possibilities of a completed engine the margin will be small, and as soon as bad weather is encountered the revolutions will fall into the resonant range again

It is evident that the possibility of such resonant vibration should be considered in the early stages of any design in order that the frequencies of the engine forces should not coincide with any of the natural frequencies Fortunately, as Prof Inglis pointed out, vibration is one phenomenon in engineering which can be dealt with by precise mathematical methods and we can calculate the natural frequencies of many designs while they still exist only on paper, and so ensure an absence of resonant vibration in the completed structure Such calculations can be made for a ship for example, taking into account the variation in load and strength along the length of the hull girder A very important consideration in such a calculation appears to be the inclusion of the effect of the surrounding water This influences the vibration by its damping effect, which will restrain the amplitude at resonance, and also by the virtual inertia effect due to the loss of energy entailed by the movement imparted to the water underneath and alongside the hull as it vibrates The amount of this virtual inertia can be determined mathematically, and is equivalent to an addition to the hull weight of about its own magnitude for normal ships, and for a wide, shallow draft ship the increase of inertia may be three times the vessel's displacement These quantities seem large at first sight, but Dr Todd showed that the calculated frequencies so obtained for the primary vertical vibration agree remarkably well with the recorded natural frequencies for some sixteen vessels on which he has obtained their values experimentally

In aircraft, similar vibration troubles arise in the fuselage and air-screws In many cases these are due to forces originating in the engines, and as before special attention to the balancing and care in avoiding resonant speeds is essential In addition, vibration can be caused by aerodynamic forces Examples of such cases were given by Major B C Carter, including tail flutter, wing flutter and flutter of air-screw blades In certain conditions of flutter, instability may arise, and portions of the structure be torn away Knowledge on this branch has increased greatly of recent years, and enough is now known about it to avoid such disastrous effects Any new design of air screw is also subject to exhaustive tests to ensure that it is free from flutter before being used in machines.

In order to study vibration of aircraft in flight very delicate instruments are necessary, and some of those developed at the Royal Aircraft Establishment were described by Major Carter. One vibrograph designed there records the amplitude on a photographic film and can be operated by the pilot during flight by remote control, and yet is very compact and only weighs a little more than two pounds. To obtain records of air screw blade tip vibration in flight, a camera is secured to and rotated with the hub, the motion of the blade tip being recorded on a film by means of the relative movement of a small electric light bulb cemented to the tip of the blade. Other modern methods include the use of photo-electric cells, the variation of the resistance of a body under stress and cathode ray oscillographs. It is evident that all the latest developments of the electrical and physical sciences are being adopted in these instruments.

One aspect of the vibration problem touched upon by all three speakers at the symposium was the use of elastic mountings for prime movers, and this is a device which is being developed very rapidly, particularly in the design of motor vehicles. Such mountings bring with them their own problems, but we can look forward to a progressive improvement in comfort in all forms of transport by the successful elimination of vibration through their use. Much remains to be done in this way, but it was evident from this discussion at Cambridge that the engineering profession is fully alive to the necessity and is progressing rapidly in all its many and varied branches.

Incremental Permeability of Special Steels

THE importance now attached to the incremental permeability of silicon steel and of nickel iron alloys arises from the use of these materials for the cores of transformers and chokes in communication apparatus. Under these conditions the magnetization is due to a continuous steady current upon which a variation is imposed either by modulation or by separate coils carrying alternating currents. Generally the amplitude of the imposed wave is not great enough to reduce the steady magneto-motive force to zero, so that the value of the induction rises and falls as the resultant magneto-motive force changes, but it does not reverse. The calculation of the induced electromagnetic force in a secondary coil in these circumstances is fraught with peculiar difficulties.

Adopting the usual convention and indicating magnetic induction by B, magnetic force by H and permeability B/H by μ, then if the mean value of B is not high and its variation small, the mean ratio B/H over the change will approach the value of μ as measured and used for simple alternating currents. But as the mean value about which B varies gets nearer to the saturation region of the iron, and particularly when the imposed variation is large, not only does the mean value of μ fall rapidly but also its instantaneous value varies considerably. The consequences are (1) that the prediction of a secondary induced E.M.F. is difficult; (2) that if the imposed variation of H be sinusoidal the wave form of B will be distorted; (3) that if the imposed variation of B be sinusoidal the wave form of H will be distorted; (4) that losses associated with given variations in B and H become difficult to measure and very different from those in the same iron under simple alternating current conditions. Yet makers of communication apparatus must know what results they may expect from the material that they purchase, so that some method of specifying and of testing the quality of steel for these purposes is badly needed.

This was pointed out by Dr. J. G. A. Sims at a meeting of Section G (Engineering) of the British Association at Norwich (1935), and he added that the British Standards Institution specification for transformer steels (No. 601), which had been published that year, would not serve for these new purposes. Section G, recognizing the importance of the matter, asked Dr. Sims to ascertain what was being done both in England and abroad and to report at the Blackpool meeting in the following year. As a result, a questionnaire containing eleven questions was sent out from the University of Birmingham, and an analysis of the replies was presented at the British Association meeting of 1936, representatives of the British Standards Institution being present. On seven of the questions world opinion was sufficiently unanimous to enable Section G to ask that tests should be begun upon silicon steels based upon an alternating current method of test, sinusoidal variation of induction at 50 cycles per second and with samples in the form of a ring.

In February 1937 the British Standards Institution formed a committee to consider the drafting of a specification based upon these tests and the extension of such tests to cover the much wider conditions occurring in practice The experimental work has been proceeding at both the University of Birmingham and the Northampton Institute Clerkenwell London and substantial progress has been made by the British Standards Institution Committee At the Nottingham meeting of the British Association (1937) when papers embodying the results to date were read it became evident that methods of defining and measuring the harmonic content of a distorted wave were needed and that there were difficulties in connexion with symbols Two methods of measuring the wave distortion were given and the experiments by Greig and Parton proved that this factor could be determined either by a filter bridge or by an alternating current potentiometer

The papers presented at the Cambridge meeting of the British Association before a joint meeting of Section A (Mathematics and Physics) and Section G showed a great extension of the experimental work by the teams in Birmingham and London and in addition Mr D C Gall gave an account of the manner in which academic instruments could be adapted to commercial requirements while Mr C E Webb outlined the rapid advances that are being made in alloys suitable for transformers and communication apparatus

The subsequent discussion was remarkable for the comments by makers and users of the steels under test it is a pity that more time could not be allotted for valuable contributions of this kind which the British Association and perhaps the British Association alone can evoke In the matter of symbols and definitions little progress was made the only helpful remarks coming from Prof G W O Howe who showed that in Germany both definitions of distortion factor suggested by Sims and Greig were used rather indiscriminately with little inconvenience The official view of the British Standards Institution was expressed by Mr J F Stanley He emphasized the role of that Institution as a body holding a balance between research and utility and therefore bound to search for a practical specification He remarked upon the fact that the research work in this instance was unique in that it is in the hands of educational institutions and not commercial research organizations He welcomed as a guide the broad discussion at the British Association but held that actual decisions must be left to the Institution Committee Many references were made to the new materials mentioned by Mr Webb More than one speaker commented upon the amazingly high permeabilities which he had disclosed On the other hand doubt was expressed as to whether such values would be found under polarized conditions for Parton and Glazier have shown that there is an actual reversal of the usual order of permeability of annealed and unannealed specimens when they are polarized Again in connexion with the effect of impurities in alloys one speaker (Mr W Randall) said that atomic order has been found very important especially in the case of molybdenum and of chromium and that the direction of the crystal axes also must not be overlooked Others warned the investigators that results obtained on silicon steel would not apply to nickel iron alloys and as Mr Ronald Sankey reminded the meeting the new cold rolled silicon steels may call for special attention

Two general suggestions of great value emerged from the steel makers and users who were present The first stressed by Mr Ronald Sankey and Mr K Macfadyen was to the effect that tests suitable for quality control and acceptance—routine tests in fact—should be kept separate from tests devised to determine the exact properties of the materials This of course is bound up with the question of apparatus suitable for routine work in which connexion as an addition to Mr Gall s proposals both the disk magnetometer and the Ferrometer were mentioned It is one thing to deal with a few ounces in the laboratory quite another to deal with tests on 50 tons of stampings and no doubt the industrialists were right to direct attention to this question of perspective Dr F H Rayner of the National Physical Laboratory thinks that it might be advantageous to put forward a temporary specification that could be tried and revised after a year or so

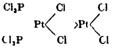
The other suggestion was a plea that any specification should so far as possible be international Section G has from the first kept this in mind as is shown by the wide dissemination of the Birmingham questionnaire but the duty of seeing that British steel makers are not penalized in the world s markets is a new aspect of this question which the British Standards Institution must not neglect

The discussion very properly laid bare the great difficulties both academic and practical with which this subject bristles It is clear that progress is being made and nothing but good can result from such an open and free debate At the same time the whole development shows a section of the Association moving in a new and useful direction For not content with recording the advancement of its science for the benefit of the public it has pointed out to an industry a region in which scientific advance is needed Further with the friendly co operation of that industry it has initiated a movement which will help manufacturers to specify and to test the magnetic qualities of their most important raw material

Organic Chemistry of the Metals

A DISCUSSION on recent advances in the organic chemistry of the metals, which had special reference to the transitional metals was held in Section B (Chemistry) during the Cambridge meeting of the British Association It was opened by Dr F G Mann, who said that recent advances in the organic chemistry of the metals are so numerous and cover so wide a field that any attempt to deal comprehensively with them in the brief time available would become a mere catalogue of individual investigations The most important advance which in his opinion was the investigations (mainly by Hans Fischer and his co workers) into the structure and synthesis of the porphyrins, was however, too specialized and too complicated for suitable treatment on that occasion, he therefore limited his own contribution to an account of certain polynuclear metallic compounds since this work was largely carried out in Cambridge and its discussion which followed logically from Prof C S Gibson s presidential address to Section B involved certain questions of chemical linkage which are of fundamental and therefore general interest

It has been known for many years that when spongy platinum and phosphorus pentachloride are heated in a sealed tube, two compounds, of empirical formulæ $(PCl_3)_2PtCl_2$ and PCl_3PtCl_2 respectively are formed These compounds when treated with an aliphatic alcohol ROH give the corresponding ester derivatives $\{(RO)_3P\}_2PtCl_2$ and $(RO)_3PPtCl_2$ Molecular weight determinations on the latter compound show, however, that it has the molecular formula $[(RO)_3PPtCl_2]_2$, and Werner suggested in 1909 that the parent compound had the structure (I) or (II) Similar results have been obtained with the corresponding palladium derivatives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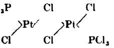
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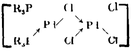
Decisive evidence for this bridged linkage of metallic atoms through acid radicals has, however only recently been obtained when its existence in gold compounds was proved by Gibson and Powell (cf the sectional presidential address) and in palladium compounds by Mann, Purdie and Wells

The non ionic derivatives of the tertiary phosphines and arsines with palladium dichloride, of general formulæ $[(R_3P)_2PdCl_2]$ and $[(R_3As)_2PdCl_2]$, were known to have the *trans* uniplanar configuration Mann and Purdie showed that these compounds in hot alcoholic solution readily react with ammonium palladochloride giving derivatives, for example, $[(R_3P)PdCl_2]_2$, similar to (I) and (II) These 'bimolecular' derivatives should theoretically exist in three

$$[(R_3P)_2PdCl_2] + (NH_4)_2[PdCl_4] = [(R_3P)PdCl_2]_2 + 2NH_4Cl$$

forms, the unsymmetrical form (III) and the *cis* and *trans* symmetrical forms (IV) and (V) In the crystalline state they occur in only one form which is the same in both the phosphine and arsine series since the corresponding members in the two series are isomorphous This form has been shown by Mann and Wells to be the *trans* symmetric form (V)

There is abundant evidence however, that these compounds in organic solvents give a tautomeric mixture of the three forms (III) (IV) and (V) This is shown partly by their anomalous dipole moments,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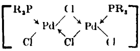
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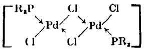

(V)

which have been measured by Dr Finn at Oxford, and partly by their chemical reactions Thus strong evidence in favour of the unsymmetric form (III) is provided by αα dipyridyl (symbolized by dpy) which splits the phosphine compound thus

$$[(R_3P)_2PdCl_2PdCl_2] + dpy \quad [(R_3P)_2PdCl_2] + [dpy\ PdCl_2]$$

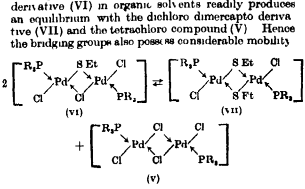
Moreover the dichloro oxalate which presumably has also the unsymmetric structure gives a similar reaction

$$[(R_3P)_2PdCl_2PdC_2O_4] + dpy \quad [(R_3P)_2PdCl_2] + [dpy\ PdC_2O_4]$$

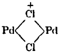
On the other hand, a monacid base such as *p* toluidine (represented as B) splits the compound in its symmetric form

$$[(R_3P)ClPdCl_2PdCl(PR_3)] + 2B \quad 2[(R_3P)(B)PdCl_2]$$

The formation of this equilibrium from the homogeneous crystalline compound shows that the unbridged groups in these molecules must readily interchange their positions This mobility is not however limited to the unbridged groups Chatt and Mann recently showed that the trichloro monomercapto derivative (VI) in organic solvents readily produces an equilibrium with the dichloro dimercapto derivative (VII) and the tetrachloro compound (V) Hence the bridging groups also possess considerable mobility


(VI) (VII) (V)

Prof N V Sidgwick had pointed out that the symmetric forms (IV) and (V) differ from the unsymmetric form (III) inasmuch as they possess the ring (VIII) and might be expected to have greater stability than the unsymmetric form (III) The chelated di sulphide and di arsine compounds (IX), (X) and (XI) have consequently been prepared by Chatt and Mann If these compounds reacted with ammonium pallado chloride, the resulting bridged compounds must have the unsymmetric structure of type (III) Actually no 'bridged' derivatives were obtained from these three compounds, and it appears therefore that the unsymmetric compounds are too unstable to exist in the solid state On the other hand, Mellor, Burrows and Morris prepared two isomeric cupro cupric compounds, of formula $[(R_3As)_3Cu_2Cl_2]$, and suggested that these isomerides have the constitutions (XII) and (XIII), the cuprous and the cupric complexes having the tetrahedral and the uniplanar configuration respectively The former compound possesses a ring structure electronically similar to that in (III), and decisive evidence for the structure of these isomerides would be of great interest Reference was also made to the cuprous and argentous compounds $[R_3As \rightarrow CuI]_4$ and $[R_3As \rightarrow AgI]_4$ investigated by Mann, Wells and Purdie



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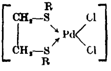

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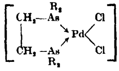

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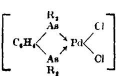

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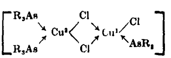
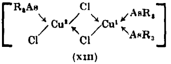


(XII)



(XIII)

Prof L O Brockway pointed out that investigations of the structure of organic derivatives of the noble metals now afford definite information with regard to the number and length of the bonds by which the metallic atom is linked to other groups, as well as the characteristic inter bond angles, the number of such bonds is 2, 4, 5 or 6 in the compounds of various metals The 4 covalent metals in the copper and nickel groups have a planar configuration in the divalent state (for example, the above palladium compounds, the cupric and argentic picolinates, and the nickel, palladium and platinum aldoxime derivatives) and a tetrahedral configuration in other valency states (for example $[Cu(CH_3CSNH_2)_4]Cl$, $Ni(CO)_4$ $(CH_3)_3PtCl$) The 2 covalent metallic complexes have a linear configuration (for example, $[Ag(\overline{CN})_2]$) the 5 covalent a trigonal bipyramid (for example, $Fe(CO)_5$) and the 6 covalent an octahedral configuration He emphasized however, that the work of Mann and Wells on the bridged palladium compounds shows that the co ordinate and co valent links (as represented in the above formulæ) are identical in length and that it is impossible to make a clear distinction between these links in complex metallic compounds As an example of the variation of bond length with the number of bonds per atom, he cited the series $Ni(CO)_4$, $Co(NO)(CO)_3$, $Fe(NO)_2(CO)_2$ $Cr(CO)_6$ The metallic atoms in these compounds are isoelectronic, but whereas the observed bond length to carbon in the first three compounds is 1 82–1 84 A in the fourth compound it is 1 91 A

A very interesting example of the application of complex metallic compounds to the study of nuclear physics was given in a preliminary announcement by Dr B C Saunders Dr Goldhaber and he have used the non ionic cupric derivative of ethyl aceto acetate to effect the separation of the active isotope of copper ($^{64}_{29}Cu$) The copper aceto acetate is irradiated by slow neutrons and its activity measured it is then dissolved in chloroform and shaken with aqueous copper acetate Some of the active isotope is thus transferred to the aqueous solution, from which it is precipitated by zinc, and its activity is measured The chloroform layer gives copper aceto acetate of much reduced activity F G MANN

Recent Research in Seismology

UNDER the chairmanship of Dr C G Darwin in the morning, and of Mr R S Whipple in the afternoon of August 23, a symposium on seismology covering a very wide field of topics was held at Cambridge in Section A (Mathematics and Physical Sciences) of the British Association At the outset, a very warm tribute was paid by Dr F J W Whipple to the pioneer work of Dr C Davison, who was the secretary of the earth tremors committee in 1895, when Prof. John Milne returned to England from Japan The work of these and others has led on to the present work on the International Seismological Summary, now being carried on by Miss E F Bellamy and Mr J S Hughes There are now 439 observatories in the northern hemisphere and 59 in the southern hemisphere sending seismological readings to Oxford, from which it has been possible to locate 2,865 different epicentres between 1913 and 1935 It is hoped that more stations will be initiated in the southern hemisphere, especially in South America and South Africa

In pure seismology, the discussion was continued by Miss I Lehmann of Copenhagen, who described and explained the characteristic seismograms obtained on instruments at different epicentral distances, the differences being due to reflections and refractions of the various pulses in the interior of the earth The suggestion by the late Prof H H Turner of the occurrence of especially deep focus earthquakes had been confirmed by the work of Dr R Stoneley, Mr F J Scrase and others, and this led Dr H Jeffreys to suggest that the hypothesis of Barrell was probably correct when he attributed finite strength to the earth down to a depth of about 700 km Further, the work of Dr D W Phillips helps to explain the existence of aftershocks, in that it has been shown that rocks may possess several strengths according to the method of application and duration of the forces The intensive study of deep focus earthquakes is likely to lead to solutions of some difficult seismological problems, including the depth of the core, the nature of the 20° discontinuity, and the times of transmission of the transverse wave up to epicentral distances of about 25°

In continuation Dr R Stoneley showed that, as the result of considerable labour, Turner's readings of the *L* phase of earthquakes corresponding to 0 48 mm /degree could be identified with long Rayleigh waves, and that the readings corresponding to 0 41 mm /degree could be assigned to the arrival of long waves first theoretically predicted by Prof A E H Love The former are usually designated *LR* waves and the latter *LQ* waves It is suggested that the difference between these two types of waves is due to differences at the origin *LQ* and *LR* are well separated at distances greater than 50°

Of interest to pure seismology is the work of Prof J D Bernal, who concludes that there may be, at the pressures and temperatures existing at some depth within the earth, a denser and less compressible form of olivine, $(MgFe)_2SiO_4$, than occurs normally on the surface This would possibly explain the 20° discontinuity Crystallography should also be considered when discussing the structure of the earth's core

Interesting on account of its application to both pure and applied seismology is the work of Dr D W Phillips, who described experiments he has performed in compression, bending and torsion on coal measure sandstones siltstones, mudstones, shales and coals, and also on some samples of marble These experiments show up very clearly the imperfect elasticity of the rocks, which behave as perfectly elastic under stresses applied for a short time, but give hysteresis loops, possibly with complete recovery only after a very long time, when a stress is applied for a longer time An interesting phenomenon found is that a stress large enough to give irrecoverable deformation may at first give only continuous deformation and yet lead to fracture if it is maintained long enough Dr Jeffreys showed later how this may account for the occurrence of continuous folding and fracture in the same arch a common geological phenomenon The fracture would cause an earthquake

In the realm of applied seismology, Mr T F Gaskell described the method of working and the results of the work of Dr Bullard and himself The method is to fire a small amount of gelignite and record automatically the seismic waves set up, by means of geophones at 200 ft intervals up to 1,000 ft, recording the initial time of the shock by a radio signal From the resulting seismograms the shape of the palæozoic floor of part of eastern England has been determined, the process being facilitated by the fact that the wave velocities in the palæozoic rocks are high, whilst those in the chalk and overlying strata are low

Educational Significance of the Cinema and Wireless

A JOINT discussion at Cambridge on August 23 between Section J (Psychology) and Section L (Educational Science) on the cinema and wireless in education was opened by Mr R C Steele, who dealt mainly with broadcasting

Pointing out the remarkable growth in the use of broadcast methods since they were first introduced in schools fifteen years ago, especially in the last two years, Mr Steele referred to the difficulty of evaluating their effects He suggested that with dull or backward children the broadcast lesson is probably more effective in proportion to their ability than with the brighter pupils It also offers a change from ordinary routine, presenting new material in a new and vivid way, which appeals to the imagination He considers that with the backward child it is a further advantage that the broadcaster, though he may ask questions, does not expect answers, and the dull child may thus gain confidence instead of being made conscious of inferiority to others Mr Steele stressed the importance of personality and, discussing the use which could be made of broadcasting in education, suggested that where detail is of prime importance, as in a science lesson, the film is likely to be supreme Where perfection of detail is less important and immediacy is the first consideration, broadcasting and television may give the best results, and he predicted a great future for television in school teaching

Mr Steele's paper was supplemented by a paper by Miss L M Holt giving some statistical results of tests made with children who had been having wireless and ordinary lessons alternately, which were designed to determine the characteristic contributions of this new aid to teaching The spontaneous contrasting of the facts in their possession was slightly higher in essays based on wireless lessons than in essays based on oral lessons, while a fine perception of specific or significant detail also characterized the wireless essays, indicating a good grasp of the subject

Dr P B Ballard, discussing the effect of wireless and the cinema on the life of the school child, emphasized the experimental nature of the educational film as part of the school programme It cannot be assumed that the child always prefers a talking to a silent film There is direct evidence to the contrary, and for educational purposes the evidence indicates that the film should be short—for example, five to ten minutes—and unless the commentator speaks slowly and clearly and in simplified language appropriate to the audience, a silent film with printed captions is preferable Reference was made to the bad influence of the ordinary cinema on children, particularly through displaying life not as service and quiet happiness but as self indulgence and the mad pursuit of pleasure Dr Ballard was emphatic that ordinary broadcasting should not be allowed to curtail a child s necessary quota of sleep or to interfere with his homework

Though broadcasting as compared with the educational film is comparatively mature, both methods have certain common characteristics and drawbacks They are not complete educational units, there is no give and take between teacher and taught They belong to the passive side of school work rather than the active—the impressional rather than the expressional Both also have their affinity with mass instruction rather than with individual study The capital virtue of the film is that it enriches the pupil's experience, while that of the radio talk is that it can do for the teacher what he could not do for himself Dr S J F Philpott suggested that both methods may tend to diminish the gap between the dull and the brighter pupils

The closeness with which a crowded audience followed the discussion bore witness to the deep interest in the possibilities of this new technique, and also to the realization of the dangers which attend its abuse in adult life as well as in childhood and adolescence

Professionalism in the Modern World

IN a highly suggestive paper on Professionalism read before Section F (Economic Science and Statistics) at Cambridge on August 19, Mr T H Marshall reviewed the development of the professions and discussed their place and inference in society to day According to Herbert Spencer, the history of the professions can be traced back to primitive societies From the first they were non manual, and Mr Marshall pointed out that their second characteristic was that they were not commercial, an ethical distinction clearly stated by the Greeks Payment must not be the motive in professional work The third characteristic of professionalism, the association follows from the first two It serves to maintain the power of brain work to command the produce of manual labour, and it ensures that men who must not work in order to be paid are nevertheless paid enough to support them at the right social level The official aim of a professional association is the preservation of a high standard of efficiency among its members This is achieved by training and examining all candidates for admission and by obtaining privileges as against all non members, which may amount to a legal monopoly Such rights can only be claimed where the profession is based on a body of special knowledge or on a scientific technique which can be imparted in training colleges and tested by examinations The typical professional association is a body that controls the application of science to the service of society

In spite of this corporate responsibility to society, the professions are by tradition intensely individualistic, and the close personal relation of trust between the professional man and his client has proved an obstacle to the enlistment of the professions in the service of the State Under the growth of science, the evolution of capitalism and the advance of democracy towards the social service State not only have many new professions been developed but also the part played by personal character and tradition in the older professions has diminished Capitalism requires professional men to work for impersonal corporations and may make him an employee Democracy is leading the professional men to study the whole social background of the problems confronting him, and the professions are being transformed from strongholds of narrow individualism into most hopeful agencies for scientific social planning

Simultaneously Mr Marshall pointed out the antithesis between commerce and the professions has been greatly weakened While the professions have been enlisted in the service of trade the administration of trade is becoming professionalized The salaried employees of big businesses are like the professional man, neither capitalists nor wage earners Mr Marshall suggested that they might become merged into a homogeneous social group, working not for profit, but for economic security, and out of interest in the job, a group favouring rational planning in public life, and individual freedom in private life, a group opposed to war whether between nations or between classes There is much in common between professionalism in its modern form and some parts of the theory underlying Fascism Moreover if this new class is to be effective, either its tactics must be Fabian in the extreme or it must seek allies Mr Marshall suggested that the vital question is the attitude this new class is inclined to take up towards the conflict between capital and labour, or whether it is likely to evolve a system of its own differing from that advocated by either of the two contending parties

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Research Co-ordination Committee

An account of the work carried out by the Research Co ordination Committee during the past year was given at a meeting of the Group held in Cambridge on August 22 The work included (1) a list of essential statistics, on which the views of bodies utilizing statistical data (Political and Economic Planning, Engineers' Study Group, New Fabian Research Bureau), the Institute of Statistics and several leading statisticians have been obtained, (2) co ordination of work on South Wales problems including a résumé of industrial proposals, bibliography on South Wales, report on land improvement, and on family budgets of employed and unemployed workers, (3) information on numerous societies and sources of information, which it is hoped will be published in the form of a directory of associations The Research Co ordination Committee has also been active in bringing together editors of scientific and other periodicals to consider co ordinating publications and has gathered material which is to be put before the new Division of the Social Relations of Science of the British Association

Safeguarding Unpublished Research

During the recent period of uncertainty in international relations, the Research Co ordination Committee approached several organizations having valuable unpublished data with the view of securing co operation for their safety in case of war The microfilm technique of duplication was considered, since it is relatively inexpensive (about 0 1*d* per page) when the necessary apparatus, which can be hired for a minimum period of one year, is available This could be arranged if a sufficient number of bodies co operate The response has been satisfactory, and others interested should communicate with the Hon Secretary, Research Co ordination Committee, 35 Gordon Square, London, W C 1

Memorandum on Smallpox

During the last three years, Great Britain has enjoyed comparative freedom from smallpox, and the Ministry of Health has therefore considered it appropriate to issue a memorandum in order to direct the attention of local authorities to the possibility which now exists of limiting the spread of smallpox by prompt and vigorous action as soon as it is reported to have appeared (Memo 215 (Med) London H M Stationery Office 2*d*) The memorandum contains an account of the incidence of, and mortality from, smallpox in England and Wales since 1901, and a summary of the procedure which should be adopted should the disease appear in a district

Suggested Science Museum for Cambridge

A large exhibition of historic scientific instruments and specimens was arranged under the auspices of the Cambridge Philosophical Society for the meeting of the British Association last August It was most gratifying to see the long series of instruments associated with the great masters of the Cavendish Laboratory—with Wollaston, Clerk Maxwell, J J Thomson, Rayleigh and Rutherford—but the older periods were also well illustrated by loans from the colleges At the final meeting of the General Committee in Cambridge, it was resolved that an expression of hope that the scheme for a permanent exhibition of historic scientific instruments in Cambridge would be brought to fruition, should be communicated to the University authorities, and this has been done

Electrified Omnibuses

Mr A E Wiseman, 21 Hanbury Road, Acton London W 3, writes stating that on boarding an omnibus recently, he felt a distinct electric shock on grasping the metal handrail with one foot on the step and the other on the pavement The effect was also observed by others, particularly on crisp mornings He suggests that the electricity may be caused by the friction of the tyres on the ground, which incidentally insulate the body of the bus It is of interest to note that this effect was described in a letter in Nature of June 29, 1929, p 981, by Sir Charles Boys, who observed it on a hot dry day and ascribed it to the scuffling of the tyres on the polished asphalt

A Naked-Eye Sunspot

A giant sunspot easily visible to the naked eye, is crossing the sun s disk in latitude 17° north from October 5 until 18, the time of central meridian passage being October 11 9 The area of this spot on October 6, corrected for foreshortening, was nearly 2,500 millionths of the sun s hemisphere and on October 8 its area measured 2,800 millionths, the measurements being made at Greenwich Observatory The spot on the latter date extended in solar longitude for about 125,000 miles Sunspots as large as this one are usually associated with terrestrial magnetic disturbances commencing about one day after the time of central meridian passage On October 7, a small magnetic storm was recorded at the Greenwich magnetic observatory at Abinger the disturbance reaching a maximum between 16^h and 20^h U T The ranges of the magnetic elements were in declination 51′ in horizontal force 200 γ, and in vertical force 260 γ It seems uncertain, however, whether this magnetic disturbance can be linked to the big sunspot, the most probable time of one related to the disturbed area of the sun containing this sunspot would be about October 12–13

Colonial Service Appointments

The following appointments in the Colonial Service have recently been made W D I Corby, agricultural officer, Nigeria, T N Greeves, agricultural officer, Nigeria, D G Jones, agricultural officer, Malaya, H T Measure, agricultural officer, Kenya, R J S Waddington, inspector of mines, Nigeria, D Luke, veterinary officer, Uganda, L D Branch, inspector of plants and produce, Gold Coast, C L Crosse, sleeping sickness control officer, Nigeria, J H C Hicks, sleeping sickness control officer, Nigeria; R Patterson, inspector of plants and produce, Gold Coast, B E V Parham (temporary assistant agricultural officer), agricultural officer, Fiji, J D Tallantire (agricultural officer, Nigeria), agricultural officer, Gambia (seconded), H E Hornby (director of veterinary services) director of tsetse research, Tanganyika Territory, D A Donald (temporary assistant agricultural officer), agricultural officer, Fiji, D L Foster (temporary assistant agricultural officer, Jamaica), junior agricultural instructor British Honduras, L W Harwood (temporary assistant agricultural officer), agricultural officer, Fiji

Biology in Education

UNDER the auspices of the Educational Advisory Board of the British Social Hygiene Council, a conference of principals and biology lecturers in training colleges will be held on October 22 at the British Medical Association House, Tavistock Square, London, W C 1 Prof J B S Haldane will speak on How to Make Biology Alive, and his remarks will be followed by discussion Dr Philippa Esdaile will speak on 'The Place of Field and Practical Work in the Biology Course" A discussion on The Concept of Human Biology will be opened by Mrs E J Hatfield and Dr H C Squires A selection of biological films will also be exhibited Further information can be obtained from the Secretary, Educational Advisory Board, British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W C 1

Announcements

PROF B W HOLMAN assistant professor of mining in the Imperial College of Science and Technology has been awarded the Gold Medal of the National Bureau of Scientific and Industrial Research by the French Minister of Instruction and Fine Arts The award of this medal to a British subject is very unusual

DR ALBERT E QUINE, a medical officer of the Ministry of Health, has been appointed inspector of anatomy in England and Wales

SIR HENRY BASHFORD chief medical officer of the General Post Office, and Sir Kenneth Lee, chairman of Tootal Broadhurst Lee Co, Ltd, have been appointed to fill vacancies in the membership of the Industrial Health Research Board of the Medical Research Council

THE Council of the Iron and Steel Institute confirms that, in accordance with previous announcements, the joint Autumn Meeting of the Iron and Steel Institute and the Institute of Metals in New York and the tours in Canada and the United States of America have been cancelled The Autumn Meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, S W 1, on October 26, at 10 a m and at 2 30 p m The Institute of British Foundrymen has accepted an invitation for members to take part in the discussion on the third report of the Steel Castings Research Committee which will be presented during the afternoon session

THE Council of the Iron and Steel Institute has accepted an offer from Captain C A Ablett to present a prize of £50 for the best paper on steelworks engineering submitted to the Institute, written by a junior engineer employed in a British iron or steel works, irrespective of whether or not he is a member of the Institute Competing papers should be marked "Ablett Prize Paper' and sent to the Secretary of the Iron and Steel Institute, No 4 Grosvenor Gardens, London, S W 1, not later than January 31, 1939

THE fifth biennial conference of the National Council of Mental Hygiene will be held at the Central Hall, Westminster, on January 12–14, 1939 Further information can be obtained from the Secretary of the Council, 76 Chandos Street, Palmer Street, London S W 1

APPLICATIONS are invited for the Eunice Oakes research fellowship at the Hospital for Sick Children, Great Ormond Street, London, W C 1 Candidates must be less than thirty five years of age The salary will not be less than £750 per annum Further information can be had from the Secretary of the Hospital

THE Middlemore Prize for 1939 in medical and surgical ophthalmology, consisting of a cheque for £50 and an illuminated certificate, founded in 1880 by the late Mr Richard Middlemore of Birmingham, is offered by the British Medical Association for the best essay on the underlying causes of glaucoma with suggestions as to future research in clinics and laboratories The essay should be sent to the Secretary, B M A House, Tavistock Square, London, W C 1, before December 31, 1938

THE Council of the Ophthalmological Society of the United Kingdom has established a Treacher Collins prize of £100 to be awarded triennially for the best essay submitted upon a subject selected by the Council The subject for the first award is "Cerebrospinal Disease in Relation to the Optic Nerve' Essays should be sent before December 31, 1938, to the Hon Secretary, Ophthalmological Society of the United Kingdom, 5 Racquet Court, Fleet Street, E C 4

IT has been decided to form a medico-historical museum in Berlin after the model of the Wellcome Museum in London

AN unusually large number of cases of infantile paralysis in Holland this summer has caused German authorities in some districts to forbid Dutch children crossing the frontier

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 721.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Discovery of an Additional *Pithecanthropus* Skull

DURING the systematic search for fossil man in Java one of us (G. H. R. von K.) discovered, in 1937, in the Trinil formation of Sangiran (Central Java) an almost complete brain case of *Pithecanthropus*[1].

Amongst the material recently collected (July 1938) from the same area, a large fragment of an additional *Pithecanthropus* skull came to light. The fragment consists of the complete right parietal bone with the adjoining part of the left parietal bone and a small piece of the occipital bone. The three bones embrace in their original and entirely undisturbed arrangement a stone core composed of sandy tuft mixed with lapilli. The sagittal suture reaching from bregma to lambda is completely preserved. The right parietal bone also exhibits all the other sutures, only the sphenoidal angle being broken off. The coronal contour of the parietal bones is characterized by a very pronounced sagittal crest. Laterally there is a distinct depression reaching to the temporal line, from which the contour runs steadily outwards down to the squamous suture. The temporal line runs strikingly close to the sagittal suture.

These conditions entirely correspond to those which are characteristic of the Sinanthropus skulls. The pronounced flattening of the cap so specific for the two *Pithecanthropus* skulls known hitherto, is completely missing in the case of this new *Pithecanthropus* skull. On the other hand, this skull has the following peculiarities in common with both *Sinanthropus* and *Pithecanthropus* skulls: the lowness of the entire cap and the position of the greatest breadth, the latter having undoubtedly been situated above the origin of the zygomatic arch, as is the case with all *Sinanthropus* and *Pithecanthropus* skulls.

According to the state of the sutures the new skull belongs to a juvenile individual, in spite of the fact that the parietal bones show a thickness of more than 10 mm. near the bregma, and that the temporal line is well developed. The region of the occipital torus is preserved only to a very small extent, revealing only a faint swelling, apparently in correspondence with the age of the individual.

All the new *Pithecanthropus* finds demonstrate how important and promising it is to search for fossil man in Java, and to continue the work which has been made possible thanks to the generous support of the Carnegie Institution of Washington, D.C.

G. H. R. VON KOENIGSWALD.
FRANZ WEIDENREICH.

Bandoeng,
Java.

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[1] *Proc. Kon. Akad. van Wetenschappen Amsterdam*, 1938.

Two Stellar Systems of a New Kind

SOME months ago an extremely faint, widely extended stellar system in the constellation Sculptor was reported from the Harvard Observatory[1]. In many respects it appeared to be unlike any known stellar organization. The finding more recently of a similar system in Fornax, on photographs made with the telescopes at the southern station of the Observatory, suggests that a description of these objects may be of general interest.

The two objects are separated in the sky by a little more than 20° and both are in the south galactic polar cap[2]. The following tabulation, in which some of the quantities are clearly provisional, compares the two systems:

	Sculptor Cluster	Fornax Cluster
Right Ascension	0h 57.8m	2h 37m
Declination	34° 2.5	34° 4
Galactic latitude	−83	64.5°
Angular diameter	80	60 +
Total magnitude	9.0	9.5
Magnitude of brightest stars	1[illegible] 8	18.0

The distribution of stars is very similar in the two systems. There are no irregular nebulosities, no clumping of stellar images, no sharp or bright nuclei—only smooth and essentially symmetrical concentration to the centre with approximately 10,000 stars to magnitude 19.5. In uniformity and radial symmetry they resemble globular star clusters.

The occurrence within the areas covered by the clusters of numerous faint external galaxies of the usual types and abundance, shows that space absorption within the clusters is negligible and also permits the close comparison of their members with faint spheroidal galaxies. It is thus determined that these two systems are not supergalaxies (rich groups of galaxies) but are composed of stars.

The distances and linear dimensions could be readily determined if we knew the absolute magnitudes of the brightest stars. Colours and spectra may be procured eventually and assist in evaluating the luminosities; but at present we hope to find the distances through the discovery and measurement of Cepheid variables among the stars of magnitude 19.5 and brighter. Appropriate plates are being taken with the 60-in. reflector at Bloemfontein.

It is probable that the resemblance to globular clusters also holds for the distribution of absolute magnitudes and that the distance modulus, $m-M = 5(\log d - 1)$, for these two objects is not greater than 19.5. The corresponding distance of eighty kiloparsecs implies that they are of galactic dimensions and places them well within our local supergalaxy, three times the distance of the Magellanic Clouds and but a third of the distance to the Andromeda

Nebula At the distance of the Andromeda system these objects would, in fact, have long escaped discovery There may be several others in the local group of galaxies, such objects may be of frequent occurrence in intergalactic space and of much significance both in the census and the genealogy of sidereal systems

The new objects have some properties in common with globular clusters, others with spheroidal galaxies, and still others (nearness and complete resolution into stars) with the Magellanic Clouds If intermediate forms connecting them with one of these standard types were found, a correct interpretation would be facilitated

Within the large area covered by the Virgo super galaxy (distance two to three megaparsecs) is a number of seventeenth magnitude objects which are of low surface brightness and about one minute of arc in diameter, they are possibly clusters of the Sculptor Fornax type, associated in this super system with the two hundred or so typical galaxies that have magnitudes from 11 0 to 13 5 Details of the examination of this possibility will be reported elsewhere

HARLOW SHAPLEY

Harvard Observatory Station
Bloemfontein

[1] *Harvard Obs Bull* 908 (1938)

[2] *Harvard Obs Circ* 423 (1937)

Nature of Extensive Cosmic Ray Showers

THE counter experiments of Auger, Maze and Grivet Meyer[1], and those of Kolhörster, Matthes and Weber[2], indicate the existence of very large cosmic ray showers, extending over an area of many square metres, and consisting of several thousand particles In order to obtain information about the constituents of these showers, a cloud chamber with a 2 cm lead plate across its centre, situated in a room with a light roof, has been used in a magnetic field of 800 gauss The chamber was controlled by the five fold coincidences of counters distributed so that the outer counters were separated by 5 metres With this counter arrangement the chamber took, on the average, 0 2 photographs per hour

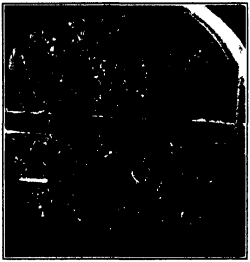
The twenty two successful photographs obtained show in all, about 250 incoming tracks, all of which can be interpreted as electron tracks Some of them produce small showers in a 2 cm lead plate in the chamber, and there is no indication of the presence of particles other than electrons One of the photographs obtained is reproduced herewith This is a part of the large shower which caused the five fold coincidence in counters separated by 5 m The photograph shows a typical cascade process, several particles, apparently energetic electrons, enter the lead plate and produce at least seven centres of multiplication

According to these photographs, it seems very likely that, if penetrating particles are present, they constitute only a small fraction of the shower particles, and are certainly insufficient in number to account for the penetration found by Auger, Maze and Grivet Meyer It is thus possible that the large air showers are in fact ordinary cascade showers A similar conclusion for the narrow air showers has been reached by one of us[3]

The distribution of the numbers of incoming tracks over the individual photographs is as follows

					Total
No of photographs	11	9	9	4	33
No of incoming tracks	0	1	2 10	>10	250 above the plate 300 below the plate

The average number of tracks per photograph given by the number in the above table is 8 It can easily be shown, however, that in order to calculate the mean density of tracks, this number must be reduced to about 5, because of the selective effect of the counter arrangement The area of collection for the chamber can be taken as the area of the lead plate in the chamber, which is 75 sq cm The mean density of tracks is then 700 per square metre This value is about twenty times that estimated by Auger, Maze and Grivet Meyer[1] from counter observations The discrepancy, however can be explained as follows



CLOUD CHAMBER PHOTOGRAPH OF AN EXTENSIVE COSMIC RAY SHOWER IN A MAGNETIC FIELD OF 800 GAUSS

A counter discharge takes place regardless of the actual number of particles passing simultaneously through the counter provided there is at least one Thus with counter observations it is not possible to differentiate between the passage of one or more than one particle, incident simultaneously on the counter Therefore the average number of particles incident on a counter can only be estimated by assuming a certain distribution law The calculations of Auger, Maze and Grivet Meyer assume inherently a Poisson distribution, that is, statistical fluctuation of the number of simultaneous tracks per unit area But since the average number of tracks per photograph is 5 the probability of finding due to statistical fluctuation, 150 incoming tracks on a single photograph (as has been observed once) is about 10^{-30} and is thus negligible Hence it may be seen from the data in the table above that the distribution of the numbers of tracks on individual photographs differs widely from a Poisson distribution The comparatively low density estimated from the counter experiments can then be understood as due to the assumption of only statistical fluctuations

Auger, Maze, and Grivet-Meyer found that one eighth of the shower particles penetrate more than 10 cm of lead Assuming these particles are electrons, the cascade theory shows that their energy must be greater than 5×10^{10} e v If we assume an area of 400 square metres for some of the showers, then *according to our new estimate of the mean density* of shower particles, some of the showers contain 30,000 particles ($\frac{1}{8} \times 400 \times 700 = 35,000$) of this energy The total energy of these particles would amount to nearly 2×10^{15} e v and the total energy of the whole shower taking into account also the particles of lower energy, would be still higher, perhaps as much as 10^{16} electron volts

I Jánossy
A C B Lovell

Physical Laboratories,
University of Manchester
Sept 2

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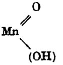
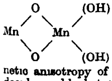
[1] Auger P Maze R and Grivet Meyer T *C R Acad Sci* **206** 1721 (1938) **207** 288 (1938)

[2] Kolhörster W Matthes I and Weber E *Naturwiss* **26** 576 1938

[3] Jánossy L *Proc Camb Phil Soc* in the Press

Magnetic Anisotropies and the Valencies of Paramagnetic Atoms in Crystals

Studies on the magnetic anisotropies of paramagnetic crystals are of interest because of the variety of information one can obtain from them under favourable conditions, on such widely different topics as (1) the magnitude and the asymmetry of the internal electric field acting on the paramagnetic ion in the crystal, (2) the geometry of distribution of the negatively charged atoms immediately surrounding the paramagnetic ion, and hence the co-ordination number of the ion, (3) the magnitude of the Stark separation of the energy levels of the ion in the above field (in the special case when the paramagnetic ion in the crystal is in the *S* state, the Stark separation of its levels is naturally feeble, and it plays an important part in determining the thermal behaviour of the crystal at very low temperatures, in the neighbourhood of 0·1° K), (4) the strength of coupling between the orbital and the spin angular momenta of the electrons in the incomplete shell of the ion, etc In some recent papers[1] we have dealt with these various aspects of paramagnetic studies on single crystals In the present note we wish to direct attention to another useful application, namely, to questions concerning the valency of the paramagnetic atom in the crystal

We shall take, for example, the well known crystal manganite, the chemical composition of which corresponds to that of hydrated hemitrioxide of manganese On the basis of the available chemical evidence, the manganese in the compound is sometimes regarded as trivalent, corresponding to the formula,  $Mn{=}O(OH)$, and sometimes as half divalent and half tetravalent, corresponding to the formula,  A measurement of the magnetic anisotropy of the crystal should enable us to decide readily between these two alternatives The Mn^{++} ion is in the *S*-state (^6S), and should therefore be almost isotropic The Mn^{++++} ion, which is in the ^4F state, and resembles Cr^{+++}, should also have very little anisotropy On the other hand, the Mn^{+++} ion, the ground state of which is ^5D, should have a relatively large anisotropy in the asymmetric crystalline field A measurement of the anisotropy of the crystal, that is, the difference between its maximum and minimum susceptibilities to find whether it is of the same order of magnitude as in manganous and chromic salts namely 10^{-5} per gram atom of manganese at room temperature or is very much greater, will therefore decide whether the manganese atoms in the crystal are half of them divalent and the other half tetravalent or all of them trivalent

The crystal is monoclinic, and at 31° C its maximum anisotropy, namely, $\chi_c - \chi_a$ is found to be $4{\cdot}0 \times 10^{-6}$ per gram atom of manganese which shows that the manganese atoms in the crystal cannot be trivalent

The mean susceptibility of the crystal does not give us similar information The susceptibility of Mn^{+++} lies almost midway between those of Mn^{++} and Mn^{++++} and further the exchange interaction between the spin moments of Mn which should be large in this crystal owing to the large concentration of manganese affects the mean susceptibility considerably and to an uncertain extent whereas its influence on the anisotropy is almost nothing

K S Krishnan
S Banerjee

Indian Association for the
Cultivation of Science
Calcutta
Aug 30

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[1] Phil Trans Roy Soc 1933 38

Relativistic Motion of a Radiating Mass

In 1926, Prof F W Brown[1] raised the question whether the usual equation

$$m\frac{dv}{dt} = F \tag{1}$$

is rigorously true for a radiating star and in a letter to Nature, Sir Joseph Larmor has advanced from considerations of momentum that (1) is true

The motion of a radiating star, according to general relativity, does not seem to have been discussed in any of the standard treatises on the subject Granted that a non-radiating small mass describes *approximately*[2] a geodesic in the space-time field, the question is whether a radiating small mass also does the same just as, in classical mechanics, equation (1) holds good whether a mass radiates or not To settle this question we may write the equation of conservation of momentum, for the particle and the outgoing radiation, as the former traces its world line as

$$(mv^\mu)_{,\nu}v^\nu + \lambda v^\mu = 0 \tag{2}$$

in the usual tensor notation Hence

$$v_\mu(mv^\mu)_{,\nu}v^\nu + \lambda v_\mu v^\mu = 0$$

and, as $v_\mu v^\mu = 1$ it follows that

$$\frac{dm}{ds} + \lambda = 0 \tag{3}$$

substituting for λ in (2)

$$(mv^\mu)_{,\nu}v^\nu - \frac{dm}{ds}v^\mu = 0,$$

or

$$m\left(\frac{d^2v^\mu}{ds^2} + \Gamma^\mu_{\alpha\beta}v^\alpha v^\beta\right) = 0 \tag{4}$$

It is clear, therefore that a radiating small mass will also trace a geodesic

Another point[3] arises here which is of considerable theoretical interest For a non radiating mass equation (3) gives a constant m and the equation of conservation of momentum (2) thus splits up into the two

$$(i)\ \frac{dm}{ds}\quad 0, \qquad (ii)\ m(v^{\mu})_{\nu}v^{\nu} = 0 \qquad (5)$$

The corresponding classical equation of conservation of momentum does not imply the constancy of inertial mass as in (5i) and Mach had to supplement therefore the Newtonian laws by his theory of the inertial mass determined by the ponderable bodies of the universe

V V Narlikar

Benares Hindu University
Sept 6

Larmor Sir Joseph Coll Papers 2 672 (1929) or Nature 117 300 (Feb 27 1926) See also Astronomy and Cosmogony by Sir James Jeans 298 (1929)

[2] Narlikar V V Nature 141 906 (May 21 1938)

[3] Eddington Sir A S The Mathematical Theory of Relativity, 127 (1924) The interpretation of (5) is not however mentioned in Eddington's book

Infra-Red Absorption Spectrum of Sulphur Trioxide

The infra red absorption spectrum of gaseous and liquid sulphur trioxide has been determined by us, in the laboratory for physical research at the Sorbonne, in the region extending from 7μ to 14μ, with the help of the self registering rock salt infra red absorption spectrometer developed and described by Lambert and Lecomte[1]

In the final experiments, the absorption of the vapour at ordinary temperature was measured in an atmosphere of air in a tube of about 10 cm length—closed at both ends by plates of rock salt—forming part of an all glass apparatus possessing a reservoir filled with liquid sulphur trioxide, separated from the absorption tube by a glass wall which was broken immediately before the beginning of the measurements The apparatus was filled at Amsterdam by the technique developed by Smits Owing to a small quantity of water vapour present in the air, some fog was sometimes formed, but in such a small concentration that it did not give any trouble It is of great importance, but not easy, to avoid this formation of fog, which causes a rapid attack on the plates of rock salt Some preliminary experiments on the absorption of concentrated sulphuric acid in a layer of some microns thickness, between plates of fluorite, have shown that its absorption is very weak

For the vapour two infra red absorption bands were found, at 8 9 μ and at 7 5 μ, with the latter the stronger, corresponding with frequencies of about 1120 and 1330 cm^{-1} The Raman spectrum of gaseous sulphur trioxide shows with certainty only a frequency shift of 1069 cm^{-1}, while from experiments with the liquid at different temperatures and mixed with sulphur dioxide, the vibrational frequencies 531, 1068 and 1389 (double, in reality 1379 and 1404) for the simple molecule in the *liquid* may be inferred[2]

The complete absence of the intensive Raman shift 1068 in the infra red absorption in the vapour proves that the *free* molecule of SO_3 has a plane, practically symmetrical configuration[2] For such a molecule the symmetrical pulsatory vibration is not combined with a change in the electric moment of the molecule, so that in infra red absorption it is inactive

The number of fundamental modes of vibration of such a molecule amounts to four, probably corresponding with frequencies of about 530 and 560 (symmetrical and anti symmetrical deformation vibration respectively)—the latter inferred from the absorption band at 1120 cm^{-1} supposing it to be a first harmonic—and further, 1069 and 1330 (Owing to the much larger mass of the sulphur atom in SO_3, compared with the central atoms in the related groups CO_3'' and NO_3', the frequency of the vibration (560) whereby the central atom moves fairly strongly perpendicular to the plane of the O atoms, may be expected to be considerably smaller for SO_3, than for the groups mentioned, where 870 835 respectively have been found)

For the liquid, several absorption bands corresponding with frequencies (in cm^{-1}) of about 795 (12 6 μ), 860 (11 6 μ), 940 (10 6 μ weak) 1065 (9 4 μ strong) 1205 (8 3 μ, moderately strong) 1330 (7 5 μ, moderately strong) have been found without doubt belonging to different kinds of molecules present in this partially polymerized liquid[3] The strong appearance of the frequency 1065 in absorption in the *liquid* proves that in this state the single molecule SO_3 is considerably deformed from the plane symmetrical configuration it possesses in the vapour state

No sign of absorption in the neighbourhood of 1390 cm^{-1} (7 2 μ) has been found in the vapour or in the liquid

It is a curious fact that the absorption bands at 12 6 μ and 11 6 μ are in their intensity dependent on the circumstances of the experiments For example in a mixture of sulphur trioxide with about the same volume of carbon disulphide the intensity of the band at 12 6 μ diminishes considerably, while that of the other increases

Our hearty thanks are due to Prof A Cotton for his hospitality and to Prof A Smits for permission to construct the apparatus at Amsterdam

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CH Bands in the Night Sky Spectrum

So long ago as 1934, we observed in the night sky spectrum, radiations characteristic of the nuclei of the comets, at about λλ 4300 and 4050 A[1] Their origin was then unknown The recent identification[2] of cometary radiations near λ 4300 with a band of the CH molecule induced us to search systematically for the CH bands in the sky spectrum For this purpose we used unpublished tables of wave lengths measured by Gauzit in the ultra violet and by Cabannes and Dufay in the blue and violet regions of the visible spectrum

Band λ 4300 The dispersion of the spectrograph is too small to allow us to find in the sky spectrum all the details observed by Dufay in cometary spectra Nevertheless, the correspondence between the sky radiations and the first rotational lines of each branch of the band is satisfactory We find in the sky the $R(3)$, $R(2)$ and $R(1)$ lines at λλ 4291, 4295 and 4299–4303, a stronger emission at λ 4312 5 can be identified with the two Q branches, we find $P(3)$ and $P(4)$ at about λ 4330, $P(5)$ at λ 4338

When we observe the spectrum of the sky near the horizon, the strong Vegard Kaplan band of nitrogen at 4316, degraded towards the red, hides the last two CH lines, but, at the zenith, while the whole Vegard Kaplan system weakens, these lines become very visible therefore there is something more in this spectral region than a Vegard Kaplan band

Since the intensity of the CH band does not obviously vary from the zenith to the horizon, it is not impossible that the CH molecules are outside the atmosphere and that a part of the night sky luminescence has an interplanetary or an interstellar origin It is interesting to recall that Swings has already proposed to identify the λ 4300 interstellar line, observed as an absorption line in stellar spectra with the $R(1)$ line of interstellar CH molecules[3]

Group of lines near λ 4050 These radiations of cometary nuclei occur also in the sky Cabannes and Dufay have shown that the lines of the 4050 and 4300 groups correspond to each other with a constant difference of frequency[4], which is about 1500 cm^{-1} In agreement with Baldet s observations, we cannot therefore identify the 4050 band of cometary nuclei and of the night sky with the weak Raffety band which, according to Grenat[5], is similar to the 3900 band It is possible that the group at λ 4050 represents a new CH band similar to the 4300 band

Band λ 3900 The 3800–3900 region is one of the least known in the spectrum of the sky Flint prisms are not transparent enough while quartz prisms do not give sufficient dispersion On the other hand, the 3889 Vegard Kaplan band coincides with the Q branches of CH The P branch only appears distinctly, the $P(2)$ lines at λ 3897 and the $P(3)$ lines at λ 3902

Band λ 3143 The very prominent maximum of this band is found in the sky at λ 3144 We have observed also the weaker maximum at λ 3157 No other origin has been suggested for these two sky radiations

Hence we conclude that the known CH bands probably exist in the spectrum of the night sky The radiations near λ 4050 form perhaps a new band similar to the 4300 band and certainly distinct from the Raffety band The emission occurs at a very high altitude or even outside the atmosphere We intend to compare again the intensities at the zenith and near the horizon in order to decide whether the emission of the bands that we attribute for the present to CH molecules is or is not connected with the earth s atmosphere

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Fatty Acids from Yeast as Respiratory Factors

A NUMBER of papers[1] from this laboratory have reported the preparation from yeast and malt combings of fractions which stimulate the respiration of yeast and of animal tissues, particularly of skin A study of these fractions appears to indicate the existence of a multiplicity of respiratory factors The fractions studied thus far have been water soluble and thermostable They have all contained nitrogen and phosphorus but the fractions have been manifestly impure and it has been difficult to correlate the respiratory activity with chemical properties except to indicate that protein probably plays no part On the other hand it has been possible to correlate the proliferation promoting activity of preparations from yeast with nucleic acid like materials containing guanine, adenine, phosphorus and pentoses and having a maximum in ultra violet absorption[2] at 2600 A

We have now found that the steam distillation of a crude concentrate prepared by extracting yeast with aqueous alcohol yields about 0 05 per cent (based on the yeast) of a light coloured water insoluble substance having an indefinite melting point near room temperature and an unpleasant odour suggestive of isovaleric acid It does not contain nitrogen or phosphorus It is soluble in alcohol, ether, benzene, and alkali It has an iodine number of 5 5 by the Hanus method The high neutralization equivalent of about 295 is probably accounted for by the presence of contaminating fat soluble materials From the steam distillate can be obtained a nearly colourless potassium salt which is unmelted at 300° C but darkens at 210° and dissolves in water to form an alkaline solution The material gives a negative Liebermann Burchard reaction These properties point to a mixture containing saturated fatty acids

The material causes as much as a 350 per cent increase in oxygen uptake of a yeast suspension in concentrations of 0 5 mgm per c c, but higher concentrations are less effective and 10 mgm per c c is inhibitory In nearly all concentrations, the material is markedly inhibitory to the respiration of rat skin, although in low concentrations (1 mgm per c c) a slight stimulation is observed This behaviour is duplicated qualitatively by pure saturated fatty acids such as capric and undecanoic Thus the respiratory activity of the distillate appears to be related to its fatty acid content

The steam distillate, in proper concentrations, markedly stimulates the growth of epithelium in tissue cultures In the concentrations thus far investigated, the material appears to be inhibitory to yeast growth and fermentation

A detailed account of this work will appear later

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[2] Cook, Loofbourow and Stimson 10th International Congress of Chemistry Rome May 1938 Loofbourow Cook and Stimson in the Press

Blood Ammonia and the Deaminases of Adenosine and Adenylic Acid

THE characteristic value of the general blood ammonia in man was shown to be either zero or below the analytical level[1] This has been confirmed for the rabbit and by H Kropowski for the dog, using the technique of this laboratory[2]

After shedding the ammonia develops from three sources The first or alpha ammonia (about 40 γ ammonia N/100 ml) forms immediately after shedding whether the pH of the blood be maintained or not, but does not form in the presence of carbon dioxide The amino compound involved may be adenosine protected by carbon dioxide (though the complex formation does not appear to be readily reversible) and deriving in turn from one or other of the adenylic acids Plasma has been shown to deaminate adenosine with great specificity leaving unattacked more than fifty other substances of biological significance and with amino or volatile amine groups This plasma deamination of adenosine and its great specificity was shown by one of us[3] prior to the communication of Drury *et al* to the Physiological Society in January 1937

The second or beta formation (about 1 mgm N/100 ml in the rabbit) comes from adenylpyrophosphate in the red corpuscles, breaking down mainly through the following stages adenylpyrophosphate → adenyldiphosphate + 1 phosphate → adenosine + 2 phosphate → inosine + 3 phosphate + ammonia (The phasic formation of ammonia previously reported[4] appears to be associated with the re esterification of adenylic acid) Adenylpyrophosphate disappears practically quantitatively in rabbit blood with the appearance of free ammonia The chief reason for supposing the final stages is that muscle adenylic acid in *high* concentration is freely deaminated by laked red corpuscles and vegetable adenylic acid also, but only at a small fraction of this rate As the concentrations of the acids are diminished so also is the deamination rate, but to a lesser degree for vegetable adenylic acid At a concentration of 0 05 per cent of the nucleotide they are deaminated at about the same rate This can be interpreted satisfactorily only on the basis of an initial dephosphation—at the low concentrations—followed by a deamination of the formed adenosine

The third or gamma ammonia (about 100—200 γ N/100 ml for man, and a mean of about 350 γ N/100 ml for the rabbit, judging from the twenty four hours formation) appears to derive largely if not entirely from vegetable adenylic acid, this being first dephosphated and then deaminated The following evidence exists for this supposition

(1) Vegetable adenylic acid is deaminated at the required rate, muscle adenylic acid and adenylpyrophosphate being excluded by the fact that the action of striped muscle extract has no effect in raising the plasma ammonia

(2) The rate of the gamma ammonia formation in plasma plotted against the pH shows two peaks, one in the region of 6 8 and the other at about 8 6 This double peak is characteristic of a phosphatase action signifying a preliminary dephosphation When vegetable adenylic acid is added to plasma, the extra ammonia formed after 24 hours shows a similar double peak and in the same position

(3) A large number of other possibilities has been excluded , for example, guanylic acid, guanosine, cytydylic, cytidine, etc , but not the adenyl compounds of desoxyribose, which remain as possible but unlikely precursors

Concerning the adenylic acid and adenosine deaminases of blood and tissues, it may be noted that adenylic acid in laked blood (and five other tissues similarly examined) is deaminated in proportion to its concentration beyond a certain critical value of 0 1–0 2 per cent of the nucleotide The activity of the deaminase also per unit volume of blood increases markedly with the dilution On the other hand, the ferment in striped muscle (about forty times greater in the mean than that of any other tissue) acts independently of the substrate concentration The indication is that the ferment in the red corpuscle and other tissues—except voluntary muscle—is reversibly bound to some inhibiting substance, which may be described as a protector substance for adenylic acid Comparative values of the adenosine and adenylic acid deaminases (adenylic acid in 1 per cent concentration) were studied in thirty six tissues of the rabbit With regard to the adenosine deaminase, it is a curious fact that the *appendix showed the highest concentration in the body*, having a mean value of 55 6 units of enzyme concentration (the unit being γ N/minute/gm tissue) compared with about 6–8 for whole blood, ileum and cæcum The values for duodenum and jejunum were also high but not so high as the appendix Of the eleven types of glandular tissue studied it is noteworthy that the liver came second lowest with 3 7 units (it contained the lowest amount of adenylic deaminase, namely, 2 2 units) The muscle group contained the least amounts of adenosine deaminase, the muscle of the auricle being highest in the series with 6 8 units and voluntary muscle lowest with 0 9 The content in adenylic acid deaminase followed to some extent that for adenosine, with many marked differences, the most extreme being voluntary muscle, which contained in the average about 1,000 enzyme units This enzyme also is greatly in excess of the adenosine deaminase in conducting nerve, cerebral cortex and pituitary gland , and in the alimentary distribution we have the proportion reversed No pure adenylic acid deaminase was found in plasma

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Application of the Feulgen Method to the Study of Viruses

'NUCLEOID' bodies giving a positive Feulgen reaction have been shown to be integral constituents of various kinds of spore bearing bacilli[1] and also of *Bact Coli* and '*Bact paratyphosum*'[2] Photographed in ultra violet light, these bodies proved to possess the specific absorption characteristic of nucleic acid

So far as we are aware, Haagen is the only investigator who has applied this reaction to a virus He has stated[3] that the inclusion bodies of vaccinia give a positive Feulgen reaction, but that the elementary bodies are negative We have been able to confirm Haagen s findings so far as concerns the elementary bodies and the small inclusions which characterize the early stages of infection, but we have invariably obtained a negative result with the large irregular type of inclusion present during the later hours

The Feulgen negative inclusion bodies of vaccinia and the elementary bodies stain red with Giemsa s stain The small Feulgen positive inclusions stain deep reddish purple, while bacteria stain a deep bluish purple Both the elementary bodies and the large forms of psittacosis virus stain a purple rather than a red colour with Giemsa s stain This circumstance induced us to test the various developmental stages of this virus with the Feulgen technique Positive results were obtained both with free elementary bodies in smears made from the spleens of mice which had died of the disease, and with all the various intra cellular stages found in tissue cultures infected with the virus

Through the kindness of Dr G M Findlay, we have also been able to examine smears of lympho granuloma inguinale virus As Findlay, Mackenzie and MacCallum have shown[4] this virus, like psittacosis, produces both large forms and elementary bodies and stains with Castañeda s stain With Giemsa s stain the elementary bodies are stained a colour intermediate between the purple of psittacosis and the red of vaccinia Both elementary bodies and large forms gave a negative result in our hands

Some investigators (for example Herzberg[5]) are doubtful whether psittacosis should be included among the viruses because of the ease with which it stains with dilute Victoria blue and with Castañeda's stain The fact that it is Feulgen positive appears to strengthen this distinction, but on the other hand in lymphogranuloma we have a virus which is at once Castañeda positive and Feulgen negative thus forming an intermediate link between psittacosis on one hand and vaccinia on the other

It will be of interest to apply the Feulgen method to as many viruses as possible and this we propose to do

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Points from Foregoing Letters

THE discovery of a large fragment of an additional *Pithecanthropus* skull (consisting of the complete right parietal bone with the adjoining part of the left parietal and a small piece of the occipital bone) is reported from Java by Dr G H R von Koenigswald and Dr Franz Weidenreich This was found in the Trinil formation of Sangiren where an almost complete brain case of *Pithecanthropus* was found last year

A type of sidereal system heretofore unknown is reported by Dr Harlow Shapley, who has based his investigations on long-exposure photographs made with various telescopes at the South African station of the Harvard Observatory The two examples now described resemble globular clusters in uniformity and radial symmetry, numerous faint external gal axies seen through them give them the appearance of supergalaxies, but they are probably members of the local supergalaxy

Dr L Jánossy and Dr A C B Lovell have obtained cloud chamber photographs of cosmic ray showers which extend over several square metres They conclude that the showers consist mainly of electrons, and that in some cases the total energy of the shower may exceed 10^{15} electron volts

The magnetic anisotropy of manganite crystals (monoclinic) is found by Prof K S Krishnan and S Banerjee to be $4 \cdot 0 \times 10^{-6}$ per gm atom of manganese This value, the authors state, shows that the manganese atoms in the crystal cannot be trivalent, but are probably half divalent and half tetravalent

Prof V V Narlikar submits a proof, using the equation of conservation of momentum, that a *radiating* small mass describes a geodesic He also points out that the constancy of the inertial mass is implicit in the equation of momentum itself when the body is not radiating

The infra red absorption and Raman spectra of liquid and gaseous sulphur trioxide have been investigated by Dr H Gerding and Dr J Lecompte who deduce that in the vapour state the molecule of sulphur trioxide has a plane practically symmetrical configuration while in the liquid state the molecule is considerably deformed

A reconsideration of the wave lengths observed in the ultra violet and visible spectra of the night sky by Prof J Cabannes Prof J Dufay and J Gauzit lead the investigators to the conclusion that CH bands probably exist in the spectrum of the night sky at 4300, 3143 and possibly 4050 A

A substance obtained by the steam distillation of yeast extract and apparently containing a mixture of saturated fatty acids is found by Prof E S Cook and C W Kreke to increase by 3½ times the respiration factor (oxygen uptake) of yeast suspensions when added in suitable concentration Capric and undecanoic fatty acids were found to have similar properties In the concentrations thus far investigated the yeast distillate appears to be inhibitory to yeast growth and fermentation, but stimulates the growth of epithelium in tissue cultures

The free ammonia formed in blood after shedding, arises from three sources according to Prof E J Conway and R Cooke These sources are (1) adenosine, (2) adenylpyrophosphate in the red corpuscles and (3) vegetable adenylic acid The authors indicate the probable stages by which the ammonia is formed, and point out that probably the ferment in the red corpuscles and other tissues, except voluntary muscle, is reversibly bound to some inhibiting substance

Research Items

Craniology of African Pygmies

SKELETONS of four African pygmies, acquired for the Musée de Congo of Terveuren by Dr P Schebesta and J Jadin in their expedition to the Ituri Forest in 1934–35, have been examined by Prof J Mateigka and Prof J Maly The first instalment of their report, dealing with the crania, appears in *L Anthropologie* (**48**, 3–4, 1938) Of these skeletons, two are male and two female Of the males, one was of about forty years of age, the female from the same locality was about fifty years of age The skulls were well preserved, and the distinctive sexual characters well marked There was a marked atrophy of the maxillaries, possibly due to the loss of the teeth, which may also have caused a certain facial asymmetry Partial caries and alveolar pyorrhea were present The sutures generally were simple Head length varied from 165 mm to 176 mm, breadth from 128 mm to 136 mm This measurement in the male crania (135 mm and 136 mm) approaches the mean for Spanish skulls and exceeds that recorded for Australian, Vedda and Bushman Head height 122–130 mm is a minimum figure The dimensions of the skull taken together, however, point to the classification of these pygmy skulls with other groups below the mean The cephalic index of 73 56–80 47 ranges from dolichocephalic to brachycephalic They may be classed generally as orthocephalic, with a tendency to metriocephaly The horizontal circumference ranges from 475 mm to 498 mm This indicates that the pygmies do not touch the absolute minimum, as smaller dimensions are found among both primitive and white peoples

Undulant Fever in France

IN a recent *Bulletin of the Health Organization of the League of Nations* (7 Extract No 9) R M Taylor, M Lisbonne L F Vidal and R H Hazemann who made a study of 869 *Brucella* strains isolated from man and animals in France, came to the following conclusions All the classified strains of *Brucella* fall into one of two types, namely, *Br melitensis* and *Br abortus* Of 507 strains isolated from man, 477 (94 per cent) were *Br melitensis* While the *melitensis* type was definitely dangerous to man, *Br abortus* was a relatively unimportant cause of undulant fever, and was essentially an economic and veterinary problem Cases of undulant fever of the *melitensis* type were usually multiple and tended to occur in localized epidemics, while those of the *abortus* variety were almost invariably sporadic The incidence of undulant fever in France reached a peak in the early spring, which is the period of parturition and abortion among domestic animals such as sheep and goats As regards age and sex, clinical undulant fever was found to be rare below the ages of fifteen years and was two or three times more frequent in males than in females Infections in goat and sheep were almost always of the *melitensis* type, whereas cows were the principal hosts of the *abortus* variety The disease was found to occur chiefly among the rural population and in those who were brought in contact with the animals or their carcasses The writers' studies indicated that the risk of infection through contact with animals was decidedly greater than through consumption of raw milk or fresh cheese Sanitary conditions were of little importance in the transmission of the disease

Aerial Vision in Freshwater Grey Mullet

AERIAL vision in fishes, demanding a modification of the under water eye, is a rare development, so that the notes by Dr S L Hora upon the freshwater grey mullet of northern India and Burma (*Mugil corsula*) are welcome, although they do not carry the problem very far (*J Bombay Nat Hist Soc* **40**, 62, 1938) The species habitually moves at the surface of the waters in which it lives with both its eyes well elevated above the surface That it can see in this position is indicated by its active capture of caddis flies, the swarms of which it seems to follow at the surface Yet the stomach contents of some consisted mostly of large numbers of copepods, and others devoured aquatic algæ, so that the fish can apparently see under water as well as in the air Hora also noted that in both media the eye balls showed movements in all directions, as if they were in active use But no experiment has been made to test the efficiency of the organ in either medium, and except that the grey mullet has no structural adaptation like that of the South American 'four eyed fish, *Anableps*, with its bifocal vision, no information is given about the minute structure of the eye itself, to suggest the direction of the aerial modification Information on these points would be of value

Genetics of Millet and *Sorghum*

MILLET (*Panicum miliaceum*) has been grown from the earliest times in India, Africa southern Europe China and Japan Its home may have been in central Asia, where nomad peoples found it useful because of its short period of maturation Mr Rangaswami Ayyangar and his colleagues have studied its genetics (*Madras Agric J*, **26**, 195, 1938) at Coimbatore They find a dominant factor P for purple pigmentation and an intensifier, I, which makes the purple darker The hairiness is governed by at least three factors H_1, H_2, H_3, which are cumulative in effect In grain colours of Madras varieties, a dominant factor O changes buff to olive grey A dominant factor L lightens the glume colour An inhibitor I lightens it further to ivory A third grain colour, reddish orange is recessive to buff, while another dominant factor suppresses the red in reddish orange, making it buff A number of species of *Sorghum* are found (*Current Sci*, **6**, 556) to have varieties with green and others with blue green seedlings, the latter tillering more This colour disappears after forty days and behaves as a dominant to green The African species of *Sorghum* and their hybrids appear to be the origin of the blue green type, which is also found to occur in many other grasses In broom corn, a *Sorghum* with long stalks to the panicle branches, a form occurs with neither auricle nor ligule to the leaves It is a simple recessive to the auriculate ligulate condition (*Proc Indian Acad Sci*, **7**, 286), and also differs in having no basal pulvini and a short spikelet-free area in the panicle branches This makes the earhead very compact with many sterile seeds It presumably represents a mutation from the ordinary broom corn condition

Constitution of the Great Barrier Reef

The Reports of the Great Barrier Reef Committee, 4, Pt 3, Nos 7, 8, 9 (Brisbane Gov Printer, 1938) contain a preliminary account by Prof H C Richards on the boring made in 1937 on Heron Island (lat 23° 26′ S, long 151° 57′ E) at the southern end of the Great Barrier Reef This bore followed on a previous boring made in 1927 on Michaelmas Cay some 700 miles farther north west along the reef The Michaelmas Cay boring failed to reach the underlying old rock platform after a depth of 600 ft It was hoped to bore to 1,200 ft on Heron Island Unfortunately, layers of rock were encountered below 510 ft which necessitated reductions in the size of the casing, and the extreme depth reached was 732 ft Once again the bed rock was not reached Comparison of the two borings shows a remarkable similarity In both it was found that loosely coherent coralline material extends to a depth of approximately 450 ft In both this was succeeded by non coralline material of loosely coherent quartz sand with abundant foraminifera and littoral shell fragments In the Heron Island bore eight siliceous foraminiferal limestone bands were met below the coral of which the thickest was 78 inches, four were of the order of 18 inches to 2 feet and the others quite thin

Oxidation and Reduction

In an article in *Scientia* of September 1938, Prof J R Partington reviews the early history and modern outlook upon the processes of oxidation and reduction, and in particular the application of the oxidation reduction potentials, now generally known as 'redox' potentials, to modern problems Incidentally, he points out the curious resemblance between the electronic theory of oxidation and the ancient theory of phlogiston Metals are now believed to be combinations of positively charged ions and negative electrons, of which the former persist in oxides and cations The process of oxidation involves then the removal of electrons instead of phlogiston It may be noted in this connexion that those metals which are most readily oxidized are those which most readily emit electrons when exposed to light of short wave length In applying the well known thermodynamic equation to the evaluation of the redox potential of an electrode of the quinhydrone type, it was assumed by Ostwald that every reducing or oxidizing agent could be replaced theoretically by hydrogen or oxygen under an appropriate pressure, and Nernst obtained some experimental support for this supposition by pumping hydrogen gas from a thin bulb of palladium immersed in a solution of a reducing agent But since reversible cells giving redox potentials can be set up with solutions of metallic salts in anhydrous solvents like pyridine or acetonitrile, which are unable to furnish hydrogen, some other mechanism must be found, and it is reasonable to postulate the presence of low concentrations of free electrons not only in these but also in all cases, to establish the potential Increasing use of redox indicators is being made with marked success in analytical chemistry, since they undergo reversible changes which are very similar in type to those of the quinhydrone electrode and are accompanied by colour changes at definite potentials, corresponding with definite electron concentrations in the redox system Even more interesting is the field opening up in the study of biological processes, which involve oxidation and reduction and are catalysed by specific enzymes It is hoped that it may be possible to extend the use of 'potential mediators' in order to overcome the difficulty presented by the thermodynamic irreversibility of many of these important reactions Much remains to be done in developing the study of one of the oldest known types of chemical reaction

Search for Super-Novæ

F Zwicky (*Phys Rev*, 53, 1019) has published a preliminary account of a systematic study of super novæ The basis of the work was a photographic survey with an 18 in telescope of aperture *f*/2 Three super novæ were discovered, corresponding to a frequency of occurrence of one nova per galaxy per six hundred years It was shown that the spectra are distinct from those of all other stellar objects and that the absolute brightness may often be far higher than that of any other star It is concluded that the existence of two classes of temporary stars, the ordinary and super novæ, is established beyond doubt

Draining the Cambridge Fens

The greater part of the fenlands of northern Cambridgeshire were drained during the first half of the seventeenth century The enterprise was very successful at first, but difficulties soon began to become evident, some of which have continued to be prominent right up to the present day, as was shown in a paper read at Cambridge before Section E (Geography) of the British Association by Dr H C Darby These permanent difficulties are associated with the lowering of the peat level and with the outfalls of the fen rivers As the peat was drained, it rapidly sank in level partly owing to shrinkage and partly to the wasting away of its surface by bacterial action, so that in time its level became lower than that of the drainage channels This difference of level may be seen to day along many of the fen rivers, which are now higher than the land through which they flow In the eighteenth century, wind mills were introduced, but as the surface level continued to subside, their limitations made them inadequate to the requirements In 1800 steam pumping was discussed, but it was not until 1820 that a steam engine by Watt was set up to work a scoop wheel at Bottisham Thirty years later it is estimated that sixty four steam plants were in operation Difficulties have also arisen at the estuaries of the fenland rivers, which have not a sufficient current to carry their silt out to sea The most recent effort to deal with this problem is the large scale working model of the Wash and its estuaries constructed by the Great Ouse Catchment Board Another type of problem is presented by the sluices which are necessary to prevent the tidal waters from passing up the rivers A case in point is Denver Sluice immediately below which the Hundred Foot River drains directly into the tidal Ouse When there is much upland water passing down this river, the level in the Ouse does not fall sufficiently to admit of the sluice gates being opened, with consequent risk of flooding

Function of Education

THE discussion on Education for a Changing Society' arranged by Section L (Educational Science) of the British Association on August 19 and 22 was maintained at a high level well worthy of the crowded audiences which it attracted

In opening the discussion, Mr W H Robinson dealt with the senior school, which he described as pre eminently the school of the people, the vast majority of the electorate Most of the pupils of the senior school would receive no further organized education but would be educated by their environment, both physical and mental He suggested that the essential function of school in a changing society is to teach pupils the art of self education to be continued through life, and to give them a conviction that education is not a thing of school alone The school should provide a connecting thread running through the educative influence of the cinema, radio, picture paper and environment generally Accordingly, the school must be related at all points to the community and as the Hadow Committee insisted, the curriculum must be thought of in terms of experience and activity rather than of knowledge to be acquired and facts to be stored

The years from eleven to fifteen Mr Robinson urged, should be used to consolidate the training already given by taking into full account the psychology of the adolescent of this age By becoming leaders of the school community by experience of the organization of school activities by discussion and attempts at agreement, they would learn by experience the basic facts on which our democracy is based and the lines along which it must develop In this way they would learn the necessity for patience persuasion and compromise, respect for the opinions and form of action of others, and that toleration is better than coercion This learning through experience, Mr Robinson considers is more important than lessons, and the great need appears to be for the development of a technique for developing the active co operation of the pupil in the work of self education for life

The second paper by Miss Ruth Dawson, also dealt with the senior school and emphasized the importance in view of the background and environment of the modern child, of giving an education designed not to accumulate facts but to train the mind to make right judgments Once again reference was made to the aims set forth in the Hadow Report and the importance of all subjects in the curriculum contributing to the formation and strengthening of character, the training of tastes which would fill and dignify leisure, and to the awakening and guiding of intelligence Miss Dawson referred in illustration to the use and opportunities of physical training, domestic science, arts and crafts, drama, etc

The part of the secondary school was discussed in papers by Dr P T Freeman and Miss Muriel Davies which presented two opposite, but not necessarily opposed, points of view and were afterwards rather severely criticized by Mr H G Wells Dr Freeman stressed the importance of discipline and urged that it is necessary not only to arouse interest but also to demand effort He deplored the recent agitation against homework and said that, in spite of the independence of the modern child, there is a lack of vitality and willingness to tackle difficulties Dr Freeman urged the value of Latin and Euclid in training particularly as teaching children not to accept statements without adequate evidence He advocated a three year course in biology as a means of conveying information about sex and, while supporting an extension of the teaching of civics and economics, considers that over-emphasis on apparatus in physical training is dangerous Although he was severely taken to task by Mr Wells for his advocacy of Officers Training Corps, his opinion of the value of such training in developing not only discipline but also self reliance will certainly find strong support

Miss Muriel Davies, on the other hand, devoted much of her time to an analysis of social conditions and of the way in which inequalities are perpetuated in our present educational system She pleaded eloquently for a unification of our educational system particularly in the ranks of the teacher, the abolition of distinctions in salary scales between elementary and secondary school teachers and the evolution of a system of education for social progress rather than for individual advancement Miss Davies s address contained many almost startling suggestions, designed to promote co operation rather than competition and to break down class distinctions such as the abolition of formal hours and holidays the education of rich and poor together, the requiring of all teachers to spend some time in elementary schools, but the vision and idealism of the address warmly commended it to the large audience, not the less because it was constructive and forward looking She deprecated the use of prizes and marks for stimulating effort, but although she advocated more freedom of choice for children in their actual work both in and out of the school, her insistence on the encouragement of the community spirit and suggestion for a group system in place of the house or house prefect system should have safeguarded her from Mr Wells s stricture

Continuing the discussion on August 22 Mr J Paley Yorke dealt with the functions and work of the junior technical school, the importance of which is enhanced by the decay of the apprenticeship system He laid particular stress upon the importance of the staff possessing adequate industrial experience in view of its bearing on the content and presentation of the training Dr W A Richardson discussed the place of the technical college Pointing out the disparity between our knowledge of the material world and our knowledge of mind and social relations, he stressed the need for research in the latter field Social conditions profoundly affect the work of technical colleges, as of all education and educational ideals, and Dr Richardson instanced the danger that the rearmament programme will have untoward effects in the educational field There are wide differences between technical colleges, and the voluntary system has a serious defect in the leakage of students, many of whom do not stay the course Moreover, difficulties also arise because often the students attend primarily for training in occupations other than that which they are following at the moment There is less leakage of students entering technical colleges from the junior technical schools than of students of any other type

Dr Richardson considers that the raising of the school age would assist the work of the technical colleges, but if education is to be effective, it must be compulsory until the age of mental maturity—at least until eighteen The idea of the local college, which is a community of students whose main purpose in attending is educational, and not social, but for whom the authorities must provide facilities for social and physical development in the fullest sense is gaining ground Such colleges would necessarily continue to have a vocational and industrial bias endeavouring to develop skill as well as to impart technical knowledge and training in administration both in the industrial and the civic sphere

Mr F Pick whose paper drew the warm approval of Mr H G Wells, criticized education for failing to give to the new subjects of an industrial civilization the breadth and quality which is given to the older subjects bred in the classic ages He argued for a new type of university of the eye and hand as distinct from that of the voice and the pen It should be possible to illuminate the accumulated knowledge of trade and industry with a wisdom and understanding which would make it a suitable medium for a liberal education The trained and broadened mind should be applied to the building up out of the mass of knowledge which they embody, human sciences to rank with ethics, politics, economics and sociology

Prof Winifred Cullis followed with a final paper in which she dealt with some questions confronting the universities in the changing world With regard to the aims of university education there is a great consensus of opinion as expressed both by staff and by students, and the stress is laid on training for living rather than for a livelihood She referred to a number of particular problems raised in recent reports such as the question whether a specialist training for particular careers is the best for developing leaders of informed public opinion, for men and women who are to be politicians, administrators, journalists or teachers Again there is the question whether post graduate teaching should be concentrated in particular universities, in which connexion Prof Cullis referred to the backward position of post graduate education in medicine in Great Britain compared with that in other countries The extension of the system of individual tutorship to all universities, and increased facilities for short term exchanges of staff between different universities both in Great Britain and abroad, and the provision of increasing numbers of residential halls are all matters requiring consideration

Prof Cullis laid particular stress on the importance of greater attention to the question of the health of students and strongly supported the demand for physical education and health services at the universities She is in favour of compulsory medical examinations at regular intervals pointing out that it is often the students who can least afford medical advice who most need it and that such examination could often prevent serious illness developing later She outlined a number of health insurance schemes both optional and compulsory, which have been developed for students in Great Britain or abroad, and finally stressed the importance of including training for the responsibilities of citizenship

Lord Stamp, who opened the discussion was decidedly more critical than Mr H G Wells of Mr Pick's paper He pointed out that we cannot say what changes in education are desirable until we have decided what is the right direction for such changes to take what is the optimum speed at which they should be made, how they can be made with the least waste and what should be the correct agencies for bringing them about Some account must now be taken of the changes in the rate of growth of the population and of its possible physical obsolescence, and Lord Stamp referred particularly to the importance of considering training which would give the right outlook and background to those occupying the intermediate executive positions since they have so much influence on the selection from the younger men and women of those who in later life will occupy the positions of highest responsibility He strongly supported the idea of refresher classes and post graduate courses for those already occupying business or professional posts Sir Richard Livingstone criticized the teaching of history and philosophy at an age too early for adequate appreciation, and expressed his regret that adult education had not been included in the discussion

New Science Buildings at Shrewsbury School

ON September 24, Sir William Bragg president of the Royal Society, opened the new science building at Shrewsbury School Charles Darwin was at the School from 1818 until 1825, and the building, hitherto used for science teaching, erected in 1903, was named after him It has been considerably re modelled and improved for chemistry teaching under the present building programme The new building was dedicated "in thankful commemoration of the life and work of Charles Darwin"

The new science building comprises two floors, the ground floor being devoted to physics, and the first floor to biology The latter floor is some two thirds the area of the ground floor and is masked on three faces by roof slopes, it being the desire that this new building should conform to the general style of adjacent buildings which are mostly of one story The construction is of brick with hollow tile fire resisting floors, and tiled roofs with asphalt flats between All rooms are fully plastered and floors generally are of teak blocks Heating is by low pressure hot water radiators

The ground floor (physics) has two large elementary laboratories, each for 26 students, with a common preparation – store room, an advanced laboratory for 16 students, two lecture rooms to seat 26 each, a large store room and a photographic dark room Both elementary laboratories are alike in fitments, long fixed double sided table type benches, having gas and electric services, occupy the middle of the room Enclosed balance cases in groups are disposed around the walls, and two large sinks are conveniently situated in each room The advanced laboratory is fitted with a service shelf 15 in wide around three sides of the room (having gas water and electric services thereon) which when used in conjunction with the four strong loose tables gives considerable flexibility

The elementary laboratories and lecture rooms contain fully equipped demonstration benches and a certain amount of local storage is provided in all rooms All rooms have dark blinds Free wall space is fitted with battens for fixing and hanging apparatus and the laboratories have beams suspended from the ceiling for the usual physical experiments Built in slate galvanometer shelves are provided in convenient positions those in the lecture rooms having measuring leads and 12 volt light leads connected to the demonstration benches for demonstration work with mirror galvanometer and ground glass scale

Large yellow glass boards (in place of the more usual blackboards) have been used throughout Experimental electrical services consist of switch plugs to all working spaces which in the elementary laboratories can be used on the 230 volts A C supply or alternatively on 12 volts A C one pair of leads only being used (designed to avoid varying voltage drops) Voltage reduction is by step down transformer and change over switch under the supervision of the master Direct current supplies for the advanced laboratory and all demonstration benches at 24 volts is provided from a battery of cells and an oxide cathode rectifier interchange of voltage being carried out by plug and socket distribution board arrangement All the D C equipment is located on one wall of the advanced laboratory and is available for instructional purposes

The first floor (biology) consists of two very large well lighted laboratories a common preparation room store room greenhouse and a small private research room for the masters use Except for incubator accommodation in one room and aquaria in the other both large laboratories are identical in fitments one portion of each room being laid out with flat topped tables and seats for 24 students (for theoretical work) with fully equipped demonstration bench projection screen and yellow board the other portion fitted with low benches (for 26 students) for microscope and dissecting work These latter benches have gas points and microscope light points fitted and are designed to accommodate microscopes and their lamps when not in use There are two large wash up sinks and drainers in each laboratory with provision for draining and storing dissecting boards and around all walls one continuous shelf allows of the display of natural history specimens and specimens in embryo North east top lights are provided over that part of each laboratory devoted to practical work and dark blinds are provided throughout Storage and preparation rooms provide accommodation graded to suit all sizes from small stain bottle racks to large diagram charts

The old building has been considerably re modelled internally to provide the necessary accommodation exclusively for chemistry comprising two, large elementary laboratories (one for fifth form work) two large lecture rooms an advanced (specialist) laboratory for 14 two balance rooms the usual store and preparation rooms and a small science library Existing fittings have been modernized new chemistry working benches provided where necessary and new ranges of fume cupboards in the fifth form laboratory and advanced laboratory have been installed ventilated by a centrifugal fan and acid resisting ducting New roof lights have been added to improve the natural lighting of the rooms

The architects for the work were Messrs Munby and Smith of 9 Old Square Lincoln s Inn London

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Effect of Inbreeding of Physiologic Races of Rust

THE recognition of the + and − strains in rust fungi and the way in which the bi nucleate aecial condition must be preceded by mycelial fusion of + and − strains or the introduction of pycniospore containing nectar of the opposite strain has led to the possibility of the study of inbred physiologic races Johnson and Newton (*Can J Res* 16 1938) have made a study of the effects produced in *Puccinia graminis Tritici* Erikss and Henn Cultures have been started from a single urediospore and these have been followed through their cycle selfing being brought about by mixing pycniospore containing nectar of pustules of the isolated race

It is found in several of the isolated races when selfing has been repeated for several generations that new features are liable to appear Thus races which originally had the normal red uredial colour have produced types with greyish brown orange or white uredia—features which are of extremely rare occurrence in Nature The proportions in which these abnormalities of uredial colour appear suggest a genetic relation in which greyish brown and orange are dominant to white and the normal red to the other three

Also in such inbred races types have appeared with decreased vigour of uredia as evidenced by a tendency towards or failure of the uredial pustules to break through the host epidermis other types have shown a weakening of pathogenicity as compared by inoculation of named varieties of wheat and still others have failed to produce aecia and instead formed urediospores or teliospores on the barberry

The authors point out that mutations have been reported several times for the rusts and the evidence from the present work suggests that certain physiologic races are in a mutable condition Owing to the multiplicity of physiologic races and the heterothallic nature of the rusts in Nature the mutants will *seldom occur in the homozygous condition* When inbreeding is maintained for several generations it is probable that homozygous recessive types are segregated (or possibly additional mutations occur during the selfing stages on barberry)

In the group of the rusts short cycle forms are of relatively common occurrence and may tend towards the production of autoecious species In this connexion it is of interest to find in *Puccinia graminis* a mutant in which the aecial stage is eliminated though the urediospores produced on the barberry are only capable of infecting wheat seedlings so that the physiologic race is still heteroecious

Science News a Century Ago

Fermentation an Act of Vegetation

'M Turpin has lately published his observations upon certain phenomena, which he considers sufficient to show, that the act of fermentation, concerning which chemists have been so much embarrassed, is owing to the rapid development of infusorial plants He states, that all yeast, of whatever description, derives its origin from the separation from organic tissues, whether animal or vegetable, of spherical particles of extreme minuteness, which particles, after a certain time, rise to the surface of the fluids in which they are immersed, and there germinate No doubt the yeast of beer consists of minute molecular matter, the particles of which are globular, and that these particles produce, from their sides, other particles like themselves, which eventually separate from the parent, but we do not know that they are *therefore* plants (*Athenæum*, October 20, 1838)

Smoke Abatement

The *Mechanics' Magazine* of October 20, 1838, when describing a plan by Iveson for effecting the combustion of smoke, which had been tried in the steamer *Royal Adelaide*, remarked Smoke has always been regarded as a nuisance As the age of steam advanced, and as its benefits were extended over, and enriched the face of the earth, so did the concomitant evil, smoke, throw a cloud abroad which bade fair to obscure the face of the sky So great became the evil, that in process of time every one not directly interested in its cause complained aloud, and seemed willing to forego the grand effects of the steam engine rather than put up with its smoke Petition after petition poured into the Houses of Parliament praying the legislature to compel the manufactories to put out their fires or swallow their smoke Learned societies offered premiums to incite their members to search for an antidote A parliamentary committee was appointed to examine into the subject An Act was the result of this inquiry rendering manufacturers indictable for a nuisance if the smoke of their chimneys annoyed their neighbours "

The Transatlantic Steamship *Liverpool*

On October 20, 1838, the S S *Liverpool*, the largest vessel built on the banks of the Mersey up to that time, sailed from Liverpool on her maiden voyage to New York Her length was given by the Surveyor of Lloyd's Register of Shipping as 218 ft 4 in , her breadth 31 ft 4 in , her tonnage by builders' measurement $1{,}042\frac{3}{94}$ tons, and her steam boat tonnage $559\frac{1}{4}$ tons She was not originally intended for work on the Atlantic, and to strengthen her for the passage she was fitted with iron beams over the engine and boiler rooms, and these beams were braced together with fore and aft iron rods Other iron rods were used to strengthen the paddle boxes She had a two cylinder side lever engine of 468 horse power, the steam pressure being about 5 lb. per sq in Leaving Liverpool on October 20, when six days out it was realized that her coal would not last the voyage, so she returned to Cork to refill her bunkers Sailing again from Cork on November 6, she reached New York in 16 days 17 hours, her best day's run being 242 miles. Between October 1838 and the end of 1840, she crossed and recrossed seven times

Societies and Academies

Paris

Academy of Sciences (*C R* 207, 385–412, August 17, 1938)

E Esclangon The sixth congress of the International Astronomical Union held at Stockholm on August 3–10, 1938

E C G Stueckelberg Interaction between elementary particles

H Pailloux A property of certain fluid movements

Y Hagihara Reduction of differential equations in the problem of *n* bodies

R Guillien Variation of the dielectric constant at solidification of homopolar liquids Work on toluene, metaxylene, carbon tetrachloride and liquid nitrogen, when solidification is slow, shows that the dielectric constant increases

J Lecomte Comparison of the infra red absorption spectra of heterocyclic compounds and of nuclear hydrocarbons

Mlle G Chauvenet Influence of radius of curvature on the speed of oxidation of cobalt

H Hubert and J Barberon Preliminary study of atmospherics by means of a cathodic oscillograph

R Guizonnier Behaviour of the semi diurnal variation of the earth s electric field, when the phase of the diurnal component is perturbed

R Gautheret and P Delaporte Statistical researches on the survival of the root cap cells of *Lupinus albus* These cells can survive in culture under a variety of conditions and it is easy to distinguish between living and dead cells Mortality follows the 'Law of Facility of Galton and MacAlister

Mlle G Mourot The ultimate terms of purine metabolism in mammals

H Schwab Modifications in the hypoglycæmia due to insulin and to adrenaline caused by the addition of salts of nickel, of iron and of copper The effects of these salts are sufficiently alike to show that their action is non specific

(*C R* , 207, 413–436, August 22 1938)

E Jouguet Remarks on Dunkerley s formula

A Guilliermond and R Gautheret Fixation by living vegetable cells of the leucobases of certain vital colouring matters

G Wataghin A generalization of relativist transformations

J Cichocki and A Soltan Radiosilicon produced by bombardment of sulphur with fast neutrons

F François Study of the system mercuric iodide – mercuric bromide – absolute alcohol, and evidence of a mercuric bromo iodide obtained by the Raman effect

J -J Trillat and A Aubry Study of oil refining by means of a photographic method

H Gault and J Skoda Researches on the condensation of acyclic aldehydes with certain compounds containing the carbonyl group Condensation of formic and acetic aldehydes with cyclopentanone

R Ph Dollfus Evolving cycle of a trematode of the genus *Cotylacæcum* W Nicoll Progenesis of the metacercarian larva in the amphipods

S Chevais and A G Steinberg Relation between the concentration of the extract of *Calliphora* and the number of facets in the eye of the bar mutant of *Drosophila melanogaster*

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Tuesday, October 18

EUGENICS SOCIETY (at the Royal Society) at 5 15 —Dr J A Fraser Roberts Intelligence and Family Size *

Wednesday October 19

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at University College London) at 8 — Dr R J Forbes Bitumen and Petroleum in Antiquity *

Thursday, October 20

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE at 5 30 —Prof H Cramér Problems Connected with the Analysis of Statistical Times Series (succeeding lectures on October 21 and 24) *

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —Dr A P M Fleming Inaugural Address

BRITISH INSTITUTE OF RADIOLOGY at 8 W E Schall British Radiology in the Future (Presidential Address)

Friday October 21

INSTITUTION OF MECHANICAL ENGINEERS at 6 —D F Roberts Presidential Address

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Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

METALLURGIST under the Director of Scientific Research War Office—The Permanent Under Secretary of State for War (C 4) War Office London S W 1 (October 17)

ASSISTANT (grade I—physics) at the Chemical Defence Experimental Station Porton—The Chief Superintendent Chemical Defence Research Department 14 Grosvenor Gardens London S W 1 (October 26)

TECHNICAL ASSISTANT in the Chemical Section, Research Station Long Ashton Bristol—The Director (October 27)

SENIOR METEOROLOGICAL OFFICERS in the Department of Industry and Commerce Eire—The Secretary Civil Service Commission 45 Upper O Connell Street Dublin (October 28)

PRINCIPAL of the Rutherford Technical College Newcastle upon Tyne—The Director of Education City Education Office Northumberland Road Newcastle upon Tyne 2 (October 29)

TECHNICAL OFFICER and ASSISTANTS (grade II) in the Meteorological Office—The Under Secretary of State (S 2 A) Air Ministry Adastral House Kingsway W C 2 (October 31)

LECTURER IN CHEMISTRY in the University of Cape Town—The Secretary Office of the High Commissioner for the Union of South Africa Trafalgar Square London W C 2 (November 5)

LECTURER IN PHYSICS in the School of Science, Khartoum—The Controller Sudan Government London Office Wellington House Buckingham Gate London S W 1 (November 10)

ASSISTANT KEEPER IN GEOLOGY in the British Museum (Natural History) London S W 7—The Secretary (December 1)

PROFESSOR OF AERONAUTICS in the University of Sydney—The Secretary Universities Bureau of the British Empire 88A Gower Street London W C 1

ASSISTANT LECTURER AND DEMONSTRATOR IN ZOOLOGY in King s College of Household and Social Science Campden Hill Road London W 8—The Secretary

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Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 9 No 4 March 1938 Compiled by Agnes Elisabeth Glennie assisted by Gwen Davies Pp v+281–422 (London H M Stationery Office) *4s 6d* net [279

East African Agricultural Research Station Amani Tenth Annual Report 1st April 1937—31st December 1937 (Colonial No 151) Pp 40 (London H M Stationery Office) 1*s* net [289

University of Bristol and Wiltshire County Council An Agricultural and Soil Survey of the Bromham District of Wiltshire By A W Ling W T Price and L D C McLees Pp 23+xv (Bristol The University) 2*s* 6*d* [289

Forest Bibliography to 31st December 1933 Part 3 C Forest Protection Pp iv+201 274 (Oxford Department of Forestry The University) 12*s* 6*d* [410

British Electrical and Allied Manufacturers' Association Some Information Eleventh (new and revised) edition Pp 46 (London British Electrical and Allied Manufacturers Association) Free [410

Other Countries

Cornell University Agricultural Experiment Station Bulletin 690 The Black Spot Disease of Roses, and its Control under Greenhouse Conditions By E W Lyle Pp 32 Bulletin 692 The Silver Scurf Disease of Potatoes By O D Burke Pp 30 Bulletin 696 Economic Studies of Dairy Farming in New York 13 100 Grade A Farms in the Tully Homer Area Crop Year 1936 By E G Misner Pp 60 Bulletin 698 Economic Studies of Dairy Farming in New York 14 Factors affecting Premiums received in Grade A Milk Production By E G Misner Pp 28 Bulletin 699 The Influence of the Central Rural School on Community Organization By Eugene T Stromberg Pp 40 Bulletin 700 An Economic Study of the Marketing of Western New York Potatoes by Motor Truck By P J Findlen Pp 52 Memoir 212 Determination of Stringiness in Celery By Denzel S Curtis Pp 20 Memoir 213 Some Interrelationships between Soil Characteristics Water Tables Soil Temperature and Snow Cover in the Forest and adjacent Open Areas in South Central New York By J N Spaeth and C H Diebold Pp 76 Memoir 214 Investigations in Plot Technic with Small Grains By H H Love and W F Craig Pp 26 (Ithaca N Y Cornell University) [269

Tanganyika Territory Department of Lands and Mines, Geological Division Bulletin No 10 Explanation of the Geology, Degree Sheet No 1 (Karagwe Tinfields) By G M Stockley and G J Williams Pp 96+6 plates+3 maps 5*s* Short Paper No 19 The Geology of the Country around Mpwapwa By Dr B N Temperley Pp 61+6 plates+1 map 4*s* Annual Report 1937 Pp 31 1*s* 6*d* (Dar es Salaam Government Printer) [269

Tanganyika Territory Department of Agriculture Pamphlet No 20 Sisal Experiment Station Report for the Year 1937 Pp 20 6*d* Pamphlet No 21 Reports from the General Experimental Farms 1937 Pp 40 1*s* Annual Report 1937 Part 1 Pp 46 2*s* 6*d* (Dar es Salaam Government Printer) [269

British East African Meteorological Service Annual Report for the Year 1937 Pp 42 (Nairobi Meteorological Service Press) [269

The Rockefeller Foundation International Health Division Annual Report 1937 Pp vi+249 (New York The Rockefeller Foundation) [289

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig Zweite Serie Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium Band 9, Heft 3 Die 10 tägige Luftdruckwelle im Sommer 1934 und ihre Dämpfungserscheinungen Von Rolf Pfau Pp 219 272 Band 9 Heft 4 Singularitäten der Zyklonenfrequenz in einzelnen 5° 10° Feldern Von Gertraud Richter Pp 73 322 Band 9 Heft 5 Geomagnetische Untersuchungen in Nordwest Sachsen und Nordost Thüringen Von Robert Lauterbach Pp 323 368 Band 10 Bericht zur 25 Jahr Feier des Geophysikalischen Instituts der Universität Leipzig Das Geophysikalische Observatorium Von J Weickmann P Mildner H Lettau G Fritzsche R Lauterbach Pp 172 Band 10 Anhang 2 Das Horizontaldoppelpendel Von Heinz Lettau Pp 83 142 Band 11 Heft 1 Untersuchungen über die Meteorologie der Staubatmosphär Von Martin Rötschke Pp 78 Band 11 Heft 2 Symmetriepunkt und Wetterkartensymmetrie Von Fritz Model Pp 79 152 Band 11 Heft 3 Über die Existenz langsamer Luftdruckschwingungen auf der rotierenden Erde Von Walter Wünsche Pp 153 200 (Leipzig Geophysikalische Institut der Universität) [289

Die in den Jahren 1931 bis 1935 in Leipzig und im Observatorium am Collmberg aufgezeichneten Erdbeben IV Bericht der Erdbebenwarte des Geophysikalischen Instituts der Universität Leipzig zugleich letzter Bericht dieser Serie Von L Weickmann und P Mildner Pp 205 346+4 plates (Leipzig S Hirzel) [289

10 Jahre Institut für Chemische Forschung (Kaiserliche Universitaet Kyoto) 1925 1935 Pp iv+185 (Kyoto Imperial University) [309

Hong Kong Nature Series Orchids First Twenty By G A C Herklots Pp 62+15 plates Flowering Shrubs and Trees, First Twenty By G A C Herklots Pp 34+13 plates Flowering Shrubs and Trees Second Twenty By G A C Herklots Pp 45+11 plates (Hong Kong The Author The University) [410

Common Marine Food Fishes of Hong Kong 40 Species described in English and Chinese (with European and Chinese Recipes) By G A C Herklots and S Y Lin Pp 75 (Hong Kong The Authors The University) [410

Report of the Aeronautical Research Committee Tôkyô Imperial University No 165 On the Mechanism of Emitting Singing Sounds from Revolving Marine Propellers By Kôzi Satô and Yutaka Kohasi Pp 273 298 45 sen No 166 Performance Calculations on the Kôken Long range Monoplane By Hidemasa Kimura Pp 299–386 1 35 yen No 167 On the Transition from Laminar to Turbulent Flow in the Boundary Layer of a Sphere By Susumu Tomotika and Isao Imai Pp 387–424 55 sen (Tôkyô Kôgyô Tosho Kabushiki Kaisha) [410

Pasteur Institute of India The Thirty sixth Annual Report of the Director of the Institute for the Year 1936 Part 2 Pp 48 (Kasauli Pasteur Institute of India.) [410

Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series A No 43 Suitability of Two Cottons for Purposes of Mill Mixings in relation to their Fibre Characters By Dr Nasir Ahmad and Dr K R Sen Pp ii+28 (Bombay Indian Central Cotton Committee) 1 rupee [410

Year Book of the Royal Asiatic Society of Bengal. Vol. 2 1936 Pp 229 (Calcutta Royal Asiatic Society of Bengal) 5 10 rupees [410

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Concepts of Human Progress

A FORTNIGHT ago, in an article entitled The Promotion of Peace", we referred to events which claimed the interest of the whole civilized world and upon the settlement of which depended the lives of millions of people We were able to record that as the result of consultations between statesmen an agreement was reached which though its justice may be disputed prevented nations from being thrust wantonly over the precipice into a world war Thanks to the facilities of rapid transit and world wide direct communication which science has placed at the service of statesman and press, the full weight of the world's judgment was brought to bear as the hour of crisis drew near until perhaps—who can say?—it turned the scale Had such rapid and extensive means of making plain the judgment and trend of opinion among peoples been available in 1914, actions which resulted in the Great War might have been averted

In the first flush of enthusiasm at the recent preservation of peace, it seemed that the crisis through which we had passed had quickened perception of values in the essentials of life, to most of which we had been prepared to bid a long and perhaps an eternal, farewell Hope, founded on the promise of the Anglo German pact, looked forward to the removal of the menace of war to set mankind free for the pursuit without distraction not merely of enjoyment of the advantages which the advancement of scientific knowledge holds out for the future, greater even than the wonders with which it has endowed mankind in the past generation, but also of real and substantial progress, in a healthier atmosphere, in the scientific study and resolution of the problems which lie at the root of world economic and social unrest

Disillusion has been rapid complete and painful The first task to which we are now bidden to turn of necessity and at redoubled speed is armament and provision for defence So much the more then are energies and resources withdrawn from the advancement of what we had come to realize were the essential needs of future development in human life The sole palliation is that our aim is the preservation of the freedom of the spirit which alone consorts with the dignity of man

Let there be no illusions as to the character of the struggle which will be involved in modern warfare It is a reversion to the methods of savagery In the scale of development of human society war has played a useful and, biologically speaking, a necessary part The society which at a certain stage of development depends upon the prowess of heroes pitted against their like breeds heroes to ensure qualities essential to its survival in the struggle for existence But the day of heroes in war is past Modern war, which will be waged from the air, is the warfare of the primitive head hunter, in which the raider returns triumphant from his raid after the slaughter indiscriminately of man, woman or child The principles of warfare are unchanged— 'Find the forces of the enemy and destroy them" , but those forces are no longer armed forces , they are the whole people, whose morale must be destroyed Could any parallel be closer to the head hunter, who brings back with each head something of the spiritual force of the enemy he has slain ?

In the development—evolution in the popular sense—of progressive human societies, the line of advance has been towards ever increasing aggregations of individuals—from family to tribe and from tribe, through a regular gradation of political units to empire If the warlike qualities have played their part in each of these forms of human association in securing that independence of existence which is essential for internal development there has been an equal and parallel development of those qualities in the individual which make for just and harmonious association between the members of a social group—the qualities of justice of capacity for co operation of consideration for others and care for the weak It is these qualities which give solidarity to the group and are no less conducive to its survival than the warlike qualities which preserve it from aggression from outside

Such social characters are however not only the essentials of internal peace and advancement but also they react on those higher qualities of the human mind in the exercise of which man approaches most nearly to exhibition of his specifically human characters unaffected by cultural divergence These higher manifestations of his spirit if in origin based upon a tradition peculiar to his group nevertheless in their highest development transcend such limitations Of such are literature art and scientific knowledge which when they attain their highest powers speak a universal language

At the same time with each advance in social gradation the system of social and religious ethics is extended to embrace a wider circle until in certain of their concepts they too approach a universal appeal to mankind at large rather than a restricted cultural group No one has ever questioned that in these higher manifestations of the spirit man attains and will attain his highest development whatever may be his advancement in the field of the material Further it is a matter of experience no less than a postulate of reason that for their full and complete expansion and growth free intercourse and exchange of experience and thought are essential without barriers of race or political frontier to exclude any form of intellectual development as alien While similarly the ethical system in the long run whether it be bound to a specific form of religious belief or not will come to recognize the claims of ethical concepts common to humanity at large irrespective of creed

In the intercourse between national groups which is become an essential condition of the development of the activities of the higher faculties civilized man has transcended the group to embrace humanity as a whole As men bend their minds to the problems which arise in this extended outlook if advancement is to continue it will demand more and more a scientific approach to these problems which however much they may depend upon conditions within the group are world wide in application or in effect

In an increasing degree these problems will arise in connexion with the backward no less than with advanced peoples An ever growing sense of the responsibility of Western civilization to protect primitive races from the more harmful and disintegrating effects of its own impact on their culture and institutions will by the logic of circumstances carry conviction that both wisdom and justice demand that this state of tutelage no longer susceptible of exploitation for national advantage or prestige should carry with it an obligation to develop in these peoples not only the capacity to deal with the special problems of their own government but also to co operate with the white man in the solution of questions of wider import Events of the last decade more especially in the economic field have driven home forcibly the lesson that there are few peoples so remote so self sufficient—in short so primitive—as to escape the repercussions of the major crises at the heart of civilization Pursuit of the material benefits conferred in the spread of Western civilization has led to the assumption all too readily that ultimately Western ways of thought Western beliefs will set the world standard In the reaction which is at hand—nay which has already begun in Africa and in the East—understanding tolerance and breadth of view can alone bring about the adjustment which will avert conflict

Unfortunately man s political and economic advancement has lagged behind his intellectual and material progress The League of Nations which represented an attempt to attain an aggregation transcending the national group has accomplished much valuable work in the study of problems in which scientific and intellectual co operation was possible without regard to national grouping Nevertheless it has failed in its main object because in the international sphere its approach to political problems has been upon a national rather than an international basis If the Anglo German pact were in fact the first step towards a policy of discussion and conciliation in which discussion proceeded to each specific problem with a scientific outlook and the aim of human and not national advancement and be it added without the accompaniment of the rattle of arms we might indeed look for the approach of an era of which the League of Nations was but the false dawn

The Critic Triumphant

Retrospect
an Autobiography By T A Rickard Pp xi+402+5 plates (New York and London McGraw Hill Book Co Inc 1937) 12s 6d

MAINLY this retrospect is the story of the author s life the life of a man who successively was mining engineer and editor retiring then to enter with no less success upon a wider scholarship Of less sustained interest it includes stories of travel of contact with American presidents and of selections from speeches made and addresses given

Born in the mining tradition and trained in an *alma mater* the Royal School of Mines London of which he remains throughout a loyal son this life story is of a man high principled and sensitive who became eminent in the profession and practised world widely but principally in the United States of America until his particular contact with financial methods provoked such distaste that the opportunity offering he turned aside to concentrate upon technical literature for which he had a liking and an already widely exercised gift

Becoming then successfully editor of the two principal mining periodicals in the United States and one leading periodical in London Rickard served the profession greatly by frank criticism of current events and tendencies never one who trembled to think he courageously ventured to speak sometimes in mordant manner of mock humility His editorials were instinct with his individual and challenging personality If nothing he ever wrote was uninteresting nothing uninformative these editorials were nevertheless his excellencies To them his readers on both sides of the Atlantic looked forward and remembering now look back The driving force behind his fluent pen was a burning almost an explosive exasperation with sloppy thought loose expression and dubious ethics To him careful writing shaped the mind as the tool shapes the hand He encouraged mining engineers to be frank and honest with themselves for

> This above all to thine own self be true
> And it must follow as the night the day
> Thou canst not then be false to any man

The flag of frank and noble criticism Rickard flew gaily Independent and subservient to none criticizing the thing and not the person he was happy in the work of creating a sound public opinion in the mining world Approval was not often expressed it was not his line if doings were left alone it might be taken that they had a measure of his approval or were not worthy of his pen Nevertheless Rickard in addition to admirers had a host of personal friends his sparkle and radiant alertness making him an enjoyable companion in spite of a pardonable egotism With this happiness there came however a growing lament that personal hurt was occasionally felt though not intentionally given But his criticism being impersonal there was no bitterness and being effective his work became complete So again he opportunely turned aside now to enter the paths of the wider scholarship

Carrying his critical faculty and his knowledge of metals into archæological and anthropological research and offering them in that field with real humility Rickard has been of signal service in correcting some assumptions made on incomplete metallurgical knowledge and in making a scholarly contribution in his Man and Metals the impulse to writing which lay in the provoking lack of appreciation by Wells in his Outline of History of the important part played by metals in man s development and history

All these services the profession on both sides of the Atlantic has recognized by its highest awards and appreciative citations the occasions receiving some description in this retrospect An editor lives in his editorials an author in his books and Rickard having been both there might remain little beyond episodes and names for an autobiography to disclose But into this retrospect a new interweaving of personal emotion with a universal theme is brought the love of a man for his country Gradually the story is unfolded of a cultured Englishman living long in the United States and becoming there almost a public character finding himself with the entry of America into the Great War at last in such completeness of sympathy with the country and the people as to feel that in all spiritual essentials that country and his England were as one with the natural consequence that to remove the last barrier to those around him he became an American citizen only then in deep disappointment and dismay to find himself, or so he thought, not accepted as a 100 per cent American not to be until he shed his English culture That being impossible he crossed into British Columbia, where with great contentment he became British again

Dominant personalities have their foibles it is as though the finite were necessary to preserve infinity from nothingness and it is all in keeping that in this retrospect occasional trivialities appear and that in places the straining for impressiveness is too evident But such foibles are part and parcel of a man the profession holds in honour and friends hold in esteem and affection Englishmen too will be proud of this stalwart countryman of theirs Accordingly this lively and most interesting story of the critic in action and of the man in intimacy makes a wide and informative human appeal

S J TRUSCOTT

Elementary Work in Zoology

Laboratory Studies in Comparative Anatomy By Dr W C Senning (McGraw Hill Publications in the Zoological Sciences) Pp ix+188 (New York and London McGraw Hill Book Co Inc 1937) 10*s* 6*d*

HERE is the method of conducting the first year course in comparative anatomy at Cornell The student is to provide himself with a text book drawing materials and specified dissecting instruments Then he is to have a set of outline plates some filled in for use with this manual—and he is told precisely how to fill up the outlines These are to present to the student readily available summarised information Three animals namely the shark a newt (*Necturus*) and the cat are chosen to supply a structural framework for subsequently acquired knowledge the student by his careful studies to absorb as much information as can be grasped The student is also indulged in oral discussions by the laboratory instructor and oral and written quizzes and dissection checks Let us say at once that the author has carried out his ideas admirably and the student is to draw figures of what he has learnt from his dissections on fifty four plates He will be an encyclopædia of facts about his three animals and presumably he will have learnt a little dissection and some elements of drawing his chief asset will be that he has learnt to observe and record topography with accuracy his memory is improved and he has acquired much information

But we deduce from the preface that the author aims to prepare his students to do independent work The reviewer has prepared or edited more than a dozen such laboratory manuals for laboratory notebooks are the same thing spaced to leave sheets for drawings He had produced some with as detailed instructions as here—and he found them very useful for instructing large classes especially useful for students who happened to be supplied with indifferent demonstrators such produced the note books in an almost verbally perfect manner for examiners who wanted facts alone Many of his most elementary students were medicals and they desirous of putting behind them a disagreeable first M B were happy Their joyous life continued for they kept the same compartment of mind for anatomy and only had to develop a second chamber for physiology the two not provided with communicating doors until much later when the students learnt that their business was with a living animal

To the real student of science such manuals were fatal and from the commencement the reviewer began to whittle them down To be of any subsequent use or to employ his knowledge for his own pleasure a student must acquire independence and be allowed considerable latitude in choice of interests and methods The anatomy of this manual is not science—this remark applies also to most text books—and indeed is boring to the young The latter centres his interest on the living animal how it lives moves and reproduces in other words is adapted to its place in the world He then demands how the functions consequent on this life are performed and what sort of organs produce them The interest of comparative anatomy is not closed but the approach is from the living to the dead for the latter can only be understood in the life of the former

The laboratory instructor has not the function of driving facts into dull minds but to encourage his pupils to inquire for themselves and to help them to do so Zoology will be killed by the use of such methods as suggested in this manual methods in vogue when the idea of evolution was very young but completely past to day Huxley was a great teacher of comparative anatomy but his most used book was his Comparative Physiology which can profitably be read as an introduction to anatomy even to day

Are the methods of this manual those which are commonly adopted in American universities ? If so the reviewer understands why he has repeatedly had to place trained American students in his most elementary classes

J S G

The Teaching of Chemistry

(1) A Higher School Certificate Inorganic Chemistry

By G. H. J. Adlam and Leslie Slater Price. Pp. viii+624. (London: John Murray, 1938.) 8s. *6d.*

(2) Inorganic Chemistry for Schools and Colleges

By Leonard A. Coles. Pp. 384. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1938.) 6s.

(3) A Modern School Chemistry

By A. J. Mee. (Dent's Modern Science Series.) Pp. ix+500+9 plates. (London: J. M. Dent and Sons, Ltd., 1938.) 4s. *6d.*

(4) Elementary Inorganic Chemistry

By Sylvanus J. Smith. Pp. viii+400. (London: Macmillan and Co., Ltd., 1938.) 4s. *6d.*

THE teaching of science to-day forms an important part of the curriculum of our public and secondary schools. The standard of teaching in chemistry was probably never higher than it is now and the number of pupils passing through the advanced courses in science is greater than ever. There is, therefore, a need for really sound elementary and intermediate text-books of chemistry like the four now under review.

All are intended for use in schools with pupils taking the matriculation and higher school certificate examinations. Each possesses qualities that will commend it to the discerning science master. They all appear to cover the subject fully, they are well illustrated and contain plenty of questions. Indeed, there are no fewer than 800 in Mr. Mee's book, whilst Mr. Smith not only includes a selection after each chapter but also gives a series of complete test papers at the end of the text. The fact that all these authors have included carefully graded exercises for the pupil to work through is an indication of the importance they attach to this essential part of schoolwork in chemistry. Suggestions are also made for further reading and these will doubtless attract the keener pupils, but it should not be overlooked that the study of chemistry in schools is a comparative one, and even the best pupils will find their memories taxed unduly if they are not guided in their reading.

The universities obtain their science students from the pupils who have passed through the courses for which these books have been written. Students who have used such books with care and understanding should enter the university with a sound foundation of knowledge in chemistry.

(1) The high standard now attained in chemistry as taught in secondary schools is demonstrated in the first of the books under notice. This might well be expected since one of the authors is the experienced editor of the *School Science Review*. It is arranged in three parts and altogether extends to fifty-nine chapters. The two major parts deal respectively with general and theoretical principles, and a detailed description of the elements and their commoner compounds. The third part gives a short account of the chemistry and physics of the atom, radioactivity and related phenomena.

Among the more noteworthy features of this work are the lucid accounts of recent developments, such as the preparation and study of heavy water and the modern views on valency and atomic structure. The references to physical chemistry are adequate, whilst those organic compounds of which a knowledge is essential for an understanding of the general properties of carbon are also described.

(2) Mr. Coles's "Inorganic Chemistry," he says, 'deals only with the material side of chemistry' and leaves physical chemistry to be studied elsewhere. It does, however, cover the subject concisely and fully, giving a comprehensive account of the metals, following a scheme based upon the periodic classification of the elements and describing the latest industrial and laboratory practice. The order of treatment is unusual. Chapters on hydrogen and water precede those on the inert gases, the alkali metals, the coinage metals, etc., as the author proceeds through the groups of the periodic table. In his hands the result is very successful.

(3) Mr. Mee has aimed at providing a complete text-book of chemistry for schools as far as the standard required for the school certificate examination. Actually he has gone rather beyond his original intention, for he includes a good deal of higher work (for example, the chapters on the hydrocarbons and "Some Important Carbon Compounds") as well as sections dealing with simple qualitative and volumetric analysis. The practical experiments selected for classwork are designed for completion within a working period of forty-five minutes.

(4) Conciseness and completeness characterize Mr. Smith's "Elementary Inorganic Chemistry",

which follows well tried lines in its manner of treatment, upon which much thought has evidently been spent in order to produce an up to date and accurate text book The early chapters give the methods and principles of chemistry and are followed by others dealing in detail with the non-metallic elements and their compounds The metals, about a dozen of which are described are dismissed in sixty pages Thus the book meets the requirements of those who wish to proceed further with chemistry and also of those who will discontinue the subject after leaving school These latter should however be able to take away an impression of chemistry that will be of use in after life For the teacher, this book has a convenient three page index to experimental work in addition to a full general index

G D

The Ways of the Weather

Weather Science for Everybody
By Prof David Brunt (Changing World Library) Pp xii+170 + 6 plates (London Watts and Co 1936) 2*s* 6*d* net

APTLY was meteorology described half a century ago as the Cinderella of the Sciences" in those days it was a humble study indeed, attractive in the main only to amateurs and scorned by the majority of physicists But Cinderella, as we know, could not be kept in the background , eventually she triumphed over her elder and more ambitious sisters Is it to be the same with meteorology ? From the utilitarian point of view the answer must surely be Yes Having regard, in particular, to the future development of weather forecasting and to the potentialities of stratospheric flight it is indisputable that meteorology has the major part of a very important career still ahead

Realization of this rather obvious fact seems to have come earlier to Germany, the United States and several other nations than to Great Britain For here and, indeed, throughout the entire Empire, there is still but one professorship of meteorology—at the Imperial College of Science and Technology, London Prof D Brunt, who now holds that solitary post, is known to meteorologists all over the world for his valuable treatise Physical and Dynamical Meteorology", first published in 1934 Having thus catered for the more learned brethren—those mathematical physicists who seek to solve the many obscure problems of the atmosphere—Prof Brunt has wisely turned his energies to instructing the laity Wisely, we say, because educational authorities, like business chiefs, are necessarily guided in the provision of their supply by consideration of the demand If meteorology is to take its proper place among the sciences taught in our universities, there must be the requisite plea from the younger generation for facilities for tuition This plea is most likely to be incited by popular books of the kind that Prof Brunt has written

The little work before us is one of the best of its type in the English language Tersely, simply and unpretentiously it sets forth as much of its subject as can be understood by the ordinary reader not at all heavily equipped with mathematical and physical training Doubtless in the knowledge that many people have the habit of glancing at the beginning and end of a book before deciding to read it through the author starts and finishes with chapters certain to have a wide appeal— Weather and Human Affairs in Peace and War and How Climate and Weather Affect Health and Comfort It is safe to say that few potential readers thus caught by Prof Brunt's wiles will fail to follow him through the remaining twelve chapters While all fourteen are meritorious those on radiation and the world's climates may be singled out for special mention

Among the occasional slips noted are a misleading account of the methods of infra red photography on p 40, an erroneous specification (temperature for pressure) of the ordinates in the diagram on p 98, and the assertion on pp 142 143 that the winters from 1930-31 to 1935 36 were all fairly mild in London Actually, the winter of 1933-34 was the third coldest of the present century at Greenwich Observatory, with a mean temperature about 2° F below the average Surely too, the English spring repeatedly refutes Prof Brunt's statement on p 65 that snow can reach the ground only when the temperature even at the ground is down to freezing point, or at most a degree or two above it ' There are numerous records of true snow flakes (as distinct from soft hail) having been observed during March and April on occasions when the surface air temperature exceeded 40° F

In view of its modest price, Prof Brunt's book is very well produced and most generously illustrated, not only with line-diagrams but also with several excellent photographs **E L HAWKE**

Annals of the Solar Physics Observatory, Cambridge Vol 5, Part 1 The Spectrum of Fe II By Dr J C Dobbie Pp v+59+4 plates (Cambridge At the University Press, 1938) 7s 6d net

PART I of vol 5 of the 'Annals of the Solar Physics Observatory Cambridge (by Dr J C Dobbie under the direction of Prof F J M Stratton) is a complete account of our present knowledge of the spectrum of ionized iron (Fe II) in the region 2150 6228 A

Previously to this work, the classification of the spectrum of Fe II was in the main that of Prof H N Russell, who in 1926 identified some two hundred lines and sixteen terms

The material used by Dr Dobbie was initially that obtained by Prof H F Newall and the late Bryan Cookson and largely extended by many new plates taken by Mr W Moss on the 21 ft Rowland grating of the Solar Physics Observatory, Cambridge and some confirmatory plates in the ultra violet taken by Prof H Dingle at the Imperial College of Science and Technology London In the photographs the lines run from pole to pole of the iron arc and the principal method of picking out lines due to Fe II was to note the lines that were only present at the poles or that were stronger at the poles than in the central part of the arc Dr Dobbie has extended the number of classified lines to some 1 700 and has identified 73 terms involving 218 levels The spectrum presents several peculiar features of interest, in many multiplets the intensities are anomalous and attention is directed especially to the line at 2272 719 A $(a^4D_{\frac{7}{2}}-z^4D_{\frac{7}{2}})$ which has an intensity of 1 only on the scale used, instead of 9 as was to be expected

Several years patient and skilful labour have gone to the production of this achievement For progress in astrophysical research, and in certain branches of physics proper there is great need of the classification of more spectra, and of more detailed or extensive classification of many already partially classified Few in Great Britain devote much attention to this type of work the results are perhaps not very spectacular and in addition to the great consumption of time, considerable skill has to be acquired before the solution of this kind of physical cross word puzzle' can be profitably attempted It is probably only in institutions with a permanent research staff that such work is likely to be done, and we welcome warmly this successful extension of the work of the Solar Physics Observatory

J A C

British Rainfall 1937

the Seventy seventh Annual Volume of the British Rainfall Organization Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1937 as recorded by over 5,500 Observers in Great Britain and Ireland (Air Ministry Meteorological Office M O 427) Pp xx+293 (London H M Stationery Office, 1938) 15s net

THE rainfall of 1937 over the British Isles as a whole was 104 per cent of the average, being 110 in England and Wales 91 in Scotland and 103 in Ireland This distribution was remarkably similar to that of 1936 The main features of the map showing the distribution of the rainfall as a percentage of the average are the large area in the north west of Scotland with less than 80 per cent, and the areas in the south east of England with more than 130 per cent—with more than 150 per cent at Southend Clacton and Boston There was a great excess of rain up to the end of May, greater than in any similar period since 1870, but owing to subsequent dry months the total excess for the year, as indicated above, was small

March and December were outstanding as snowy months Among heavy thunderstorm downpours of the year those of August 13 in the London district and of July 15 over a belt of country stretching from Somerset to Lincolnshire may be cited Approximately 6 inches of rain fell at Boston for the third time since 1930, the other occasions being on July 11, 1932 and August 8, 1931 —a remarkable cluster seeing that the previous greatest fall in a day in that town half a century or so ago was only 3 inches

This year s special articles comprise one by Miss L F Lewis on wind velocity measurements at the level of the rim of the rain gauge at Holyhead, and two by Dr J Glasspoole on the wet and dry periods of 1937 referred to above and on rainfall over the British Isles during the period 1901 1930 in which a comparison is effected with the period 1881–1915 still employed as a standard

L C W B

Handbuch der Vererbungswissenschaft

Herausgegeben von E Baur und M Hartmann Band 2F Genmutation 1 Allgemeiner Teil Von Hans Stubbe Pp iv + 429 + 1 plate (Berlin Gebruder Borntraeger 1938) 60 gold marks

THIS extensive and thoroughgoing account of gene mutations begins with a historical survey of 43 pages which contains many early records of mutations in plants and animals A full account is given of *Chelidonium majus laciniata* which appeared in 1590, also accounts with photographs, of the Ancon sheep the Manx cat laciniate leaved syringa and alder and many others

The main part of the book is taken up with a record and analysis of the modern work with gene mutations This includes accounts of polygeny heterogeny pleiotropy, dominance etc

The section on the quantitative study of mutation phenomena includes the determination of spontaneous mutation rates, the experimental production of mutations by X rays and other methods with a detailed analysis of the processes by which X ray mutations are produced

The short concluding section on the nature of the gene includes not only a historical background, with the views of Darwin, Naegeli Weismann and de Vries, but also the most recent ideas of gene structure by Koltzoff, Demerec, Muller Wrinch Timoféeff-Ressovsky and others

An extensive bibliography is appended and also a large chart classifying all the known types of somatic and gametic mutations While there are omissions, it will nevertheless be a very useful work of reference man of such a primitive type can surely be considered as obeying the same laws of migration as the higher mammals If now the pre Columbian distribution of the major races (Negro Mediterranean and Alpine) be plotted in a block diagram (Fig 1 *C*) we find a series of *zones and strata* closely resembling the two already charted It is difficult to escape from the conclusion that the centre of Asia is the common cradleland where evolution progressed most actively in the case of primitive man—just as Matthew has shown it progressed most actively here to produce new types of the earlier mammals Indeed we can almost exactly parallel the spread of the rhinoceros from Asia with the spread of the negroes while the spread of the Pleistocene Equidæ is the same as that of Alpine man

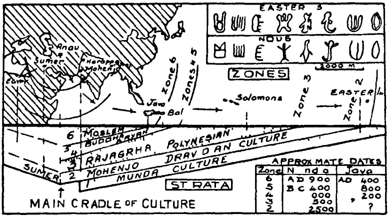

Fig 2

The spread of cultures from India eastward showing the Munda Australoid culture at the bottom covered by Dravidian Polynesian Aryan Buddhist and Moslem strata

In the inset are compared some signs from the Mohenjo and Easter Island scripts All much generalized

The centre of stimulus in Fig 1 *A* was the commercial progress in the city In the case of the mammals and man it was the stimulating climate of south central Asia

We may use as an illustration of the value of the zones and strata concept that complex of races and cultures which characterizes the Indian and Pacific areas I have had the advantage of travelling widely in Eastern Asia and in the Pacific and this has focused my attention on the general principles underlying dispersion in this area It is quite obvious that every widespread characteristic in Polynesia has migrated from west to east—and that any cultural contacts with America can be completely ignored in a general study Let us examine the data in Easter Island—the farthest of these isolated groups from Asia (Fig 2) It is almost 14 000 miles from the Caspian area to Easter Island yet I hope to demonstrate a culture sequence stretching across all this vast expanse

Two remarkable features in Easter Island are the well known stone statues and the undeciphered script incised on wooden tablets There is no reasonable doubt (as the Routledges have shown) that the statues with their bird man decorations are of the same culture complex as is common in the Solomon Islands some six thousand miles to the west (Fig 2) Hevesy and Hunter are satisfied that the script the only one used by Polynesians is connected with the remarkable Mohenjo culture which flourished in the Indus region about 3000 B C It is true that objections have been raised by Métraux that the script was not understood by any living Polynesian and that the tablets of mimosa wood etc are not likely to be many centuries old some indeed being modern in origin I think that these objections are not very relevant Our own alphabet is said to originate from not very similar signs used by miners in Sinai though all the links are not yet clear The question surely is to determine the origins of the remarkable Easter script —and to my mind the Mohenjo theory is plausible and indeed probable Moreover it offers a good illustration of clues which may be furnished by an ecological approach

Let us consider some of the major culture changes in the Indus region Gordon Childe has given data as to the races which have been discovered at Mohenjo Australoids Mediterranean Armenoids and Mongoloids were all present There can be little doubt that the first settlers (before 3000 B C) were the aboriginal Australoids who spoke a Munda language Many members of this zone of peoples are now found pushed to the margin in the East Indies and in Australia It is represented by stratum 1 in Fig 2 The general belief is that the Mohenjo culture was due to the later Mediterranean races who spoke Dravidian languages This constitutes stratum 2 and in my opinion is to be linked with Dixon s Caspian race in the Polynesian area

We have little knowledge of the period 2500 B C 1500 B C in India when the great Aryan migrations overwhelmed North India But it is significant that the earliest stone monuments in India which are found at Rajagrha (Rajgir) near Patna are of a cyclopean character quite unlike the work of the later Aryan builders and rather resemble the mysterious early stone monuments of the Pacific. For example, the Jarasandha monument (of unknown date) is a square truncated pyramid 85 ft. wide and 28 ft. high. It is built of large uncemented blocks of stone 5 or 6 ft. across. It resembles the truncated pyramids and Maræ of Polynesia. I have suggested that this culture complex spread out as stratum 3. The Aryan Sanskrit complex (stratum 4) never reached Polynesia, but was carried to Java and dominated that region for several centuries after 200 B.C. In North India Buddhism (stratum 5) flourished after 500 B.C. and was carried to Java about the eighth or ninth century of our era. It did not displace the older Hindu pantheism—but flourished alongside. Around A.D. 1400 the Moslems (stratum 6) conquered Java and the Indian religions found a refuge in the island of Bali farther east, where they still flourish. It is not, of course, suggested that the Polynesians migrated from India, for they probably lived originally in south-east Asia. But their culture probably followed the same route as that used by the Buddhist and Moslem teachers in historic times.

We may dwell for a few minutes on the recent discoveries in the vicinity of Persia. In Mesopotamia the earliest culture of Sumer is known as 'al Ubaid', and this contained copper tools and is younger than cultures from Susa and the adjacent Persian plateau.

To the north near Nineveh is the Tell Halaff culture with wheeled vehicles but with no metal. This is much older than anything discovered in Sumer near the Persian Gulf. Still older are the lowest cultures of *Samarra* in the same region, where they occur in debris seventy feet below a temple dated about 2450 B.C. Childe has corroborated my statement as to the cradleland of man with his comment that the early cultures of China resemble those of Anau in Turkestan (Fig. 2). It is significant that Zoroaster, the first great religious teacher, lived in this same vital region. Thus we see that the centre of the zones of the *races* of man in Turkestan is also likely to be near the cradle of civilization.

We may use the stage diagram to correlate our scanty knowledge as to the early wave fronts of the Aryan languages. There are three fairly definite subdivisions of Aryan: (1) the early *Kentum* or *K* speeches like Gaelic and Latin; (2) the Intermediate *P* languages like Welsh (with which we may associate Teutonic and Greek for convenience); (3) the later *Satem* languages like Slav and Indian.

Turning to Fig. 3 some idea of our knowledge of the language distribution in Sumerian times is given in the lowest map of the series. At this time Hamitic languages were used by the Pharaohs in Egypt, akin to those still spoken by the Berbers in the Atlas Mountains. Semitic languages characterized Arabia and Syria, as they still do. Sumerian itself has some resemblances to the Altaic, though its affinities are not yet clearly understood. In Europe at this early date there were racial allies

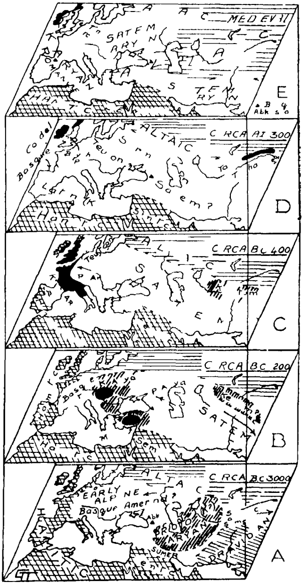

Fig. 3

A STAGE DIAGRAM GIVING A TENTATIVE RECONSTRUCTION OF THE DISTRIBUTION OF EUROPEAN LANGUAGES AT VARIOUS EPOCHS.

Black areas are the Primitive (marginal) *K Aryan* languages. It is suggested that the early Mediterranean race spoke *Hamitic* and that the early Alpines spoke languages akin to *Basque Abkasian* (and Amerind ?). Aryan developed near the Caspian Sea and spread out in waves. The outer ripple (*K*) was akin to *Gaelic*, the second (*P*) akin to *Welsh*. The latest type was the *Satem* group.

of the present day Hamitic speakers—all of Mediterranean race—living in the western regions who probably spoke Hamitic according to Rhys and Jones Central Europe was occupied by early migration of Alpine Brakephs (broadheads) of whose language we know nothing It was almost certainly not Aryan and something akin to Basque seems most likely In view of the important corridor linking Turkestan with China by way of the Tarim Basin I have ventured to suggest that a linguistic kinship between early Chinese (Sinitic) and Sumerian or early Aryan is only to be expected

In the second map (Fig 3 at *B*) for the period around 1200 B C we are on surer ground Vast migrations of Satem speakers had poured into India from Turkestan The Hittites who seem to have spoken an Aryan tongue somewhat akin to the Kentum Group were in control of Anatolia Semitic was now the chief language of Egypt and Mesopotamia

In Central Europe (if we adopt the suggestions of Peake) Kentum languages were spoken in the regions east of the Alps while Brythonic (one of the Intermediate *P* type) was that used by the Cimmerians of the Ukraine and Caucasus areas It seems logical to assume that many Satem speakers still remained in Turkestan and were perhaps allied to the Sarmatian tribes

In the next map (for 400 B C) we see the first great Aryan conquest in the Near East that of the Persians They spoke a Satem language and it is probable that their Sarmatian kin were occupying the European steppes about this time The latter may have been the ancestors of the Slavs who already seem to have settled in the Vistula Basin Meanwhile the marginal *K* speakers (Gaelic etc) had reached Britain and Ireland and still occupied parts of France The distribution of place names in Central and Western Europe clearly shows the migration of waves of Gaelic and Welsh speakers across much of these areas

The conditions some seven centuries later (A D 300) are shown in the next map which deals with Europe during the zenith of the Roman Empire The marginal primitive Aryan language Latin had been carried far and wide so that it later gave rise to Italian French and the other Romance tongues—which are clearly offshoots of the *K* group of Aryan Brythonic (Welsh) was spoken in England South Scotland and Wales at this time and probably in parts of the continent besides Brittany Possibly some Hamitic dialects still persisted in the Scottish Highlands as suggested by some of the Ogam inscriptions Gaelic (a *K* language) was spoken in Ireland and in most of Northern Scotland

Of great interest is the discovery that a Kentum language called Tocharese was still in use north of the Tarim Basin in Central Asia about this time (Fig 3 at *D*) Tocharese seems however to have some affinities with the Intermediate and Satem groups also Hence it may well be fairly close to the *generalized* Aryan ancestor from which all three groups of Aryan have descended It is suggested in the diagrams that this Kentum speech had been continuously used east of Turkestan since early Aryan times

The medieval distribution of languages and of the three subdivisions of Aryan is shown in the top map To day Gaelic is almost the sole representative of a little altered primitive Aryan speech —though the much evolved derivatives of primitive Latin are still very important languages (Jespersen 1894) Hamitic has died out in Europe Altaic has encroached in Hungary and Finland and displaced Hittite and Greek in Anatolia Semitic has driven out Hamitic in much of North Africa Satem Aryan in the form of Russian is in turn displacing Altaic throughout much of the U S S R

The conclusion to be drawn from this tentative geographical approach to the Aryan problem is that the waves of language have spread from Turkestan towards India Persia and Europe There seems to be no support for the origin of Aryan in the German or Lithuanian regions a theory which has been strongly upheld by a number of notable continental philologists

During the twentieth century the trend of geography has been away from the belief of Ritter in providential control and from environmental control as expounded by Ratzel towards the possibilism concept of Vidal de la Blache and his school The latter geographers picture any particular region as offering almost innumerable possibilities of exploitation to man Our material evolution in their opinion is essentially a matter of our own choice depending on which of the possibilities *we* choose I have come to a different conclusion no doubt primarily owing to my experience in pioneer countries like Australia and Canada where the possibilities offered by Nature to man are more meagre than in Great Britain or the United States Indeed of these three schools which we may label the theocratic the geocratic and the we ocratic I definitely belong to the second However I propose to illustrate by the correlative method first in a pioneer country like Canada and secondly in the old established culture complex of Europe that man is not really a free agent—but definitely a product of his environment

A generalized economic map about 1750 shows that fish farms and fur had expanded to Saskatchewan Some sixty years later by 1810 farming had spread approximately to Detroit while Mackenzie was exploiting for furs the river basin named after him By 1870 mining was becoming of some importance and gold silver and iron mines were being exploited both near the St Lawrence and on the Fraser River Still more important Selkirk had more than fifty years earlier settled his isolated band of farmers on the silts of Lake Agassiz in the heart of the continent About 1880 the modern migration to the wheat fields of the prairies began In 1930 the whole north of the Dominion is being exploited not only for furs but also for metal mines the latter in part by air transport Agriculture has covered most of the inland prairies and will extend north (and into the clay belt) Manufactures have spread along the St Lawrence from Montreal to Ottawa and Windsor in large part owing to the bountiful water power

But while there have been these striking advances and changes in the type of industry man has not really been a free agent His advance from fur hunting to wheat growing is only possible where rain and sun and soil are satisfactory *All* the fur country cannot be utilized for wheat even if man so wishes Using a foreign example we shall never see hydro electric power or coalfields leading to the development of factories in that half of the southern continent known as empty Australia however much man may wish to replace the sparsest of pastoral occupation by better paying industries On the other hand it seems clear to me that in the future the immense coal resources of Alberta must inevitably be utilized as the more accessible coalfields are used up elsewhere Man may very probably some day choose (as the possibilist school would say) to give up ranching in the drier parts of Alberta and turn to manufacturing based on the almost inexhaustible coal But he is none the less controlled by his environment

Exaggerating somewhat I feel that man s part in the programme of a country s evolution is not unlike that of a traffic policeman He can accelerate slow or halt the traffic but he does not alter its direction This stop and go determinism has no supporters among the historians and not many even among geographers But it expresses something of the conclusions that I have arrived at from my lengthy study of the difficult environments of Australia and Canada

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Sense Perception and the Evolution of Colour and Pattern

THE recent symposium* and discussion on Sense Perception and the Evolution of Colour and Pattern held under the auspices of Section D (Zoology) of the British Association at Cambridge directs attention to a field of inquiry where the artist the naturalist and the psychologist may meet

In the interrelationships between animals of the same or of different species—as between predator and prey between rival males or the opposite sexes between parent and offspring or between members of the group—characters which exert their influence from a distance by sound by sight or scent and the sensory equipment with which such stimuli are perceived each play a vital part

The study of such characters to which Dr J S Huxley has applied the term allæsthetic[1] involves various questions of wide interest How far has the evolution of vision gone parallel with the development of characters serving as visual stimuli ? What is the functional significance of the elaborately evolved stimulating equipment on one hand and of the highly specialized sensory apparatus possessed for its appreciation by other animals ?

The phenomena may be approached from various points of view the nature of the allæsthetic characters themselves the public in relation to which they have evolved the ecological significance of the relationship between the organisms concerned Broadly speaking the phenomena of adaptive coloration fall into three main classes according to the visible results achieved—namely concealment advertisement and disguise The biological function of such elusive attractive or deceptive features varies widely according to circumstances Through reduced visibility they may facilitate the capture of food or escape from the aggressor Through increased conspicuousness they may serve as a warning to enemies or a threat to rivals as a courtship display or a recognition mark Through deceptive or mimetic effects they may mislead the observer as to an animal s whereabouts attitude or identity

Studies of adaptive coloration and visual perception have shown that there exists a close correlation between allæsthetic characters and the sensory equipment of the animals towards which they are directed and in relation to which they have evolved Such characters therefore assume a new interest in the indirect light they throw upon questions of comparative psychology and sense perception On these grounds it may be concluded for example that the rarity of bright colours among mammals below the primates is evidence of colour blind vision in these forms while conversely the varied and saturated hues exhibited by different fishes and birds and by entomophilous flowers postulates a colour sense in the vertebrates and insects concerned Such conclusions are borne out by the evidence of experiments upon colour vision in these groups

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* Speakers at the symposium were Dr J S Huxley Dr H B Cott, Mr D Lack and Mr L H Birkill

The optical properties of the structures displayed also permit deductions as to the differential reception of light rays by different animals The limits of the visible spectrum for man and for animals do not necessarily coincide Bees for example are blind to red but have a range of colour vision extending far into the ultra violet and it is significant that many bee flowers reflect ultra violet light On the other hand red is an efficient stimulant to diurnal birds and it is more than a coincidence that red finds a dominant place in bird advertisements whether their function is attractive—in the form of ornithophilous flowers or fruit or repellent—in the shape of aposematic insect prey

Allæsthetic characters may also throw light on higher faculties It is to be noted that where visibility from a distance is required as in characters subserving the functions of warning threat or recognition crude colours and simple patterns have been developed On the other hand characters which are employed solely or mainly in epigamic display and used at close range like the plumes of birds of paradise tend to be detailed delicate and beautiful rather than merely conspicuous advertisements and as such they suggest powers of æsthetic appreciation in the species which display them Similarly in the field of concealment the extraordinary degree of perfection attained by many insects and other animals in their special resemblance to bark lichen leaves and other objects—achieved by the combined effect of colour pattern and posture—almost presupposes in birds (their natural enemies) those exceptional powers of visual acuity and form perception which on other grounds we know them to possess

Viewing the relationship in a somewhat different light it is becoming increasingly clear from an investigation of their nature and occurrence that the so called adaptive appearances are in fact to be interpreted in terms of visual perception—that their end is an appeal to the eye Thus in the sphere of concealment it is significant that the particular arrangements of colour and pattern which for optical reasons are those best adapted to reduce visibility and which include special optical devices for obliterating the visible characters upon which recognition depends—such as differences of colour of light and shade continuity of surface outline and shadow—are those actually employed in the coloration of different cryptic species Moreover various patterns especially those of the coincident disruptive type[2] contradict and frequently cut right across separate structural elements—underlying anatomical features becoming subordinate to the illusionary appearance superimposed upon them Further such colour schemes are largely independent not only of anatomy but also of affinity—a point which was effectively stressed by Sir Edward Poulton forty years ago[3] Equally convincing is the evidence to be derived from the general habits resting attitudes and special reactions of cryptic sematic or mimetic animals when considered in relation to their conditions of life

Modern knowledge demands considerable modification of Darwin s theory of sexual selection While the Darwinian doctrine almost confined the effects of epigamic display to the sphere of psychology—to the female choice of mates—and as such was applicable only to displays of unmated males before pairing up recent research has pointed on one hand to the prevalence of displays by one or both sexes during later phases of the breeding cycle and on the other to the far reaching physiological effects of these and other visual phenomena in stimulating and regulating reproductive functions

It is now recognized that displays by one or by both sexes subsequent to pairing up and leading to coition have a profound influence in serving to promote ovulation or to synchronize physiological rhythms connected with the readiness to mate[4,5,6] These effects depend not merely upon epigamic display they may be decided by such characters as the population density of a breeding colony[7] the presence of correct nesting material or of a suitable nesting site[9] On the other hand mutual displays during the post nuptial period in such birds as grebes and divers where both sexes share family duties seem to serve as an emotional bond between the pair throughout the breeding season[10]

A distinction is not easily drawn between characters evolved in relation to epigamic display and those serving other functions involving conspicuousness Many display characters whether of colour or posture have no direct bearing upon courtship In some species such as the Bishop bird (*Euplectes h hordeacea*) the display apparently has to do solely with territorial claims[11] Or again the same conspicuous characters may in different circumstances take on different functions as of recognition or warning threat or courtship Thus the ruff of the great crested grebe is employed in different ways for threat against rivals of the same sex and for display towards members of the opposite sex The complex nature of the phenomena has been demonstrated by Mr David Lack, who has shown that the robin, while able to distinguish its mate from other individuals, will yet sometimes attack the headless remains of a stuffed specimen in which little more than the breast is visible

In conclusion, it is to be noted that the study of all æsthetic characters is not devoid of application to everyday matters Just as the form of fishes and birds has in the past been invoked to assist the marine architect and the aircraft designer, so, it may be hoped, will the coloration of cryptic animals read a much needed lesson on the principles and practice of concealment to those responsible for the applications of camouflage in time of war

Hugh B Cott.

[1] Huxley J S *Proc 8th Int Ornith Congr* (1934) 430 (1938)
[2] Cott H B *Photographic J* 563 (1938)
[3] Poulton F B *Linn Soc J Zool* **24** 558 (1898)
[4] Harper F H *Amer J Anat* **3** 349 (1904)
[5] Howard E Bird Behaviour (Cambridge 1929)
[6] Howard E The Nature of a Bird s World (Cambridge 1935)
[7] Marshall F H A *Phil Trans Roy Soc* B **226** 423 (1936)
[8] Darling F Fraser Bird Flocks and the Breeding Cycle (Cambridge 1938)
[9] Lack D *Proc Zool Soc London* 231 (1933)
[10] Huxley J S *Linn Soc J Zool* **35** 253 (1923)
[11] Lack D *Ibis* 817 (1935)

Obituary Notices

Cavaliere Filippo De Filippi, Hon. K.C.I.E.

Cavaliere Filippo De Filippi, who died at his home near Florence on September 23 at the age of sixty nine years, is probably best known in England as the leader of the Italian Scientific Expedition to the Himalayas, Karakorum and Chinese Turkestan in 1913–14

This Expedition, probably the largest and best equipped that has ever visited Central Asia, was the conception of, and entirely organized by, De Filippi His basic idea was the connexion of the gravimetrical surveys of India and Russian Turkestan by a chain of stations across the mountain ranges—the Himalayas, Karakorum and Kuen Lun—which separate them This involved the accurate determination of the astronomical and geodetic co ordinates of the stations, necessitating the use of instruments and methods of much greater accuracy than those normally used for survey work in such areas The use of wireless time signals for the determination of the differences in longitude was the pioneer experiment in this method, and was highly successful The anomalies of gravity deduced from the determinations made by the Expedition confirm the general conclusions drawn from those made by the Survey of India and the Russian Geodetic Service

Complete sets of magnetic observations were made at each gravity station, and in addition, throughout the period November 1913–August 1914, full meteorological records were taken three times daily These were extended to hourly readings from 6 a m to 8 p m during June 1914 and for the whole 24 hours during July, during which time the observers were on the Depsang Plateau Observations for solar radiation and of the velocity and direction of the higher air currents were also made when weather permitted

The geology of the whole area traversed was thoroughly examined by the two eminent geologists who accompanied the Expedition, and at the same time anthropological and ethnological studies were made. A topographical survey of the country was also carried out and the very interesting geographical discovery made that the Rimu glacier divided on the Central Asian watershed The main branch forms the source of the Shyok the largest tributary of the Indus River, while a large but subsidiary one, extending to the north, is the source of the Yarkand River, which eventually loses itself in the deserts of Central Asia

Dr De Filippi was responsible for all the preliminary organization of the Expedition, and during it, in addition to his work as leader and medical officer, took charge of the transport and supply work, thus leaving the scientific officers free to devote their whole energies to their own special work All his arrangements worked without a hitch, and the success of the Expedition was undoubtedly due to his great forethought and organizing abilities, and his tact in handling all sorts and conditions of men He had a most charming manner and made friends with every one he met, who must all deplore his death

The results of the Expedition have been published in Italian in seventeen large volumes, but only the general narrative has been translated into English

Dr Josef Rosenthal

Dr Josef Rosenthal, formerly of Munich, died at Hampstead on August 7 last As a young physicist, Rosenthal was one of the first to recognize the importance of Röntgen s discovery to medicine, and he devoted his life to the development of the X ray tube, with special regard to its medical use

Rosenthal's first experiments were reported to the Deutscher Naturforscher und Aerzte Tag in Braunschweig in 1897 in a paper "Ueber Röntgenbilder" In the same year, he began to work with H Rieder, the medical radiologist, and this collaboration, which lasted for more than thirty years, led to many important results One of Rosenthal s constant aims was to reduce the exposure time necessary for X-ray photography This made possible two of the outstanding results of his work with Rieder, namely, the first X ray photograph of the human thorax in a living subject (1899 , later frequently improved), and the first successful attempt at X ray cinematography of the movements of the human stomach (1909) Jointly with Rieder, Rosenthal was editor of the first Lehrbuch der Röntgenkunde (first edition 1913 , second edition 1924)

In later years, Rosenthal took an active interest in the development of the Deutsches Museum in Munich, especially in its Department of Radiology, an activity which found its official recognition on the occasion of the laying of the foundation stone of the new Museum, in 1928, when he was awarded the 'Goldene Ring of the Museum A popular lecture, given in the Museum, entitled 'Das Jahrhundert der Strahlen appeared as a pamphlet in 1930

We regret to announce the following deaths

Sir Henry Fowler K B E , formerly chief mechanical engineer of the London, Midland and Scottish Railway on October 16, aged sixty eight years

Dr Willis R Gregg, chief of the United States Weather Bureau known for his work in aeronautical meteorology, on September 14, aged fifty eight years

Dr Thomas C Hebb, professor of physics in the University of British Columbia on August 13, aged fifty nine years

Prof Maurice d Ocagne, free member of the Paris Academy of Sciences known for his work on the application of geometrical methods to the calculus, and author of the Traité de Nomographie (1919) on September 23 aged seventy six years

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News and Views

Sir Daniel Hall, K C B , F R S

The impending retirement of Sir Daniel Hall from the directorship of the John Innes Horticultural Institution will presumably close his very long connexion with agricultural administration and research From the time when he was the first principal of the South Eastern Agricultural College Wye, and throughout his directorship of the Rothamsted Experimental Station his tenure of office as principal scientific adviser to the Ministry of Agriculture and Fisheries and lately as director of the John Innes Institution, Sir Daniel has impressed all by his knowledge, his sound judgment and tact, and not least by his great ability as a writer and speaker Like the late Lord Ernle, and his successor at Rothamsted Sir Daniel excels in the art of exposition, and British scientific agriculture has indeed been fortunate in commanding the services of men of this type Now that he has passed the stage when, in the pursuit of duty, it is no longer necessary to "rise earlier than virtue and go to bed later than vice", we hope that Sir Daniel will find occasion to continue his great interest in the social contacts of science , but no one will grudge him time to devote to oriental art and other "digressions of a man of science" Science needs men like him who can write and speak, as well as think and do in order that its voice may be heard amidst the disharmonies of a world torn by political turmoil and social strife

International Study of African Problems

The Volta Foundation Congress, which met in Rome at the beginning of October under the auspices of the Italian Royal Academy for the discussion of questions relating to Africa, was attended by delegates from fourteen European countries, including representatives of Great Britain and Germany The delegates appear from the reports of the proceedings to have appreciated to the full both the joint responsibility of the nations of Europe for the future development of Africa, which was stressed by Prof Orestano in his address at the opening of the Congress, and the desirability of international co operation on a broad basis in the study of conditions which is a necessary preliminary in the approach to the problems, upon the solution of which advancement of Africa and her peoples must depend Among the topics discussed on these lines were such matters as tropical diseases, native education, European settlement, anthropological studies, communications, and the like In view of the attitude of the delegates on these matters, it is not surprising that in the final session strong expression was given to the opinion that some permanent organization should be formed for the promotion of international co operation in further inquiry , while it was also urged that nations other than those at present interested directly in Africa, should be invited to participate in the interests of civilization at large While any proposal is welcome which aims at promoting study of the problems of Africa as a whole, and seeks to attract collaboration from as wide a field as possible, it may not be out of place to recall that there are already in existence international organizations, which in certain fields are doing excellent work, and are capable of ready extension,were funds available It would, however, be premature to offer comment before the present proposal takes more definite shape

Boundaries for University Teachers

Any action which affects the positions of members of scientific staffs of universities or similar institutions concerned with the promotion of natural knowledge, or restricts fields of research, or is in conflict with the spirit of internationalism in science, commands the attention of scientific workers everywhere It is on this account, and as an indication of the restrictions imposed upon the movements of university teachers by State authority, that we print the following translation of a decree issued for information and action in August last in Vienna by the Ministry for International and Cultural Affairs

Invitations to positions in foreign countries issued to Austrian university teachers who are non Aryan married to a non Aryan or politically unreliable

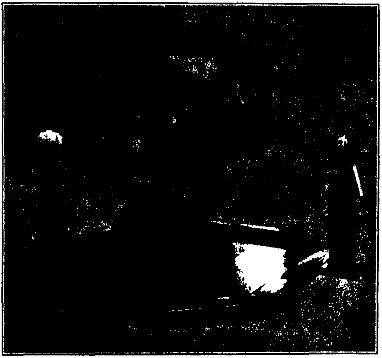
To the Rectors of the Austrian universities and to the Dean of the Theological Faculty in Salzburg also to the Academies of Fine Arts and to the Rector of the World Trade College

At the instance of the Minister of Education the attention of the Rectors and Dean is drawn to the fact that the decree of April 23rd 1938 Zl 12822 forbidding all university teachers to negotiate about a call to a university outside the German Empire without previously obtaining the consent of the Ministry of Education applies also to university teachers who have retired and to others who for other reasons have ceased to occupy their positions

Should the Rectors or Dean learn of an Austrian university teacher, retired or dismissed who is non Aryan, married to a non Aryan or politically unreliable who is trying to obtain a call to a foreign university or already preparing to occupy such a position, they must report the case here at once —The State Commissar Plattner

A Geological Globe

A TERRESTRIAL globe, believed to be the largest yet prepared to show both orographical detail and the distribution of the main geological formations was formally installed in the Geological Museum at South Kensington on October 10 by Sir Frank Smith secretary of the Department of Scientific and Industrial Research The globe was modelled by Mr C d O Pilkington Jackson, of Edinburgh, from data compiled by Mr D L Linton It consists of a sphere of fibrous plaster, 5 ft 11 in in diameter, strengthened internally by steel stays arranged around a steel tube which forms an axis from pole to pole and is tilted at 23½° from the vertical The globe is supported by a steel spindle which is electrically rotated at a rate of one revolution in 2½ minutes The linear scale is approximately 1 7,000,000, and relief is exaggerated twenty times The geological colouring has been carried out in the Museum by Mr C Keefe under the direction of Mr A J Butler The colour scheme is designed to demonstrate the broad outlines of the geological structure of the continents in a fashion sufficiently simple to appeal to the non geological visitor and at the same time to reveal on closer inspection sufficient detail to render the globe of special use to teachers and students of geology and geography Six distinct colours are used to indicate the sedimentary deposits of the geological eras and the systems formed during each era are distinguished by graduated shades of the appropriate colour the lightest shade represents the newest system the darkest represents the oldest A system of stipples is used to show the age limits of rock groups which cannot be divided into systems Igneous rocks appear in scarlet and orange and ice caps rivers and lakes are also marked Provision is made for corrections and additions as new information comes to light The geological globe bears no lettering or symbols Two small physical globes which are mounted near it act as geographical indexes, and a sphere some 19 inches in diameter and 60 yards away demonstrates the relative size and distance of the moon



GEOLOGICAL GLOBE AT THE GEOLOGICAL MUSEUM SOUTH KENSINGTON

Decibels and Phons

WE owe it largely to the public interest in the abatement of noise that two hitherto unfamiliar, but now international, units—the decibel and the phon—have come into common use The decibel, which arrived from America via the telephone engineer represents approximately a 5/4 geometrical increase in acoustical energy or intensity This forms the basis of a logarithmic scale of energy levels which advance by increments of one decibel, starting from a zero which is arbitrarily fixed near the threshold of hearing The phon which was imported from Germany, is the unit of loudness or, more precisely, of equivalent loudness It is derived through the medium of a pure tone of 1000 cycles per second which is set up as a standard of reference Where the reference tone is stimulated by an energy level equal to n decibels above the zero its loudness level is declared to be n phons If further the reference tone has been regulated so that as heard by an average ear under specified conditions its loudness is assessed as equalling that of some other sound or noise then the equivalent loudness of the latter is also declared to be n phons

In this way we overcome the difficulty that energy and loudness do not necessarily keep in step when the frequency is changed and so through the intermediary of a device akin to the standard candle of the photometrician we can link the phon level with the decibel level which latter is measurable by physical instruments called noise meters Mr Ll S Lloyd feeling that all this is too difficult for a musician to comprehend has based a simple explanation of it on the parallelism of the decibel to the musical interval of a major third (5/4) and has published it in an attractively written pamphlet (Decibels and Phons A Musical Analogy London Oxford University Press 1s 6d net) The major third can naturally serve as an increment to build up a scale of pitch which is of course no less a logarithmic scale than any other musical scale such as that of the more familiar octave To interpret pitch as intensity apparently comes naturally to a race of selectively gifted monsters whom the author amusingly creates for his purpose Even those to whom the analogy may seem somewhat circuitous will find the treatment pleasant reading while there will no doubt be others besides monsters and musicians to whom Mr Lloyd's method of approach will commend itself

Science and the Welfare of Animals

A Scientific Investigations Committee has been formed by ULAWS (University of London Animal Welfare Society) which is in the course of being incorporated into the newly formed Universities Federation for Animal Welfare The committee will concern itself with the acquisition of knowledge calculated to benefit animals in their own interests as distinct from the interests of the human species Its functions will be to define problems for inquiry to advise as to the allocation of funds for the purpose and to collect and communicate any new knowledge which may be of value for increasing the well being or diminishing the sufferings of animals A small grant has been made in aid of an ecological investigation relevant to the control of wild populations which is frequently carried out by methods considered by many to be inhumane Among the other topics in which the committee is interested are the widespread failure to utilize existing knowledge of dietetic principles the problem of bait poisons the destruction of sea birds by oil waste and the use of an electric goad as a substitute for the stick in droving cattle The members of the committee are Capt C W Hume (chairman) Dr S Graham Brade Birks (hon secretary) Dr Paul Haas Mr H R Hewer and Dr W R Wooldridge Men of science who are in sympathy with the objects of the committee are invited to communicate with Dr S Graham Brade Birks South Eastern Agricultural College Wye Kent

London Scientific Film Society

The proposed formation of a scientific film society which would give shows of scientific documentary films to its members and their guests was announced in Nature of June 4 Such a society has now been formed under the name of the London Scientific Film Society and its inaugural meeting was held on October 14 at the Conway Hall At the meeting Mr L V Chilton explained how the formation of the Society was a direct result of the work of the Association of Scientific Workers on scientific films One of the functions of the Association is the promotion of a proper understanding of science by the general public and of what science can do for society the Association is therefore interested in the teaching of science and in the proper treatment of science on the screen Mr Arthur Elton referred to the London Film Society which was formed eleven years ago and has had a broadening influence on the æsthetic film He said that if the London Scientific Film Society is to be successful it must reveal to the public both the achievements of science and the potentialities of the scientific documentary film Such a society can do much to raise the standard of scientific accuracy of the films shown in public cinemas and also to increase the number of scientific films shown The first show of the Society will be held at 2 30 p m on Sunday November 13 at the Academy Cinema Particulars of the Society and forms of application for membership can be obtained from the Secretary at 28 Hogarth Road S W 5

Faiths and World Fellowship

The World Congress of Faiths was founded several years ago by Sir Francis Younghusband to promote a spirit of fellowship among mankind through religion The object of the organization is to awaken and develop a world loyalty while allowing full play for the diversity of men nations and faiths There have been three congresses in London Oxford and Cambridge respectively in 1936 1937 and 1938 and the proceedings have been published in volumes obtainable from the Secretary World Congress of Faiths 36 Victoria Street London S W 1 Owing to the tension in the international situation the committee of the Congress has decided to postpone the holding of the next congress at the American University Beirut and arrangements are being made for the 1939 Congress to be held in Paris A meeting will be held in the Kensington Town Hall at 8 30 p m on October 31, at which Lord Gorell will take the chair and Hindu Jewish Muslim and Christian speakers will deliver addresses on The Crisis through Faiths to Fellowship

Air-Raid Precautions

Two publications recently issued by the British Steelwork Association, Steel House, Tothill Street London, S W 1, are of permanent value, although happily the international crisis is over The first of these, entitled "Steel for A R P", suggests ways in which standardized steel products can be used for air raid protection One of these standard products is corrugated steel sheets and it can be used for overhead cover Similarly the steel arches used to support the roadways of collieries are applicable to construct shelters in basements, railway embankments and cuttings The booklet dwells on the advantages of steel frame construction from the point of view of its ability to resist explosive shock These frames withstand stresses in any direction A frame is not dependent for its strength upon the walls, and it can easily be repaired Various types of wall and floor construction are described and so also are the customary brick panels The latter are considered to be able to deal with blast and splinters when well tied up to the supporting structure The use of pressed steel window sub frames can increase their strength In existing buildings the most appropriate site for a shelter is the basement, and some useful hints are given of the best way of using existing steel products to strengthen it The second book deals with the Everyman trench shelter, and will be of interest to many It describes with the help of drawings how a householder can build a shelter capable of holding four persons and sufficient to afford protection against blast and splinters For the roof curved sheets five feet long are used and standard flat corrugated iron sheets six feet long for lining the walls A bill of the quantities required is given It has been suggested that now that time is not important, there will be many who will consider it worth while to build such a shelter in their leisure hours As the roof will be covered with the excavated soil, it might be sown or planted in such a way that the amenities of the garden would not greatly suffer

Protecting Airships Against Fire

SOME of the problems that have to be solved when protecting airships against fire, due to electric sparks in the neighbourhood of free hydrogen, are discussed in an article in *The Times* of October 18 The latest German airship, the LZ 130, which inherits the name of *Graf Zeppelin*, is denied the use of helium, and so uses hydrogen gas Dr Hugo Eckener and his colleagues are engaged in experiments during flight to test a project for making the potential of the static electricity within the airship frame equal to that of the electrical field outside The experiments are based on the use of a new instrument which records the nature and intensity of the static charge in the airship and of the electrical conditions in the atmosphere surrounding the hull Its function appears to be that of warning the captain of conditions in which it would be dangerous to 'valve gas or to have an appreciable leak of gas There is little danger even when the aircraft passes through a field of opposite charge, unless there is a gap in the bonded structure across which a spark may jump If the new instrument works satisfactorily, it would give a warning when the conditions were dangerous and special precautions could be taken It would enable the captain to see whether or not it was desirable to earth a positive charge when in the neighbourhood of a negatively charged cloud Such stations have been made in miniature and experiments on a small scale have been carried out Experiments will shortly be made in full scale under natural conditions

Excavation of a Neolithic Barrow in Kent

SIR EDMUND DAVIS's excavation of Julaber's Grave, Chilham Hill Kent, under the direction of Mr R F Jesup, in continuation of the investigations of 1937, after a brief interruption during the recent crisis, owing to the absence of the director, has been brought to a close, after being carried to a point at which it was proved conclusively that the barrow is of neolithic age Reports of the result of the excavation (*The Times*, October 1 and 12), state that a polished flint axe about six inches long, with flattened sides, curved edge and made of creamy white flint, was found in a layer at a depth of four feet six inches, in which were also rough sherds, a human tooth, pointing to a burial, and a number of flint flakes, such as are found only in the area of the mound in the adjacent cultivated soil Traces of charcoal in the core of the mound, particularly in the neolithic turf layer, support the theory that the area was cleared by burning The polished flint axe which substantiates the neolithic dating of the mound, is of Scandinavian type, and, it is suggested, allies the mound with the megalith builders of the Baltic, rather than with the long barrow peoples of Dorset and Wiltshire It is certainly significant that, as the report points out, Julaber's Grave in relation to the other long barrows of Britain, stands in a position of isolation Further investigation of the Roman burial containing the skeletal remains of three individuals which was found in 1937, has revealed a remarkable, and at first sight puzzling, construction of flint at the southern end of the grave This has proved to cover the burial of a man and a horse The head of the horse, however, is missing, and the usual platter and bowl are in fragments Apparently the burial had been disturbed, while the flint structure had been placed there to prevent the remains, buried in the side of the mound, from slipping into the ditch

Reduction of Maternal Mortality

THE Minister of Health has communicated with local supervising authorities on methods that may be adopted in order to secure that the best obstetric aid is available to expectant mothers on occasions when midwives have to call in a doctor (Ministry of Health Circular 1705 H M Stationery Office 1*d* net) The recommendations are that a panel of doctors who will be available for this service should be drawn up for the area of each authority, and that a small advisory committee should be set up to advise the authority in regard to the operation of the arrangements and on any alteration that may be deemed necessary in order to secure and maintain a high standard of obstetric practice It is hoped that the adoption of arrangements on those lines will help in reducing the present maternal mortality rate

Conference of the National Union of Teachers

A BOOKLET has been issued containing eight of the addresses delivered at sectional meetings of the Annual Conference of the National Union of Teachers held in Margate in June last (London National Union of Teachers, 6*d* net) Exemptions and Beneficial Employment , in connexion with the Factory Act, 1937, which has just come into operation was the subject of addresses by Major Evan Davies Mrs Alderman Wainwright and Mr F A Ring, who all foresee considerable difficulties for the authorities and administrators who have been given the task of working the Act The subject of handicraft in schools was dealt with by Mr F Potter, who considers that the prestige of handicrafts and of handicraft teachers never stood higher and continues to increase He expressed the hope that, in the future, room would be found for promotion to headships in the newer senior schools of the really educated and skilled craftsman

London Lectures for Teachers

THE L C C *Handbook for 1938 39 of lectures* and classes for teachers gives particulars of 114 courses distributed over a wide field Nearly half (52) relate to art and crafts music and physical education, 19 are listed under pedagogy and 7 under science Among what may be called the star turns are lectures on food production by Sir John Russell on recent advances in physics by Prof J D Cockroft and Prof F K Rideal on vitamins, hormones and stimulating substances by Dr J Needham and on astronomy by Sir Arthur Eddington There are three courses which should prove useful on how to make use of museums (British, Victoria and Albert and London) Four deal with the important, but too often neglected, subjects of speech training, speech therapy and backwardness in reading Another often neglected subject will be dealt with under the title Thinking and Writing by Mr R W Jepson at Mercers School on lines designed to help in the training of children of 11–14 years of age to use language as a medium for clear and exact thought and expression—to understand its structure and working and the meanings it conveys, to realize its potentialities for enlightenment and confusion, and to apply the knowledge thus gained to their own writing The equally neglected science and art of cookery find no place in the programme except by implication in the syllabus of a course on domestic subjects

Australian Journal cf Science

THE first number of the *Australian Journal of Science* has recently been issued This journal is published by the Australian National Research Council under the auspices of the Australian and New Zealand Association for the Advancement of Science, and six numbers will appear each year Scientific work in Australia has developed greatly in recent years, and the need for a means of publishing short advance summaries of research has become more and more apparent The new journal is designed to satisfy this need and also, in line with other well known scientific journals, to publish reviews, news and views, reports of proceedings of various scientific institutes and correspondence The first number now to hand augurs well for the success of the project The substance of the inaugural lecture by Prof Eric Ashby, newly appointed professor of botany in the University of Sydney, on "The Place of Biology in Australian Education" is purposely provocative and should be read with interest and profit by all biologists, but especially by those responsible in some way or another for the teaching of biology in Australia Sir Douglas Mawson has an interesting short article on research in the antarctic *Australian Science Abstracts* are in future to be incorporated in the *Australian Journal of Science* as a supplement Subscription for the *Journal* is 12*s* for one year Further information can be obtained from the Australian National Research Council, Science House, 157–161 Gloucester Street, Sydney N S W

Institution of Civil Engineers Awards

THE following awards of the Institution of Civil Engineers have been made *for session 1937–38* *Telford Premiums* to Sir George Lee, M G J McHaffie, jointly to W C Parker and Hubert Clarke jointly to William Hudson and J K Hunter, George Ellson, jointly to F J Buckton and H J Fereday R W Mountain W A Tookey, F C Vokes, Prof A H Gibson, J F Hay, Frank Fancutt, T H Seaton , *Coopers Hill War Memorial Prize* to William Hawthorne and F H Williams (jointly) , *Trevithick Premium* to R G Knight , *Manby Premium* to Dr H J Gough and W A Wood (jointly) , *Indian Premium* to M R Atkins and D H Remfry (jointly) For papers published in the *Journal* without oral discussion *Telford Premiums* to Prof F C Lea and J G Whitman (jointly) , Dr C F Colebrook and Prof C M White (jointly), Herbert Addison, Thomas Donkin , *Trevithick Premium* to G C Blofield *Crampton Prizes* to J R Daymond, Serge Leliavsky For students papers read in London or at meetings of local associations *James Forrest Medal and a Miller Prize* to John Hayes , *Miller Prizes* to I S Chisholm, A R Collins, A L Arnold, F F Humphries, Jack Mercer, J M P Hooley

Australian and New Zealand Association

THE twenty-fourth meeting of the Australian and New Zealand Association for the Advancement of Science is to be held at Canberra on January 11–18, 1939, under the presidency of Prof Ernest Scott, emeritus professor of history in the University of Melbourne This meeting is regarded as the jubilee meeting of the Association, the first meeting having been held in Sydney in August 1888 under the presidency of the late Mr H C Russell Six men of science from Great Britain have accepted invitations to attend this meeting they are Prof F T Brooks Sir John Flett, Dr Julian Huxley, Sir John Russell, Dr N V Sidgwick and Mr H G Wells It is hoped that the practice thus introduced of welcoming a group of scientific workers from overseas will be continued at all future biennial meetings The presidents of the sections are as follows Section A

(Astronomy, Mathematics and Physics), Prof T Parnell, Section B (Chemistry) W Russell Grimwade, Section C (Geology) Prof R Speight Section D (Zoology), E J Goddard, Section E (History) Prof S H Roberts, Section F (Anthropology) F F Williams, Section G (Economics Statistics and Social Science) L G Melville Section H (Engineering and Architecture) Sir Henry Barraclough Section I (Medical Science and National Health) Dr E Sydney Morris, Section J (Education, Psychology and Philosophy) J R Darling Section K (Agriculture and Forestry) Dr W I Waterhouse Section L (Veterinary Science) Dr L B Bull Section M (Botany) Prof J G Wood Section N (Physiology) Prof W J Young Section O (Pharmaceutical Science) Dr E M Watson Section P (Geography and Oceanography) G A V Stanley

Announcements

THE Duke of Kent will preside at a meeting called by the Duke of Devonshire (chairman of the Society for Extending the Rothamsted Experiments) and the Earl of Radnor (chairman of the managing committee of the Station) to consider arrangements for celebrating the approaching centenary of the Rothamsted Experimental Station at Harpenden The meeting will be held in the rooms of the Royal Society on November 1 at 3 p m

DR ROBERT COURRIER professor of medicine at the Algiers Faculty of Medicine, has been made professor of experimental morphology and endocrinology at the Collège de France

THE Twelfth Annual Radiological Congress and Exhibition will be held on December 7 9 at the Central Hall Westminster London S W 1 The nineteenth Mackenzie Davidson Memorial Lecture will be given by Dr G Shearer and the twenty first Silvanus Thompson Memorial Lecture by Dr R Ledoux Lebard

A COURSE of ten lectures and demonstrations on tropical hygiene for men and women outside the medical profession proceeding to the tropics, will be given by Mr H H Clay Prof R T Leiper and Sir Malcolm Watson on November 28 December 9 at the London School of Hygiene and Tropical Medicine Further information can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street Gower Street W C 1

THREE meetings of the Association of Scientific Workers open to the public have recently been announced On October 25 Prof A Ferguson, Prof H Levy and others will speak on 'Scientists and War, on November 3, Prof J D Bernal will speak on The Finance of Scientific Research', and on November 23, Prof Winifred Cullis will discuss "The Film in Education Further information can be obtained from the Secretary at Kelvin House, 28 Hogarth Road, South Kensington, S W 5

A CONFERENCE on Child Guidance will be held at the Royal Sanitary Institute on November 17 at 2 30 p m under the chairmanship of Sir Henry Brackenbury The discussion on What can local authorities do for the maladjusted child? will be opened by Dr C J C Burns Special School medical officer and director of child guidance Birmingham Further information can be obtained from the Secretary Royal Sanitary Institute 90 Buckingham Palace Road S W 1

THE programme of the Sex Education Society for 1938–39 includes lectures on sex in prison, by Mr Wilfred Macartney on masturbation, by Dr Wilhelm Stekel on female homosexuality, by Dr Adrian Stephens on sex and the adolescent by Mr A S Neill and on problems arising out of the new divorce law by Mrs M L Seaton Tiedemann Further information may be had from the Secretary 127 Harley Street W 1

THE sixty seventh annual meeting of the American Public Health Association will be held at Kansas City Mo on October 25 28 There will be ten sections devoted respectively to health officers laboratories vital statistics public health engineering industrial hygiene food and nutrition child welfare education in public health public health nursing and epidemiology Further information can be obtained from the American Public Health Association 50 West 50th St New York

SMALL POX has become an extinct disease in Poland owing to the strict enforcement of the law on compulsory vaccination and re vaccination

THE October issue of the *British Journal of Dermatology and Syphilis* is a jubilee number (1888–1938) containing retrospective articles by Drs J M H Macleod James H Sequeira and Sir Ernest Graham Little with portraits of the editors of the journal and celebrated British dermatologists of the past fifty years

THE present issue of the *Nederlandsch Tijdschrift voor Geneeskunde* the organ of the Dutch Medical Association, is a Boerhaave number containing the addresses delivered at the Boerhaave celebrations at Leyden on September 23 (see NATURE September 17) of which the following are in English Boerhaave s influence upon American medicine by Prof Henry E Sigerist Boerhaave and the early medical school at Edinburgh by Dr J D Comrie the influence of Boerhaave s Institutiones medicae on modern physiology, by Prof J F Fulton, and Boerhaave as a botanist by Mr T A Sprague

WE regret to find that the name of S Abdul Aziz was inadvertently omitted from the letter entitled Raman Spectra of Compounds with Three Benzene Rings published in NATURE of September 10, p 477 The letter was a joint one from Prof S K Mukerji and S Abdul Aziz

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P 758

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Mechanism of Light Flicker Fusion during the Course of Dark and Light Adaptation

IT follows from the data of Schaternikoff, Fedorov and Fedorova[1], R Lithgoe and K Tansley[2], and others, that during dark adaptation the critical flicker frequency for photopic vision is decreased It has been shown by Alexanian and Livshitz in Orbeli's laboratory (Leningrad) that the same is the case in scotopic vision provided the effect produced by the change of threshold sensitivity during dark adaptation is eliminated Critical frequency was therefore always determined for a light intensity which was a multiple of the threshold at the given moment In the course of light adaptation the critical frequency is, on the contrary, increasing (R Lithgoe and K Tansley) The purpose of the present study was to analyse the causes underlying the above change of critical flicker frequency in the course of dark and light adaptation Both dark and light adaptation were therefore studied by means of a special optical device which afforded the possibility of watching in a homogeneously illuminated field (angular size about 10°) the flickering of a central point visible within an angle of 1°, the brightness of which was equal to that of the background

The critical frequency of flicker was found to undergo a decrease during dark adaptation and a considerable increase during light adaptation, the latter only up to a certain limit, whereupon the critical frequency has somewhat decreased (Fig 1, line "a") With red and green stimuli light adaptation proceeds similarly provided the initial flicker frequencies are similar (Fig 2) In the light of Adrian's data on the action current of the isolated optic nerve of the eel induced by stimulation of the retina with flickering light, Piper's data on isolated eyes of a number of animals (dog, ape, etc), Sachs's findings regarding the action currents of the human eye submitted to intermittent light, as well as the data of Granit and Hartline and Graham, who have studied the impulses in the isolated optic nerve fibres without synapses in the retina of *Limulus poliphemus* (cf also Barcroft[3]), the conclusion will seem irrefutable that fusion of light flicker takes place in the synapses layer of the retina As to the mechanism of this fusion, it may be suggested that it results from deformation (enlargement) of impulses set up by the action of light on the cones (and rods) of the retina during the passage of the impulses through these synapses, due to the resistance they offer to the passage of the impulses Light adaptation reduces the resistance of synapses, establishing stable connexion between them, while dark adaptation produces an opposite effect It becomes thus comprehensible why in the course of light adaptation intermittent light seems to become progressively more bright (the critical frequency is increased), while during dark adaptation an opposite impression is produced (Ives' concept[4] that diffusion of impulses occurs in the optic nerve fibres themselves is opposed by the recent data, according to which impulses are not deformed during their passage along the nerve fibres Nor can we agree with Houstoun[5] that light flicker fusion occurs "before the stimulation of the rods and cones")

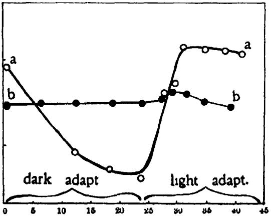


Fig 1.

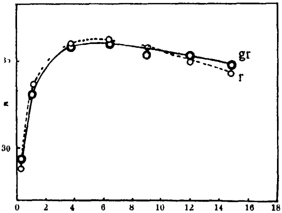


Fig 2

Our suggestion was completely confirmed by special experiments carried out in this laboratory on the effect of strychnine injections (1 c c. of 0 1 per cent solution) and of illumination of the other eye upon the critical flicker frequency.

Twenty-four hours after strychnine injection, neither light nor darkness could influence the fusion of light flickers, which can be accounted for only from the point of view presented above (Fig. 1, curve *b*)

The main effect of strychnine upon the visual apparatus consists, according to Granit[6] and others*, in the establishment of stable connexions within the synapses, thus reducing their resistance in facilitating a neural interconnexion between the ganglion cells of the retina This is also the reason why illumination of the other eye which induces centrifugal impulses in the optic nerve of the first eye is likewise ineffective Without strychnine, the curve *a–b–c–d* is obtained; and one day after the strychnine injection, the curve *e–f–g–h* (Fig 3) (Similar curves were obtained with a dark background)

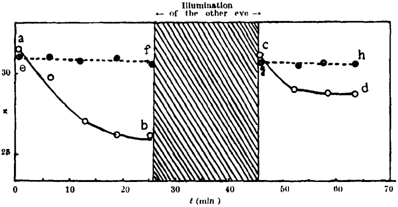


Fig 3

It should also be pointed out that caffeine, which renders the perception more acute (Kräpelin) and increases the excitability of the nerve elements of the cortex (Lindberg), while increasing the final threshold sensitivity of the eye, did not exert, in our experiments, any noticeable influence upon the critical flicker frequency

The complete analogy between the critical flicker frequency during the course of dark and light adaptation with the corresponding curves for electric excitability of the eye (phosphen phenomenon—A Bogoslovsky) renders it very probable that the electric excitability of the eye after strychnine injection will likewise not change either in light or in darkness

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*According to Duke-Elder's "Text book of Ophthalmology" and others (Loewenstein Brill, Schlagintweit) strychnine does not change the threshold stimulus, but the reaction time

[1] Fedorov, N , and Fedorova, V , *Z Phys* , **57**, 855 (1929)

[2] Lithgoe, R , and Tansley, K , Med Res Council, Spec Report Series, No. 137 (1929)

[3] Barcroft, J , "Features in the Architecture of Physiological Function' (1935)

[4] Ives, H , *J Opt Soc Amer* , **27**, 107 (1934)

[5] Houstoun, R. A , "Vision and Colour Vision" (London, 1932)

[6] Granit, R , (*a*) "Die Elektrophysiologie der Netzhaut und des Sehnerven, Copenhagen", 1936 (*Acta Ophth* Suppl VIII), and (*b*) "The Physiological Significance of the Retinal Synapses" (Report of a Joint Discussion on Vision, 263–271, 1932)

Strontium in Sea Water and its Effect on Calcium Determinations

The concentration of strontium in sea water from the English Channel has been estimated by Desgrez and Meunier[1] as 13·5 mgm per litre, and this value has been confirmed by Thomas and Thompson[2], who obtained for water of 19 per mille chlorinity from the Pacific coast of America a value of 13 mgm per litre, corresponding to a Ca/Sr ratio of 30

In all methods of estimating calcium in sea water, it is to be expected that this strontium will be precipitated along with the calcium as oxalate, and will give rise to a positive error Spectrographic examination of both filtrate and precipitate obtained by precipitating calcium as oxalate from sea water shows that this is in fact the case, no strontium can be detected in the filtrate, and the Ca/Sr ratio in the precipitate is indistinguishable from that in the original sea water The error thus introduced into calcium determinations, which, though small, is much larger than the maximum analytical error of the best modern methods carefully performed, seems, however, to have been ignored by all authors, except for a statement by Thompson and Robinson[3] that "the presence of strontium is indicated when careful attempts are made to compare gravimetric and volumetric procedures for calcium in sea water"

In view of the very careful work that has been done recently, at the University of Washington and elsewhere, to establish authoritative ratios for the principal constituents of sea water, taking chlorinity as unity, it seems a pity that this error should go uncorrected The difficulty is that the final determination of the calcium, after it has been precipitated as oxalate, may be performed in various ways, it may be estimated volumetrically as oxalate or oxide, or it may be weighed as oxalate, as carbonate, or as oxide, and the magnitude of the strontium error varies in accordance with the method employed This may be seen from the table below.

Method	Ratio from which error is to be calculated	Value of ratio in col 2 when Ca/Sr 30	Error due to strontium (reciprocals of figures in col 3)
—	Ca/Sr (by weight)	30	3·3 per cent
Volumetric estimation as oxalate or oxide	Ca/Sr (by atoms)	65	1·5
Weighing as oxalate	$\frac{CaC_2O_4 \, H_2O}{SrC_2O_4 \, H_2O}$	49	2·0 ,
Weighing as carbonate	$\frac{CaCO_3}{SrCO_3}$	45	2·2 ,
Weighing as oxide	CaO/SrO	35·5	2·8 ,,

Since no method exists of separating quantitatively small amounts of strontium from relatively large amounts of calcium, it is clearly impossible to obtain the true calcium content directly by analysis. It is desirable therefore that an arbitrary meaning should be given to the term "calcium content", as has already been done for chlorinity, so that its value shall bear a constant and known relation to the true calcium value, and shall at the same time be ascertainable by direct analysis Most determinations in the past have been performed by weighing the calcium as oxide , but recently volumetric methods, claiming considerable accuracy have been published[4] [5], and on the other hand it has been shown that calcium may be weighed conveniently and very accurately as carbonate[6]

On the whole, it seems best that a convention should be adopted in conformity with that already established for the halides, and it is hereby proposed therefore that, in speaking of the calcium content or calcium/chloride ratio of sea water, 'calcium' shall be taken to mean 'calcium after the strontium and barium have been replaced by calcium (The barium concentration is probably small enough to be completely negligible) This value will be given directly by volumetric methods , to methods involving weighing as oxide or carbonate, corrections of − 1 3 per cent and − 0 7 per cent respectively would have to be applied If this convention be adopted, the value of 0 02150 established by Thompson and Wright[7] for the Ca/Cl ratio becomes 0 02122

The decision must, of course, be left to those competent to speak with authority on the subject of chemical oceanography

Further discussion of certain analytical aspects of calcium determination in sea water and biological fluids of similar composition will appear shortly in a paper written in collaboration with Dr J D Robertson

D A WEBB

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Aug 19

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[3] Desgrez and Meunier C R Acad Sci 183 689 (1926)

[4] Thomas and Thompson cited in *Bull Nat Research Council* No 85 174 (1932)

[5] Thompson and Robinson *Bull Nat Research Council* No 85 118 (1932)

[6] Kirk and Moberg *Ind and Eng Chem* (Anal Ed) 9 198 (1933) Gripenberg *J du Conseil* 12 284 (1937)

[7] Willard and Boldyreff *J Amer Chem Soc* 52 1888 (1930) Thompson and Wright *J Amer Chem Soc* 52 915 (1930)

Effects of Trimethylamine in Plants and Animals suggestive of Hormonal Influence

TRIMETHYLAMINE is known to accumulate in the sexual organs of many plants and animals[1] Its action as an aphrodisiac has also been observed Some connexion of trimethylamine with sex hormones appeared therefore possible On the other hand, the effects of animal sex hormones on flowering[2] and on the development of 'phytocarcinomata'[3] having been demonstrated, a further association of ideas concerning the possibility of similar parallelisms of action of trimethylamine did not seem to be too far fetched

I have accordingly tested the influence of trimethylamine on plants and animals by the following methods ·

(1) Trimethylamine in a 1 60,000 aqueous solution was introduced through a cut in the stem of young tomato plants by a method previously described[4] On the average, 17 c c of the substance was absorbed by each plant during the period May 12–July 18, 1936 The effect of this treatment was an increase of about 22 per cent in the number of flowers produced, as compared with the controls to which water was administered by the same method

(2) Another group of tomato plants was inoculated with a virulent strain of *B tumefaciens*, five inoculations being made on the main stem of each plant A 1 60,000 solution of trimethylamine was afterwards administered, using the above mentioned technique The control plants similarly inoculated were treated with water by the same method As a result of the treatment with trimethylamine, the total average weight of the tumours was about 17 per cent higher than that of the controls

(3) *Rhodeus amarus* males produce in the breeding season a characteristic colour change (*Hochzeitskleid*) and the females a marked elongation of the ovipositor These effects can also be obtained by the administration of sexual hormones[5] When *Rhodeus amarus* males were placed three to four months after the normal breeding season (July 1935 and August 1937) in an aquarium containing a 1 10,000 solution of trimethylamine, the brilliant carmine 'nuptial colour was obtained within 60–90 minutes No appreciable effect was observed on the females In the concentration used, the substance proved to be toxic to the animals

(4) In July 1935 (about three months after the mating season in Hungary), *Rana esculenta* males and females were placed in 1 25,000 to 1 6,125 solutions of trimethylamine In less than 24 hours, moulting was observed, and in another 24 hours the normally faint designs of the epidermis became as vigorously outlined as in the mating season From the third day on, the behaviour of the males showed an awakening of the sexual instinct, although no copulation was observed On the fourth day, the colour change attained its maximum and lasted until the seventh day, when owing to the toxicity of the substance the experiment was discontinued

(5) *Triton cristatus* males and females were placed about three months after the mating season in a 1 1,000,000 solution of trimethylamine The successive phases of colour change similar to those observed in the breeding season had begun about two hours after the beginning of the treatment, and were fully displayed in five hours They faded again at the end of 13 hours The effects of a second treatment lasted 24 hours, however, and those of a third treatment until the end of the experiment, namely, 23 days Signs of awakening of the sexual instinct were shown by the males from the sixth to the twentieth day of the experiment , but neither did their crests appreciably develop nor did copulation take place No additional effects were obtained by increasing the concentration of the solution to 1 25,000

The histological examination of some organs of the treated newts, kindly undertaken by Dr A Wolszky (Hungarian Biological Research Institute, Tihany), has shown the following results the histological structure of the skin is normal, but the amount of pigment normally diffused in it is greatly reduced The bulk of the pigment is condensed in big blocks of 120–150 μ diameter in the corium, thus differing markedly from the normal consistency and distribution In the ovary the number of ripening eggs (filled with eosinophile yolk granules) appears to be increased Their diameter reaches 1 2 mm In the oviduct no histological changes were observed

Although some of the above preliminary findings are suggestive of hormonal effects, further experiments are in hand to establish how far this claim is justified.

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Sept. 10

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[1] Czapek, Fr., "Biochemie des Pflanzen" (Fischer, 3rd ed., 192).
[2] Schoeller, G., and Goebel, H., *Biochem. Z.*, **278**, 298 (1935).
[3] Havas, L., Nature, **136**, 516 (1935).
[4] Havas, L., *Bull. du Cancer*, **26**, No. 6 (Dec. 1937).
[5] Beaune, A., *Bull. Sci. pharmacol.*, **42**, 193 (1935).

Colchicine and Acenaphthene as Polyploidizing Agents

From the communication by B. R. Nebel[1] in Nature of August 6 reporting that acenaphthene solution does not induce chromosome doubling in *Tradescantia*, I believe that he is not well acquainted with the method by which I worked. In my first paper[2] I described the method as follows: "Soaking seeds from *Triticum vulgare*, *Tr. monococcum*, and *Secale cereale* in saturated aqueous solution of acenaphthene, with excess of crystals (sublimated particles), during two days and then putting them into Petri dishes, watered with the same solution, we found that the seedlings react morphologically in the same way as they react to colchicine solution" (p. 198). In the treated material polyploid cells and sectors were found. Excess of crystals was necessary (which act in the form of sublimated particles), since saturated solution alone was not sufficient to induce chromosome doubling. (I shall not quote here the further elaborations of the method[3] described in my paper quoted by Nebel, since it was published in Nature.)

We know now quite well that the active principles[4,5,6] are the sublimated particles, since dry acenaphthene crystals act effectively from a distance in inducing chromosome doubling; therefore I am applying it now by covering the plants or the shoots with reagent tubes (glasses) or cylinders the walls of which are covered with acenaphthene crystals from inside. For some experiments we dissolved the crystals in ether, shook up the solution in the reagent tubes and cylinders, the ether evaporated rapidly and the walls of the tubes and cylinders were left covered with crystals.

Treating branches of *Nicotiana longiflora* with acenaphthene sublimating particles, I produced tetraploid and octaploid shoots from which seeds were produced and further polyploid plants were raised.

Applying colchicine solution I obtained tetraploid plants from *Nicotiana rustica*, *N. tabacum*, *N. glauca*, *N. suaveolens*, *N. megalosiphon*, *N. Velutina*, *N. alata-Sanderæ*, *N. suaveolens-alata*, *Petunia hybrida*, *P. parviflora*, etc., and octaploid in *N. alata-Sanderæ*. Treating *Lactuca* (salad) germinating seeds with colchicine solution, I obtained only polyploid cells, but no polyploid shoots or plants. Tetraploid *Lactuca* plants were obtained, however, by treating germinating seeds with acenaphthene sublimated particles from crystals.

In studying the procedure of the meiosis and mitosis in plants treated with acenaphthene and colchicine[4-7], and inducing polyploid cells, sectors and whole shoots and plants by these two agents in many species and hybrids, I have collected data on the basis of which I can affirm (contrary to Nebel) that acenaphthene interferes with the mitotic and meiotic processes in a way similar to that of colchicine, creating conditions for chromosome doubling. Thus acenaphthene can be successfully applied for inducing polyploidy, as had already been done in *Nicotiana*, *Triticum*, *Lactuca*, etc.

It should be mentioned here that the effect of the acenaphthene is increased with increase in the amount of sublimating particles and in the time of exposure. The quantum of the particles increases with increase of crystal surface and with increase of temperature (within limits). Large amounts of sublimated particles, and also a long time of exposure without interruptions, may injure and even kill plant tissues.

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[1] Nebel, Nature, **142**, 257 (1938).
[2] Kostoff, *C.R. Acad. Sci. U.S.S.R.*, **19**, 197–199 (1938).
[3] Kostoff, Nature, **141**, 1144–1145 (1938).
[4] Kostoff, *Current Science*, **6**, 549–552 (1938).
[5] Kostoff, *Current Science*, in the Press.
[6] Kostoff, *Current Science*, in the Press.
[7] Kostoff, *C.R. Acad. Sci. U.S.S.R.*, in the Press.

Production of Growth-Substance by Clover Nodule Bacteria

Thimann[1], using the standard *Avena* technique, showed that a growth-substance is produced in considerable amount in root nodules. He furthermore claimed that the growth-substance produced is not derived from the meristematic tip of the nodule, but comes directly from the bacterial tissue. He found that the symptoms induced by 3-indole-acetic acid upon roots closely resembled those produced, in Molliard's work, by the action of sterile filtrate of nodule bacteria upon pea roots, and he consequently believed that the bacteria cultivated in laboratory media produce growth-substance in considerable amount.

Using Went's pea test technique[2], I have confirmed Thimann's view that nodule bacteria do produce a good deal of growth-substance in a culture provided with a small amount of tryptophane in the medium. The filtrates of four weeks old cultures of strains of clover nodule bacteria grown in a yeast-water medium containing 0.02 per cent tryptophane were tested against pea shoots prepared according to Went's method. The results of a typical experiment are shown in the accompanying table.

	*p*H	Dilution				
		1/4	1/8	1/16	1/32	1/64
Uninoculated control	8.2	O	O		−	−
Strain 2057 in medium without tryptophane	8.4	O	O	O	O	O
Strain 2057	7.9	+	+	+	±	O
Strain 2027	8.0	+	+	+	±	O
Strain 202	7.8	+	+	+	O	O
Urine	−	+	+	±	−	−

+ Positive reaction O No reaction
± Reaction doubtful − Not tested

It appears that strains that are effective in fixing nitrogen in the plant produce in this tryptophane medium very little if any more growth-substance than do the non-beneficial strains that are not effective in fixing nitrogen The old laboratory strains which have lost their virulence, that is are unable to produce nodules when supplied to the plant, were found in most experiments to produce less growth substance, as illustrated by the strain 202 in the table

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Sept 7

[1] Thimann K V *Proc Nat Acad Sci* 22 511 514 (1936)
[2] Went F W and Thimann K V Phytohormones 54 55 (New York 1937)

Cyclical Changes in the Adrenal Glands of Spayed Rats

In an earlier note published in these columns[1] it was reported that cyclical variations occur in the responsiveness of the uterus of spayed monkeys to constant œstrogenic stimulation In view of several considerations, it was suggested in a later communication[2] that variations in the size and function of the adrenal cortex such as occur in normal rats in the œstrous cycle[3], may be responsible for these cyclical variations in the uterine response Later work[4] showed that cyclical uterine changes occur in spayed rats as well as in monkeys, and that the adrenal gland is probably concerned in their occurrence[5]

We have now found that the adrenal gland does in fact continue to fluctuate in size in an approximately five day rhythm in spayed rats (Glaxo strain) that are injected daily with the same threshold dose of œstrone The gland is larger at œstrus than in the diœstrous period the observations being made on the basis of the difference between the ratios of adrenal weight in grams to body weight in kilograms The difference between the two means in an equally divided experimental group of 38 rats of similar age and weight was significant *P* being less than 0 01

S Zuckerman
G Bourne (Beit Memorial Fellow)
D Lewes

Department of Human Anatomy,
Oxford Sept 27

[1] Zuckerman S Nature 139 628 (1937)
[2] Long C N H and Zuckerman S Nature 139 1106 (1937)
[3] Anderson D H and Kennedy H S *J Physiol* 76 247 (1932)
[4] Zuckerman S *J Physiol* 93 12 *P* (1938)
[5] Zuckerman S *J Physiol* 93 13 *P* (1938)

Toxicity of Mercury Vapour to Insects

A reference was made in a communication under this title by H C Gough in Nature of May 21, p 922, to an old Indian custom of placing a small quantity of mercury in a container amongst stored pulses It seems worth while to direct attention to an analogous belief amongst the Āhoms A notable feature of the Āhom reign in Assam was the construction of large 'tanks' or open reservoirs of water, of which the surrounding embankment and the level of the water enclosed therein were considerably above the level of the surrounding countryside Most of these tanks are in existence to day, one fine specimen near Sibsagar town having a perimeter of more than two miles The tanks were dug on the site of a spring, the position of the spring within the tank being indicated by a substantial post, and it is said to have been the custom of the Āhoms to bury an earthenware vessel of mercury at the foot of the post and on the site of the spring in the belief that the water would thereby be purified and the tank remain clean and free from undesirable vegetable growths

We are not aware of any documental evidence for these statements, but they are so well founded in the folk lore of the people that there seems little reason for doubting at least a substantial basis of truth

W Wight
P K Barua

Tocklai,
Cinnamara P O,
Assam

Ninhydrine Reaction in the Quantitative Determination of Different Amino Acids

In the so called ninhydrine reaction there is formed in addition to carbon dioxide, an aldehyde corresponding to the particular amino acid present When the reaction is carried out so that the formation of aldehyde is as quantitative as possible, the amino acid can be determined by the aldehyde We have made this method quantitative for α alanine which gives acetaldehyde[1] The ninhydrine reaction can also be applied to the quantitative determination of certain other amino acids Thus one of us (Laine) has developed the method for the determination of leucine by means of isovaleraldehyde formed in the reaction[2] We are continuing our work for the determination of other amino acids in the same manner

The ninhydrine reaction for the determination of the total amino nitrogen has also been improved by us The reaction must be accomplished at *p*H 2–2 2 as the ammonium sulphate employed as the condensing substance forms colour with ninhydrine already at *p*H 2 5 and above that

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T Laine

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Sept 8

[1] *Skand Archiv Physiol* in the Press
[2] *Suomen Kemistilehti* B in the Press

Energy Levels of the ^{24}Mg Nucleus

Using the cloud chamber method, we[1] have investigated the beta ray spectra of ^{24}Na The K U plot showed clearly the existence of two groups The energy difference between the higher energy group and the lower one is about 1 Mv, their relative intensities being 2, 3 and 1 respectively The higher energy group lies on the first forbidden Sargent curve, for which $\Delta i = 1$, while the lower one is on the permitted Sargent curve, $\Delta i = 0$

Kurie and Richardson[2] and Richardson[3] have investigated the gamma-rays emitted by ^{24}Na, their results being as follows

Energy (Mv)	1 01	2 04	3 00 ± 0 05
Relative intensity	1 05	0 95	0 65 ± 20 per cent

We have tried to construct an energy level scheme of ^{24}Mg which accounts for all the above experimental facts regarding the beta- and gamma rays For this purpose we made, besides the energy relations, some plausible assumptions as follows

(1) In the first place, ^{24}Na is assumed to be in a single energy state because it has only one decay constant, and this nucleus emits two beta ray groups

resulting in two excited states of ^{24}Mg These go over either to the ground state or to lower excited states with the emission of gamma rays

(2) The change in angular momentum due to the beta ray emission is $\Delta i = 1$ for the transition corresponding to the higher energy group, $\Delta i = 0$ for the lower one and $\Delta i \geq 3$ for any other transitions

(3) Moreover, the ground state of ^{24}Mg has zero spin since the nucleus contains $4n$ particles

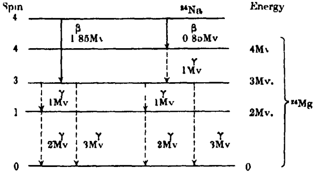
Now, according to Bethe[4], the probability of emission of multipole radiation of order Δi is given by the following formula

$$\frac{1}{\tau} = \frac{1}{5 \times 10^{21} (\Delta i\,!)^2 (20/\hbar\omega)^{2\Delta i + 1}} \text{ sec}^{-1},$$

where $\hbar\omega$ is the energy of gamma rays in Mv and Δi is the change in angular momentum during the process of emission

Taking the intensity ratio of the two beta rays groups into account, we can calculate the relative intensities of the gamma rays by means of this formula, and compare them with the observed values of Kurie and Richardson

Of the level schemes which have been studied for the cases having two and three excited states, only the one shown in the accompanying diagram satisfies the observed intensity relations of the gamma rays



Level Scheme of ^{24}Mg

The relative intensities of the gamma-rays calculated for this level scheme are as follows

1 Mv	2 Mv	3 Mv
1 26	0 86	0 52

These figures agree with Kurie and Richardson's values within their limit of experimental error of 20 per cent All the other level schemes give intensity ratios that deviate greatly from the observed values

It is probable that there exists some uncertainty in the determination of the intensity ratio of the two beta ray groups, and the above value (2 3) may be under estimated This, however, does not materially affect the above conclusion

I wish to express my gratitude to Dr Y Nishina for his kind guidance throughout the course of this work

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Aug 26

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[1] Amaki, T, and Sugimoto A *Sci Pap Inst Phys Chem Res* in the Press

[2] Kurie and Richardson *Phys Rev*, 50 999 (1936)

[3] Richardson, *Phys Rev*, 53, 124 (1938)

[4] Bethe, *Rev Mod Phys*, 9, 226 (1937)

CN Bands in the Night Sky Spectrum

In August 1933, at the Pic du Midi, we photographed the spectrum of the night sky simultaneously at the horizon and at the zenith On each of the four spectrograms so obtained, we noticed that the Vegard Kaplan bands of molecular nitrogen weaken at the zenith and that new radiations can be distinctly seen in their place For example, the ($3 \rightarrow 15$) λ 4531 Vegard Kaplan band, strong and broad at the horizon, disappears almost completely at the zenith, while, at λλ 4554 and 4576, we observed radiations the intensity of which remained constant So we were led to draw up a list including about thirty radiations the intensity of which does not vary obviously from the zenith to the horizon

The probable presence of the CH bands in the sky spectrum and the analogy of the latter with cometary spectra led us to search in the preceding list for other band systems associated with carbon Let us examine the CN case The 4554 and 4576 sky radiations can be identified with the R and P branches of the $1 \rightarrow 3$ band in the CN violet spectrum But in order to justify this identification we must find in the list the other CN bands Indeed we observe the bands of the same sequence R ($5 \rightarrow 7$) near λ 4480, R and P ($4 \rightarrow 6$) near λ 4499, R and P ($3 \rightarrow 5$) near λ 4517, we notice also the R ($3 \rightarrow 4$), R ($2 \rightarrow 3$) and P ($3 \rightarrow 4$), R and P ($1 \rightarrow 2$), R and P ($0 \rightarrow 1$) bands

In order to go further, we must give up this list, obtained from only four spectrograms and consequently a little brief, and use the tables of wavelengths which result from all the observations we have made since 1933 Kaplan has already found a good concordance between the wave lengths given by Gauzit and those of the 'tail' bands[1]

But before considering the bands with high vibrational quantum numbers, it is certainly useful to consider the beginning of the sequences For the $v' - v'' = -1$ and -2 sequences, we find in the sky (1) radiations near the origin of the P and R branches, (2) radiations corresponding to rotational quantum numbers near $K = 10$ This distribution is not surprising In the laboratory, we observe it in presence of active nitrogen, the same distribution was found by Dufay in the comets[2] In this last case, the maxima correspond precisely to $K = 9$ or 10 when the distance from the sun is one astronomical unit

It is difficult to go on with a similar attempt at identification for the $v' - v'' = 0$ and $+1$ sequences, for the P and Q branches of the successive bands overlap more and more Further, we come to a region where the night sky spectrum is imperfectly known

As to the 'tail' bands it is interesting to notice that the coincidences observed by Kaplan concern the origin of the bands, although he did not express this precisely After examination of the structure, we observed also good coincidences with the lines the rotational quantum numbers of which are near 10 These lines are usually the most intense in the laboratory

Finally, it seems that the bands of the violet cyanogen system are found among the night sky radiations the intensity of which does not increase obviously from the zenith to the horizon But among the thirty radiations of the list mentioned at the beginning of this communication, there still remain twenty to identify

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J Gauzit

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Aug 27

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[1] Kaplan J Nature, 52 1552 (1937)

[2] Dufay, J *C R Acad Sci.*, 206 1948 (1938)

Absorption Spectrum of Cobaltous Chloride in Deuterium Oxide

SMALL differences in the colour of solutions of copper sulphate and silver permanganate when dissolved in deuterium oxide instead of ordinary water have been reported by Bell[1], and Hein and Bähr[2] respectively Displacement of the absorption lines in the spectrum of potassium chrome selenium alum $(KCr(SeO)_4 12\,H_2O)$[3] and of several complex chromium salts[4] when H_2O is replaced by D_2O have also been observed Bell s work was confirmed by Brodsky and Zanko[5], who made spectrophotometric measurements with copper sulphate in pure H_2O 43 6 per cent and 92 7 per cent D_2O mixtures

I have determined the absorption curves of anhydrous cobaltous chloride dissolved in H_2O and 99 6 per cent D_2O These curves lie within the visible region between the wave lengths of 4000 A and 6000 A and they were obtained by means of a wave length spectrophotometer Distinct differences were apparent, the molecular extinction coefficient in D_2O being smaller throughout the region of absorption, and the height of the maximum is lower The accompanying table indicates the nature of those differences at various points of the curves Up to 4900 A, the difference is practically insignificant, above 4900 A it increases and appears to be greatest between 5300 A and 5400 A that is at lower frequencies than the maximum

Wave length (A)	4700	4800	4900	5000	140	5300	5400	5600
Mol extinct coef								
Solvent D_2O	2 82	3 17	3 46	3 92	4 14	3 30	2 54	1 04
Solvent H_2O	2 89	3 19	3 48	4 02	4 34	3 67	2 84	1 20

These differences are comparable to those obtained by Brodsky and Zanko for copper sulphate

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Sept 14

Bell NATURE 137 534 (1936)

[2] Hein and Bähr *Z phys Chem* 38 270 (1937)

[3] Joos and Bölm *Phys Z* 36 826 (1935)

Duhm *Z phys Chem* 38 359 (1937)

[5] Brodsky and Zanko *Acta Physicochem U R S S* 5 919 (1936)

Photo-electric Absorption of Radiation in Gases

A LETTER on the above subject by Page[1] and a reply by Menzel[2] have recently appeared in NATURE While I am in agreement with most of Dr Menzel s letter, I feel that discrepancies between theory and laboratory experiment in the above field are more radical than his remarks would appear to suggest

Theoretical calculations are based on the assumption that interactions between neighbouring atoms or molecules may be neglected, so that the atomic absorption coefficient is a true constant, independent of temperature and pressure Detailed experiments[3] have shown that this assumption is true only at low pressures The transition probabilities for the photo electric process for cæsium, for example, are greatly reduced by the presence of only a few millimetres of the rare gases Much larger effects are produced by active gases like hydrogen or by the interaction of cæsium with cæsium It should be emphasized that the continuous state is much more sensitive to these pressure effects than the internal quantized states of the atom These results indicate that it is not correct to base astrophysical calculations on the assumption that the absorption is proportional to the number of atoms present, except at low pressures Thus atomic absorption coefficients measured in the laboratory or deduced from one set of stellar data cannot, in general, be used to make calculations on a mass of gas at another temperature and pressure

Even if we confine ourselves to the region of low pressures, the agreement between theory and experiment is by no means satisfactory It has been shown that for hydrogen[4] and the alkali metals[5] the absorption should theoretically decrease monotonically from the series limit in the direction of short wave lengths This conclusion is independent of any precise assumption concerning the form of the atomic field[4] Experiments are available for potassium[6], rubidium[7] and cæsium[8] For potassium and cæsium the absorption is found to reach a minimum a short distance from the series limit and then to increase again in the direction of short wave lengths (For rubidium it is probable that the minimum is just at the end of the observed region of the spectrum)

A second prediction is that there is no discontinuity in the absorption at the series limit This result has been rigorously calculated for hydrogen[9] and probably applies also to the alkali metals In a recent paper[10] I have assembled strong experimental evidence which shows that the absorption changes sharply, by a factor of about two, at the series limit This discontinuity is found for hydrogen and for all the alkali metals but for hydrogen its magnitude is probably small

These discrepancies suggest that the present calculations omit some essential factor or else that the normalization of the continuous states is not correctly treated I believe, with Dr Menzel, that the wave mechanics will eventually yield a satisfactory theory for this problem I think, however, that attempts to apply Kramers formula (or the wave mechanical modifications of it) to astrophysical problems may be very misleading and certainly must be so at high pressures At present, it would appear to be necessary to admit that we have no theory of continuous absorption which is satisfactory in the sense of being well verified by terrestrial experiments While Kramers formula may be useful as a rough guide, it is safer to regard the opacity as a quantity which cannot be determined theoretically, and, in comparing one system with another, to remember that the atomic absorption coefficient is, in general, a function of the temperature, pressure and state of ionization of the gas surrounding the absorbing atom

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Sept 12

[1] Page NATURE 141 1137 (1938)

[2] Menzel NATURE 142 433 (1938)

[3] Braddick and Ditchburn *Proc Roy Soc* A, 150 478 (1935) Ditchburn and Harding *Proc Roy Soc* A 157 66 (1936)

[4] Gaunt *Proc Roy Soc* A 126 654 (1930) Sugiura (see ref 9 below)

[5] Phillips *Phys Rev* 39 905 (1932)

[6] Ditchburn *Proc Roy Soc* A 117, 486 (1938) Lawrence and Edelfsen *Phys Rev* 34 233 (1929)

[7] Mohler and Boeckner *Bur of Standards J Research* Paper No 96 (1929)

[8] Braddick and Ditchburn *Proc Roy Soc* A 143 473 (1934)

[9] Sugiura *J Phys Rad* 8 113 (1927)

[10] Ditchburn *Z Phys* 107, 719 (1937)

Technique of the Painting Process in the Kailasanatha and Vaikunthaperumal Temples at Kanchipuram

THE Kailasanatha and Vaikunthaperumal temples are situated in Kanchipuram a town forty five miles west south west of Madras by rail The former was built during the time of the Pallava king Narasimhavarman II *alias* Rajasimha (A D 680–722)[1] and the latter by Nandivarman II *alias* Pallavamalla (A D 725 790)[1]

The paintings in these two temples are some of the best specimens of Hindu mural art of the classical or Ajanta school Those in the Kailasanatha temple are executed on the inner walls of the cells lining the outer walls of the courtyard But most of them have either disappeared or faded, due to the vicissitudes of time and environment These paintings probably belong to the seventh–eighth centuries A D and were brought to light in 1931 by the French archaeologist, Prof Jouveau Dubreuil of Pondicherry

The paintings in the Vaikunthaperumal temple, which probably date from the eighth–ninth centuries A D , are under the eaves and in the niches (*kudus*) of the central tower or the *vimana* Most of them have disappeared, leaving only a miniature head But traces of paint are to be seen everywhere on the *vimana* The paintings in these two temples are older than those in the Brihadisvara temple at Tanjore[2] or in the temple of Vijayalaya Cholesvaram at Narthamalai in the Pudukottah State[3]

As an extension of my studies on Pallava paintings[4] in India, I recently investigated the methods and materials of Pallava artists in these two temples

The paintings in these two temples are executed on surfaces of sandstone The painted stucco consists of the *rinzaffo* or the rough coat of lime plaster with fine lime wash thereon the latter being applied while the former was still wet On the lime wash is a layer of paint film In the case of some of the paintings in the Kailasanatha temple, there is no rough plaster, and the paintings are executed on the lime wash directly applied to the sandstone The thickness of the rough plaster varies with the inequalities of the surface of the sandstone

The thicknesses of the different layers composing the stucco are

	Kailasanatha temple	Vaikunthaperumal temple
Painted stucco	2 1 4 3 mm	3 4 4 7 mm
Lime wash	0 3 mm	0 3 mm
Paint film	0 3 mm	0 8 mm

The results of analyses of the rough plasters are as follows

	Kailasanatha temple (per cent)	Vaikunthaperumal temple (per cent)
Moisture	1 08	0 17
Carbon dioxide	9 45	21 52
Loss on ignition (excluding moisture and carbon dioxide)	5 66	2 66
Silica (SiO_2)	65 37	46 63
Iron and alumina ($Fe_2O_3 + Al_2O_3$)	2 06	1 97
Lime (CaO)	15 71	26 73
Sulphuric anhydride (SO_3)	nil	0 15
Magnesia (MgO)	nil	0 04
Undetermined (mostly alkalis)	0 67	0 13
	100 00	100 00

The rough plasters in both the temples have been laid in true fresco technique, and they contain only sand as inert material

The pigments used in these two temples are the same Carbon has been used for black, yellow and red ochres for yellow and red and terre verte for green The pigments have been applied in lime medium or in fresco secco technique

Full details of the investigation will be published elsewhere

S PARAMASIVAN

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Aug 24

[1] Minakshi C Social Life and Administration under the Pallavas (Chap viii (Madras University Publication in the press) for other dates *vide* Prof Jouveau Dubreuil Ancient History of the Deccan p 0 (Pondicherry Modern Press 19 0)

[2] NATURE **137** 867 (193) *Tech Studies* (Harvard University) **5** 221 4) (193)

[3] NATURE **140** 198 (1937) *Proc Ind Acad Sci* **7** 282 29 (1938)

[4] NATURE **139** 114 (193)

The Tetrads in Apoda (Amphibia)

WORKERS on urodelan spermatogenesis have reported the occurrence of large multiple rings in the first maturation divisions of the animals of that group These multiple rings form the most conspicuous of the tetrads in practically every urodele studied Multiple ring tetrads in Anura are very rare and are practically confined to some members of the Discoglossidae (*Alytes obstetricans* Janssens and Willems[1] *Bombina pachypus* Galgano[2] *Bombina orientalis* Sato[3]) Swingle[4] reported such multiple ring tetrads in the male sexual cycle of the tadpoles of *Rana catesbiana* of 40 60 mm length while in the second larval sexual cycle of this animal the typical anuran kind of tetrads (simple rings) were present Swingle and later Iriki[5] advanced the view that the multiple ring tetrad must be regarded as the ancestral type of tetrad in Amphibia and this view has been further emphasized recently by Sato[3], who has found such compound tetrads in *Bombina orientalis*

The position of Apoda is very interesting in this respect It has already been reported[6,7] that in *Ichthyophis glutinosus* the larger chromosomes form multiple ring tetrads In this animal the two large V shaped and one large rod shaped pair of chromosomes form during meiosis three compound tetrads I have recently examined *Uraeotyphlus menoni* another example of Apoda from South India and in this form I have found that there are three pairs of large V shaped chromosomes which form compound tetrads Whether the view that the multiple ring tetrad is the ancestral type in Amphibia be accepted or not the resemblance between Urodela and Apoda in this respect is very striking A full description of the spermatogenesis in *Uraeotyphlus menoni* will be published separately

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Janssens F A and Willems J *La Cellule* **25** 151 (1909)

[2] Galgano M *Arch Ital Anat Embriol* **31** 1 (1933)

[3] Sato I *J Sci Hiroshima Univ* Ser B **6** 53 (1938)

[4] Swingle W W *J Expt Zool* **32** 235 (1921)

[5] Iriki S *Sci Rep Tokyo Bunrika Daigaku* Ser B **1** 91 (1932)

[6] Seshachar B R *Z Zell* **27** 133 (1937)

[7] Seshachar B R *Cytologia* **8** 327 (1937)

Prof Buckland and Oxford

IT may be of interest to note that the verses on Buckland quoted by Prof J L Myres (NATURE Oct 8 p 673) were actually published at Oxford in 1869 in an entertaining little volume entitled Fugitive Poems connected with Natural History and Physical Science collected by C G B Daubeny F R S sometime professor of chemistry and botany in the University of Oxford They are there dated Dec 1, 1820 and attributed to Richard Whately at that time fellow of Oriel and later Archbishop of Dublin The verses are reprinted in the Life and Correspondence of William Buckland published in 1894 where it is stated that Buckland was so pleased with them that he had copies lithographed to present to his friends

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THE verses on Buckland appearing in NATURE of October 8 p 673 were published in The Life and Correspondence of William Buckland, by his daughter Mrs Gordon (London 1894) page 41 It is there stated that they were written by Richard Whately afterwards Archbishop of Dublin and that Buckland had them lithographed and gave copies to his friends The version there printed contains minor variations from that given in NATURE and is entitled Elegy Intended for Professor Buckland. December 1st 1820 In the same volume there are several other sets of amusing verses on geological subjects

The verses are also printed in Frank Buckland s Curiosities of Natural History Second Series (1903 edit pp 144–146)

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Points from Foregoing Letters

FROM a study of the action of strychnine and caffeine upon the critical flicker frequency Prof N T Fedorov and Lucy Mkrticheva conclude that fusion of light flickers in the synapses of the retina during dark and light adaptation results from the resistance offered by these synapses to the passage of impulses set up in the cones and rods of the retina so that the impulses undergo deformation and enlargement

Spectrographic analyses by D A Webb show that the presence of strontium gives rise to errors in the estimation of the calcium content of sea water Since the magnitude of the error varies with the method employed it is suggested that a conventional interpretation should be given to the term calcium content as is given to the term chlorinity, calcium shall be taken to mean calcium after the strontium and barium have been replaced by calcium'

Dr L Havas reports that treatment with dilute solutions of trimethylamine increased the flowers produced by tomato plants and the average weight of tumours produced by *B tumefaciens* Also it had effects suggesting sex hormonal influence upon *Rhodeus Rana* and *Triton*

Prof D Kostoff considers that B R Nebel s failure to obtain chromosome doubling by treatment of *Tradescantia* with acenaphthene solution was due to the method employed The active agent is, he states the sublimated particles and he has found acenaphthene crystals to be effective at a distance in producing chromosome doubling in *Nicotiana Triticum* and *Lactuca*

A table showing the growth stimulating effect upon oat seedlings of filtrates of various strains of clover nodule bacteria (in presence of tryptophane) is given by H K Chen The non beneficial strains (which do not lead to nitrogen fixation) appear to be equally effective as growth stimulants

The adrenal glands in spayed rats injected with œstrone fluctuate in size in an approximately five day rhythm, according to Dr S Zuckerman, Dr G Bourne and D Lewes

It is stated by W Wight and P K Barua that an account in the folk lore of Assam indicates that the Ahom tribes used to bury an earthenware vessel of mercury on the site of springs which were feeding reservoirs in the belief that the water would thereby be purified

An energy level scheme for the nucleus of nitrogen atoms of mass twenty four is outlined by A Sugimoto to account for the energy and intensity of the beta and gamma radiations emitted by sodium atoms of mass twenty four from which the magnesium atoms are derived

A number of cyanogen bands are identified by Prof J Cabannes Prof J Dufay and J Gauzit among radiations recorded in the spectrum of the night sky These radiations do not change in intensity from the zenith to the horizon and consequently it may be presumed that they have their origin outside the earth s atmosphere

The molecular extinction coefficient of cobaltous chloride dissolved in deuterium oxide (heavy water) is found by D C Martin to be smaller than in water throughout the region of absorption

In connexion with the use of Kramers absorption formula in astrophysical calculations Prof R W Ditchburn points out that the atomic absorption coefficient is in general a function of the temperature, pressure and state of ionization of the gas surrounding the absorbing atom

S Paramasivan reports that the Pallava paintings (seventh ninth centuries A D) in the Kailasanatha and Vaikunthaperumal temples at Kanchipuram (South India) have been executed in fresco secco technique He gives the results of analysis of the plasters and the pigments Carbon (for black), yellow and red ochres and terre verte (for green) have been used as pigments

B R Seshachar finds that in the South Indian amphibian *Uraeotyphlus menoni* there are three pairs of large V shaped chromosomes which form compound tetrads, similar to the large multiple rings observed by other workers in Urodela

Research Items

Arteries of Peking Man

PROF. FRANZ WEIDENREICH has made a study of the evidence afforded by endrocranial casts of fossil hominids for the character of the meningeal artery, with special reference to its bearing on the phylogenetic problem (*Palæontologia Sinica*, No. 110, N.S.D. No. 3, 1938). It is known that the medial meningeal artery exhibits a rather great variability in recent man with respect to its ramifications. Two main groups are distinguished, of which the second, in which the trunk is divided at a low level into two branches, is the more primitive. In *Sinanthropus* the trunk is as a rule divided into two, or even three branches. There are numerous variations in detail, but the ramifications of all branches, which are rather abundant in recent man, are markedly poor. Little is known of the conditions of the medial meningeal artery in anthropoids or lower apes; but when the gibbon and the great apes are compared with *Sinanthropus* and recent man, it becomes evident that they bear a much closer resemblance to *Sinanthropus* than to recent man. The endocasts of Neanderthal man reveal that *Sinanthropus* is more primitive. Rhodesian man exhibits an instructive example of a mixture of primitive features and a far advanced character; while the peculiarities of the Neanderthal type, so far as known, confirm the conception that it is an intermediate form between *Sinanthropus* and recent man, as supported by the characters of teeth, brain and skeleton. The arterial pattern, in fact, comes close to the more primitive type of recent man. *Pithecanthropus* exhibits a typical hominid pattern similar to advanced *Sinanthropus*, but shows that the classification of *Pithecanthropus* as a gibbon by Dubois is untenable. The pattern of the Piltdown skull conforms in all respects to that of the more advanced type of recent man, while Swanscombe is also typical of recent man. It is evident that the ramifications of the artery in recent man are independent of both size of brain and racial character, but are peculiar to mankind at large.

Boat Processions in Egypt

AMONG the customs of Ancient Egypt which have survived in attenuated form into modern times is that of the boat procession from Karnak to Luxor, in which the god Amun, accompanied by his divine companions Mut and Khons, journeyed up the Nile attended by the Pharaoh and his court. In the opinion of most Egyptologists, this great festival of Opet, of which there is a representation on the walls of the temple of Ramses III at Karnak, survives in shadowy form in the boat processions of Luxor and Qena, held annually on the birthday festival of the Muhammedan patron saint of the towns. The festival and the course of the procession have often been described; but Mr. James Hornell points out in *Man* of September 1938, that the boats which form part of the procession have not received special attention. The procession at Luxor takes place on the fourteenth day of the month Sha'bân, when the participants gather around the gaily flagged boats in a square adjacent to the mosque of Sheykh el Miqashqash. The two boats are mounted on four-wheeled lorries drawn by men and boys. Each boat is freshly painted and fitted with a mast, on which is hoisted a blue striped lateen sail. Flags inscribed with texts are carried before and after the boats and float from the masts. In build these boats differ completely from the clumsily fashioned craft seen on the Nile. Their lines have a certain dainty elegance. They have clipper bows, long beak-like prows, and an open gallery frame built out beyond the transom stern. Instinctively we feel that in former years, when the festival had more importance than to-day, the boats used were really small replicas of Turkish galleys of the Middle Ages. The nearest related design to these Luxor craft is that typical of the galley-shaped sardine fishing boats now belonging to Malaga, a town held by the Moors until 1487.

Nutritive Value of Pasteurized Milk

Two sets of very similar, though not identical, experiments on the value of pasteurized, as compared with raw, milk for the nutrition of calves have been carried out at the National Institute for Research in Dairying (University of Reading) and the Rowett Research Institute, Bucksburn, Aberdeen, respectively, and the results are published in a joint report (Milk and Nutrition. New Experiments reported to the Milk Nutrition Committee. Part 3. The Effect of Commercial Pasteurization on the Nutritive Value of Milk as Determined by Experiments on Calves. Pp. 27. Shinfield, Reading: National Institute for Research in Dairying, 1938. *2s.*) In both experiments calves were divided into two similar groups, one group being fed on commercial raw, and the other group on commercially pasteurized milk from the same bulk, with equal small supplements of other foods in the later stages of the experiment. In brief, it may be stated that there was very little difference at the end of the experiment in the weight, growth and general nutrition of the two groups.

Under-water Movements of the Dipper

MANY observers have witnessed the fact that the dipper or water ousel (*Cinclus cinclus*) can remain and move freely under water, but there has been much speculation as to how a bird, having a specific gravity less than that of water, can remain upon the bottom. It has been suggested that it grips with its toes, but it has been seen walking upon the sandy bed of a stream which afforded no possibility of holding. Dr. J. M. Dewar suggests that in moving water the bird makes its way against the current, at the same time depressing its head and neck, so that part of the force of the current has the effect of pressing it downwards (*British Birds*, **32**, 103, 1938). In still water, the movement of the bird itself creates a current which has a similar effect. By a simple experiment with a block of wood, Dr. Dewar found that the speed of movement (by traction at a suitable angle) necessary to keep the block at the bottom of still water 10 inches deep was equivalent to a rate of only 0·5 mile per hour. More observations are required of the positions actually assumed by the dipper in its submerged movements under different conditions.

Cattle Bot flies in Norway

IN Norway, as in most European countries, the damage caused to cattle and hides by the presence of bot flies, *Hypoderma bovis* and *H lineatum* was excessive up to about 1920 L Reinhardt Natvig summarizes the position by stating that in 1922 the loss *in England was £15 million, and for England* (that is Great Britain) and its colonies £30 million Similar heavy losses are given for other countries In many countries however, the last twenty years has seen the institution of a vigorous campaign against these insect parasites which aided by the discovery of the value of derris in destroying the bots, has had strikingly successful results Natvig illustrates the effect of the measures taken in Norway by means of two maps the first showing the distribution and incidence of bots in cattle in South Norway in the years from about 1875 to 1920, and the second showing the same features in 1936 (*Naturen*, **62** 243, 1938) No evidence could be more convincing of the value of suitable preventive measures firmly and generally applied

Framework Grafting

AN interesting paper upon the regeneration of fruit trees by W F Walker, of Tasmania has recently been published (*J Roy Hort Soc*, **63**, Pt 9, Sept 1938) Many fruit trees in Tasmania ten years ago were not of the varieties most suited to modern needs The orchards could, of course, be destroyed and re planted, but several unproductive years would have to be spent The usual methods of re grafting and budding were also tried, but most success was obtained with framework' grafting The tree is headed back slightly, but only sufficient to retain the main framework of the branches Scions are then inserted at intervals of about 8 in all over the tree They can be disposed so that they occupy space to the best advantage, whilst future pruning and yield are also under control Closer spacing results in more fruit spurs, whereas more extended distribution gives greater vegetative growth Several methods for the quick performance of the grafting operation are described in detail, and the method offers the fascinating possibility of changing the variety without the loss of more than one season s crop Agricultural success is surely based upon such scientific versatility

Copper Deficiency in Cultivated Soils

RECLAMATION disease has been known in parts of Northern Europe for some time It was first recognized as a disease and named by Elema, the name being derived from its frequent occurrence on sandy heaths and moorland soil recently reclaimed These soils are rich in humus and strongly acid, but it is also found in peaty clay soils, in Denmark it has occurred in *Calluna* heath soils when brought into cultivation In Holland the reclamation by draining of large areas of waste sandy heath and moorland has met with difficulties from this cause, earlier investigations showed that heavy dressings of urban refuse gave some measure of control, such refuse contains copper salts, and later work has shown that copper sulphate alone was most effective Liming such soils increased the trouble, presumably lowering the availability of the copper and apparently also removing the small amount of available manganese Now the observations of C S Piper and of D S Riceman and C M Donald have shown that the 'coastal sickness' attacking grazing sheep in certain coastal areas of South Australia, and the poor crops of cereal obtained from the same soils, similarly yield to treatment with copper salts Dressings of 28 lb of copper sulphate to the acre gave much improved yields of wheat, oats and barley, and a new feature is the fact that the original soil in these cases has a very high content of calcium carbonate and a *p*H between 8 5 and 9 0 The same dressing of copper did not effect much improvement on pastures on these soils, but there is evidence that higher dressings of copper or possibly treatments including other elements such as iron, will greatly improve the pasturage The experimental work with the South Australian soils *is described in* Pamphlet No 78 of the Council for Scientific and Industrial Research, Melbourne

World's Natural Resources

IN a paper on this subject by Mr F E Lathe read at the June meeting of the American Association for the Advancement of Science in a series of communications on Science and Society, an attempt is made to reach a quantitative estimate of the world s resources in food power and minerals The conclusions are that with the continued applications of science, food supplies will suffice for a population of four times the present numbers, and that in power and most of the minerals of value to man there is little cause for anxiety This is true however, only when the world is considered as a single economic unit For the large number of units, most of which are striving for economic self sufficiency, the outlook is very different In order to illustrate the extreme mutual dependence of nations, Mr Lathe has compiled a table showing the extent of national sufficiency of the seven great powers of the world in coal, iron, copper, lead, zinc, nickel, tin, asbestos and petroleum Ascending numerical order shows decreasing sufficiency for national needs in each commodity The table shows that only the British Empire, the United States and the U S S R are each self sufficient in half or more than half these substances, but that no other power reaches that level in more than one commodity and several in no commodity Thus he illustrates his theme that international trade is essential and self sufficiency an economic fallacy

Antarctica and the Glacial Ages

THE Antarctic ice sheet in Pleistocene times, which has recently been under discussion in the correspondence columns of NATURE (see Sept 3, p 438), enters into the argument of a consideration by Prof F E Zeuner of the chronology of Pleistocene sea-levels (*Ann and Mag Nat Hist*, Ser 11, **1**, 1938), though the evidence taken into account concerns volume rather than extent Prof Zeuner compares actual conditions of sea levels observed in the Mediterranean in the work of A C Blanc with those postulated on the basis of the 'glacial control theory and the curves of solar radiation as calculated by M Milankovitch in 1930, which have been found to reproduce correctly and in detail the fluctuations in the extension of the ice during the Pleistocene age As a result of his comparison, Prof Zeuner finds that the observable climatic phases and changes of sea level in the Mediterranean agree completely with the fluctuations postulated on the basis of the curve of radiation In the course of his computation, he has occasion to observe that the Pleistocene sea levels appear to be related to the glacial phases of the northern hemisphere only. This conclusion is based on his view that at no time did the increase in the volume of ice in the Antarctic, as compared with present conditions, ever exceed one third of the present volume. Taking W. B. Wright's figures of approximately twelve million cubic kilometres as the present volume this would give in the most intense phase, that is, according to Milankovitch's figures of the solar radiation curve, the first phase of the last glaciation, Wurm I, an approximate maximum volume of 16 million cubic kilometres, whereas R. A. Daly's calculation for the Scandinavian ice cap of the last glaciation is approximately five million cubic kilometres, the variation in the antarctic sheet being put at four to six million cubic kilometres at most, as against a deglaciation of the north American, European and Siberian ice caps of 35 million cubic kilometres since the maximum.

Nickel Carbonyl

In 1931 Pauling (*J. Amer. Chem. Soc.*, 53, 1367; 1931) showed that, on the theory of directed valency, nickel carbonyl ($Ni(CO)_4$) should have a tetrahedral structure. In 1934, the Raman spectrum appeared to indicate a square configuration. In the following year, electron diffraction studies pointed to the tetrahedral structure, but the observed nickel-carbon distances suggested that resonance occurred with some structure (probably the square configuration) having nickel-carbon double bonds. Recently Bailey and Gordon (*J. Chem. Phys.*, 6, 225; 1938) and Crawford and Cross (*ibid.*, 6, 525; 1938) have measured its infra-red spectrum and their results are in satisfactory agreement. In the later paper the data obtained for liquid $Ni(CO)_4$ from 1μ to 8μ and for $Ni(CO)_4$ vapour from 1μ to 23μ, are analysed in conjunction with Raman spectral data, and indicate that the molecule has a tetrahedral structure, although the square configuration is not completely excluded. By the methods of group theory, normal co-ordinates, selection rules, and spectroscopic characteristics of both models have been derived, and the calculated values of fundamental frequencies, first overtones, and binary combination tones are compared with the observed results. Further, evaluation of the force constants shows that that for carbon-oxygen stretching has a value intermediate between those for $C = O$ and $C \equiv O$ bonds. Interatomic distances derived from force constants, agree with recorded values.

Lighting in Mines

The Mines Department has been co-operating with the manufacturers of safety lamps and lamp bulbs and with other associations with the object of assisting the industry. The Secretary for Mines has published a circular (M.D. No. 115) giving an account of the directions in which progress is being made. A most important development is in connexion with lamp bulbs. It is found that the argon now commonly used for lamp bulbs can be replaced advantageously by krypton. Recent investigations show that a higher lighting efficiency is obtained without any reduction in the life of the bulb or any increase in its current consumption. The tests made at the Mines Department Testing Station on krypton filled bulbs show increases of 20–30 per cent in lighting efficiency as compared with argon-filled bulbs of the same rating and life. The arrangements already in use for testing the performance of 'approved' bulbs will be applied to krypton filled bulbs, and collieries can therefore rely on the maintenance of the improved results obtained in the tests. The use of these bulbs, which are slightly smaller in diameter than ordinary bulbs, does not entail any alteration in the construction of the lamps or batteries, but as krypton is more expensive the bulbs are 2½*d.* dearer. The Secretary of Mines considers that owing to the high efficiency of the lamps the cost will be less for a given illumination. When the British Standards Institution undertook to specify the requirements for miners' lamp bulbs it was necessary to fix the life of the lamp. This was fixed at 600 hours, but it was found in practice that the actual working life was longer than this. The B.S.I. has now reduced the laboratory test of 600 hours to 500 hours as this greatly improves the efficiency. Attention is also directed to a new type of mercury vapour bulb for lamps fixed in position which works at the low pressure of 100 volts and gives high efficiency and a long life.

Measurement of Powdered Materials

The methods at present available for measuring the fineness of powdered materials used in engineering and industrial processes are described in detail in a paper submitted to the Institution of Mechanical Engineers by Dr. Harold Heywood, senior research officer of the British Coal Utilization Research Association. In it, definitions of particle size and shape are discussed and examples are given by means of typical size distribution curves for granular and powdered materials such as moulding loam, pulverized coal, Portland cement, and mine atmospheric dusts. For the size grading of comparatively coarse powders the method of sieving or screening is used, and the author explains and elucidates the theory of sieving and the relationship between particle size and sieve aperture. Differences in materials due to density, particle shape, stickiness, hygroscopicity, etc., have made it impossible to devise a general sieving specification and, as the process cannot in general be carried to completion, the usual practice is to specify an end point either by limiting the time of sieving or by continuing the operation until the weight passing the sieve in a given time is a stated percentage of the original sample or of the residue on the sieve. The first is an easy test to apply and, in the case of a particular material not likely to vary much in fineness, provides a useful test. The last is more sound fundamentally but is difficult to apply. In the grading of particles of sub-sieve size the processes used involve motion in a fluid. Dr. Heywood discusses the motion of such particles and gives a method by which their falling velocity can be calculated when the fluid flow around them is turbulent. He describes several processes which are employed in this form of analysis and explains their respective merits and advantages, including in his survey elutriation by means of air or water, sedimentation, hydrometry and the obscuring of a beam of light by dilute suspensions. Reference is also made to a device developed at the Fuel Research Station for comparing the fineness of viscous suspensions such as coal-oil mixtures for boiler firing, and consisting of a test tube containing the mixture and pivoted slightly above its centre of gravity. This is made to oscillate, and the changing time of oscillation as the powder sinks provides the means of determining the rate of settling.

Seventh International Management Congress

THE Seventh International Management Congress was held in Washington, D.C., in September last. According to a leaflet, issued to prospective members, a feature of the Congress was to be "the presentation of both American and foreign points of view on the most important aspects of management in relation to social and economic problems".

More than twenty countries sent delegates to the conference, the most notable exception being Soviet Russia, the absence of delegates from which may be regretted since a socialist State has many interesting management problems of its own. Business men were in a majority among the delegates, although there were also many research workers and university representatives, largely from the United States. This is in itself an interesting indication of the rapid development of the social sciences in the United States and their contact with the world of production and distribution and management in general.

More than two hundred papers were presented to the Congress for discussion, covering the fields of administration, production, distribution, personnel, agriculture, and home management. But a great deal of this material was nothing more than propaganda for or against various political regimes. There was much that might have been better said and even more that would have been better not said at all, though one must concede that many of the contributors may have been misled by the terms of reference which have been quoted.

It would have been well if more of the delegates had written their papers and speeches from the point of view so ably expressed by Lord Leverhulme in an address to the Congress. "We are all conscious," he said, "of the striking disparity between the world's actual consumption of goods and services and the potential powers of production with which science has now endowed mankind. Few of us, on the other hand, accept this situation as the natural and permanent result of the progressive application of science to all departments of our life and culture. We recognize our present troubles to have arisen to a large extent because our progress has been unbalanced and there has been a time lag between technological progress and progress in other departments of human endeavour. We recognize that the danger of our present situation lies not in the increasing impact of science on our lives, but in the uneven incidence of this impact. While productive efficiency has increased and continues to advance with bewildering rapidity, we destroy much of the possible advantage to be derived from this progress by the methods we adopt in our distributive machinery and in our dealings with our fellow men. As long as we continue to believe that the problem must be solved by the artificial creation of scarcity through restricting production, so long will the situation continue to grow worse."

The reason why the above approach to management problems was largely absent from the Congress was best expressed by Dr. H. C. Link in an excellent speech on the psychological foundations of management. "A few weeks ago", he said, "the steel companies announced their annual appropriations of about ten million dollars for research into the development and behaviour of steel. This is more in one year than has been spent in the entire history of psychology, since it became a quantitative science, for research into the development and behaviour of personality. . . . What are the results? One of the most obvious is this: while denying the possibilities of a science of man, almost every manager regards himself as an authority on human nature. Managers who consider themselves ignorant of the dynamics of machines nevertheless consider themselves, with no more scientific study, authorities on the dynamics of the emotions of man. The result has been a continuous conflict of personal opinions and the triumph of might rather than right, of expediency rather than truth."

It can be very easily understood from this, that a management conference is handicapped by the fact that there is so little concrete data to talk about and discuss, and wherever such a state of affairs exists there are bound to be numerous papers about nothing at all. A great deal of the general addresses were nothing more than orations on the merits of private enterprise, re-echoing time and time again old, familiar, and outworn phrases. In view of the fact that the Congress included delegates from the co-operatives of many countries and also from labour organizations, such speeches were thoroughly misplaced, and although the delegates listened with good humour, many of them must have felt that they indicated the presence of a terrible number of guilty consciences. But in spite of this, it was encouraging to find quite a few of the delegates expressing the view that managerial problems ought to be studied strictly from the professional aspects, and that their study is obscured by political contentions, selfish motives and class conflicts. A plea from Major Urwick that management problems should be approached from the scientific rather than from the nationalistic attitude was passed by without much consideration.

On the whole, it may be said that neither the papers presented at the general sessions nor the subsequent discussion were particularly noteworthy. Some of the papers dealt with management problems, but the majority were concerned only with technological procedures. The agricultural section, which stood in a class by itself in so far as quality was concerned, discussed a total of thirty-seven papers, of which seventeen dealt with purely technical matters such as the control of plant diseases, soil erosion, etc. Prof. John D. Black in some concluding remarks to this section said that "it is not difficult for one who has had contact with our agricultural colleges to understand how management in agriculture has come to be discussed in this segmentary way. . . . No satisfactory co-ordination of technology and social science has been achieved".

With regard to the other sections, very little can be said. The distributors spent three days discussing problems such as sales promotions, touch appeal, branded goods and more often still arguing about the meaning of the terms they were using. The consumer was in the forefront of all such debates, though he was talked about more as a victim than as one who is to be served The Swedish co operators, who had much to contribute to the general theme of improving on our present methods of distribution, as also some of the other foreign visitors, were given little opportunity or encouragement to take an active part in the discussions

Similar remarks could be made about the other sections

During the meeting The American Society for the Advancement of Management ' held a dinner for those attending the Congress, at which various New Deal administrators were invited to speak This was the only occasion during the week at which the New Deal was mentioned other than in derogatory terms From the point of view of the visitors from overseas this was the most instructive meeting for here alone was it possible to learn about things which they did not understand and to hear things which had been heard many times before

R M W TRAVERS

Research and Development in Glass Technology

New Laboratories at St. Helens

THE new research laboratories of Messrs Pilkington Brothers, Ltd at St Helens, opened by Sir William Bragg on October 5, represent a yet further stage in the scientific development of glass technology in which such striking progress has been made during the post War years At the luncheon before the opening ceremony Lord Cozens Hardy, chairman of the company, reviewed its progress , the firm has carried out glass manufacture at St Helens for more than a century, the first works chemist having been appointed in 1844 and the analytical laboratory dating from 1869 He referred to the high level of glass making which had been attained by chemical and technical skill in the early years of the century Not only was it known what types of ingredients and proportions were necessary to obtain high quality glass but also very considerable strides had been made in manufacturing refractories to stand up well to high temperature conditions without being unduly attacked by the molten glass Since the Great War, however, the manufacture of glass has largely been mechanized, necessitating very close control of the compositions and the temperature at which glass is melted and worked Out of the experimental investigations necessitated by this position there has grown a technical development department

Towards the end of 1936 the directors of Messrs Pilkington Brothers decided to supplement this work by forming a research laboratory, closely associated with which was to be a general analytical laboratory for control of the Company's products The new research department is intended to function in the more academic field of science and will, it is expected, frequently be responsible for fundamental work on first principles The problems with which the new laboratories will be confronted fall into seven categories, covering the melting of glass, the study of refractories, the processing of glass, uses of glass the properties of glass, methods of testing glass, and miscellaneous matters such as the production of mirrors to withstand rigorous weathering and temperature conditions, etc Lord Cozens Hardy referred to further advances in glass manufacture which are approaching completion, by which a ribbon of glass flowing out of a tank is passed successively through the annealing process and through a grinding and polishing machine which treats both sides simultaneously, the whole machine being more than 1,000 feet long Its use, it is believed, will once more completely revolutionize the manufacture of plate glass

Before cutting a glass silk ribbon across the doorway of the new laboratory, Sir William Bragg referred to the way in which in recent years the use of X ray methods has elucidated the ultimate structure of glass with some approach to completion The remarkable net like structure thus revealed has laid the foundation for a wholly new attempt to relate the physical and other properties of glass with its chemical constitution This fuller understanding of the constitution of glass has led to further control over manufacturing methods

The new laboratories have been built to the design of Mr Herbert J Rowse who also designed the United Kingdom Government Pavilion at the Glasgow Exhibition Together with the equipment, the cost of the new laboratories is about £40 000, and they are designed to house the director of research, Dr H Moore and a staff of forty seven including fifteen to twenty university graduates and about twenty five qualified technical assistants The laboratories are designed essentially to meet individual requirements and a novel feature is the use of glass bricks for the internal corridor walls Most of the physical laboratories are devoted to special instruments or special testing processes, and they include an X ray laboratory with a fully automatic X ray apparatus for the identification of crystals and the determination of the viscosity of glass Other laboratories are specially equipped for thermal expansion measurements, the determination of refractive index and hardness, the measurement of the bending of loaded glass beams, flatness testing and optical work Among the equipment of the latter is a photometer head integrating sphere for measuring the transmission of light through opaque glass and a Babinet strain viewer An annexe to the laboratory is devoted to high temperature work on refractories glass melting and toughening Among the apparatus exhibited was a stirring test designed by a member of the staff for comparing the merits of different materials for the construction of tank surfaces In this apparatus five fingers of these various materials, fixed into a flat circular plate are rotated vertically in a bath of molten glass at 1,500°

The main block of the research laboratories includes a large analytical laboratory and laboratories for general chemical research and organic research In addition the building includes a library, the furniture for which was made in Messrs Pilkington Brothers own carpentry and cabinet making shops The library already contains a nucleus of about 2 000 books, including a number of the earliest records of the firm dating from 1869 A number of striking examples of coloured glasses and fluorescent glass were shown in the laboratories Both the exhibits and the equipment of the laboratories fully justified Sir William Bragg s remarks as to the national importance of the inauguration of this new research institution

Fifth International Congress for Applied Mechanics

THE Fourth International Congress for Applied Mechanics was held at Cambridge England in 1934 and the Fifth very appropriately met at Cambridge, Massachusetts on September 12 16 The Congress was attended by more than four hundred members as the guests of Harvard University and the Massachusetts Institute of Technology More delightful hosts could not have been desired by the members who shared in the meetings and in the entertainments arranged by the local committee consisting of H M Westergaard, J P Den Hartog J C Hunsaker, L S Marks and H Peters

The Congress was opened by Prof K T Compton, president of the M I T acting as president of the Congress The work of the Congress was accomplished by means of technical sessions at which communications from members were read, by general lectures and by a symposium on turbulence The field of applied mechanics was divided into the following general heads (I) Structures elasticity, plasticity, fatigue strength theory crystal structure (II) Hydro and aerodynamics gas dynamics hydraulics meteorology, water waves heat transfer (III) Dynamics of solids, vibration and sound, friction and lubrication wear and seizure Simultaneous sessions of the three sections were held Abstracts of the papers presented were printed in English in the September issue of the *Journal of Applied Mechanics*, a copy of which was given to each member Communications were received from the following workers from the British Empire S Brodetsky L P Coombes, J N Goodier A A Hall, C F Inglis G J Klein, L M Milne Thomson, F F Relf E G Richardson D M Smith, A V Stephens J L Synge, and G I Taylor who gave a general lecture on turbulence The meetings were held at the M I T for the first four days and on the last day at Harvard University

On Monday September 12, members were able to be present at the dedication at the M I T of the Wright Brothers Wind Tunnel, among the speakers at the opening ceremony being G Brewer of the Royal Aeronautical Society The tunnel is a closed welded cylindrical steel circuit with a 2 000 h p electric motor and a variable pitch propeller in which the air can be compressed to four atmospheres giving a Reynolds number of 6 500 000 or exhausted to one quarter of an atmosphere, when a velocity of 400 miles per hour is expected to be attained The working section of this remarkable tunnel is an ellipse, ten feet by seven and a half feet

Apart from attending lectures and hearing papers read, one of the great advantages of an international Congress is the opportunity of scientific workers from different countries meeting personally and exchanging ideas in a quite informal fashion This opportunity was amply afforded by the receptions and conversaziones which were organized for each evening and contributed in no small measure to the success of the meetings The largest social undertaking apart from the final dinner was the excursion on Thursday September 15 to Middlesex School the route passing through Lexington and Concord, places famous in American history At the School a picnic supper was served an address on Galileo's Discorsi was given by Dean S H Hollister, of Cornell University and the proceedings were thereafter enlivened by a bonfire and a male chorus of Boston Negroes

Following the Congress members were invited to visit the National Bureau of Standards at Washington, D C, and the aeronautical laboratory at Langley Field, Virginia Many members availed themselves of this opportunity of seeing important scientific work in progress, and some very pleasant parts of the United States

New Laboratories of the Metropolitan Water Board

NEW Laboratories of the Metropolitan Water Board were opened by the Minister of Health, the Right Hon Walter Elliot, M P, on October 17 in the presence of a distinguished company They are situated at New River Head, Rosebery Avenue, adjacent to the Board s head offices, and replace laboratories in Nottingham Place, which have been in use since 1905

The Metropolis Water Act of 1871 provided for the appointment of a 'water examiner by the Board of Trade and in early days the water supplied by the London water companies was subjected to daily examination by Sir William Crookes and Profs James Dewar and Percy Frankland Under the Metropolitan Water Act, 1902, by which the several existing water companies were consolidated into one undertaking under the newly constituted Metropolitan Water Board, the Board was similarly placed under an obligation to conduct chemical and bacteriological examinations of its water

The Board in 1905 appointed the late Sir Alexander Houston to be Director of Water Examinations he died in 1933 and was succeeded by the late Lieut Colonel Harold In 1936, the Board approved a scheme for the erection of new laboratories, and Colonel Harold and the appointed architect, Mr Murray Easton, visited many laboratories in the United States in order to ascertain the latest developments in modern laboratory planning and practice The present building is the outcome of their inquiries but unfortunately Colonel Harold did not live to see its completion A descriptive booklet has been issued in connexion with the opening which contains views of the new building and of some of the laboratory interiors

The new laboratory block has a north south aspect and is built on a curved plan, the object of which was to allow more open space around, and to relate it to the existing head office block so that in case of extension the quadrant would strike the end of that building This construction not only produces a striking appearance architecturally, but also provides some thirty feet more space for the rooms facing north

The basement contains store rooms, cold, cool biological, and spare laboratories, cold room and refrigerating plant, air conditioning plant, motors, centrifuge and boiler room, and workshop The director s room is on the ground floor, with offices, library, photomicrographic room, biological, biochemical and bacteriological research laboratories The first floor houses wash rooms for apparatus preparation and sterilizing rooms for culture media the bacteriological laboratory and sub culture rooms and four constant temperature rooms for incubation All the top floor accommodation faces north and is allotted to the chemical section, with rooms for distillation, balances, stills and fume cupboards

The building is of brick with stone facings, and is steel framed Rubber flooring is used for most of the laboratories, and laboratory benches are in teak Vacuum and compressed air points are provided on the benches, also steam where required Access to the various floors is provided by a lift and a circular staircase housed at the east end in a circular tower like extension Full details respecting construction, fittings and general lay out are given in the booklet referred to above

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University Events

BOMBAY —Dr K Venkataraman, reader in dyeing and printing, has been appointed Mody professor and head of the Department of Chemical Technology in succession to Prof R B Forster

CAMBRIDGE —The following appointments have recently been made. Dr R H Thouless, of Corpus Christi College, University lecturer in education, Dr J T Irving, of Gonville and Caius College, University lecturer in physiology, F R Berridge of Trinity College, assistant in research in radiology (diagnostic), Dr A Paterson, of the University of Edinburgh, assistant in research in psychiatry

The Research Committee of the Dyestuffs Group of Imperial Chemical Industries, Limited, has offered a research studentship to the University when the Company requires to encourage research of a particular subject The stipend will be £350 for two years, with a possible extension, the appointment to be made by the University, after advertisement if desired.

A R H Trim, of Trinity College, has been elected to the B W Levy studentship in biochemistry

Dr H G Sanders, University lecturer in agriculture, has been elected into a fellowship at St John s College

R Howles of St John s College, has been appointed to the Frank Smart studentship in botany

At Trinity College the following have been elected into fellowships Dr S A H Rushton, Michael Foster student, 1925, Stokes student, 1927, Gedge prize, 1928, research fellow of Emmanuel College 1930 University lecturer in physiology D J Bauer, for research in physiology Mr Bauer gained a double first in the Natural Sciences Tripos and was Michael Foster student in 1937 38 E R Love, for research in mathematics, Mr Love was a senior optime in Part II of the Mathematical Tripos and gained honours with distinction, in Part III, he was Smith s prizeman in 1937 W C Price, for research in physical chemistry

The Managers give notice that an election to the Pinsent Darwin studentship in mental pathology will be made in January 1939 The studentship is of the annual value of not less than £225 and is tenable for three years The student must engage in original research into any problem having a bearing on mental defects diseases or disorders, but may carry on educational or other work concurrently Further information can be obtained from the Secretary, Pinsent Darwin Studentship Psychological Laboratory Cambridge

LONDON The appeal for an endowment fund of £100,000, which was launched a year ago on behalf of the Department of Business Administration, at the London School of Economics in the University of London, has not yet achieved its full objects It had been hoped to raise a sum, the income from which would not only make the finances of the Department permanently secure, but would also enable it to carry out several much needed developments Further donations are urgently needed in order to achieve fully the purposes of the appeal The amounts so far subscribed will nevertheless be sufficient to ensure the maintenance of the Department on its existing scale for a further period of seven years, and university students who contemplate a business career and wish to devote a post graduate year to special training, may plan their studies in full confidence that the course will continue to offer at least the same facilities as hitherto

SHEFFIELD The following appointments have recently been made Dr G C Hampson, assistant lecturer in chemistry, J C Colman, assistant lecturer in zoology, E Baildon, assistant lecturer in mechanical engineering

The Council has received a notification of a bequest free from legacy duty, under the will of the late Mrs Lucy H Habershon in the following terms To the University of Sheffield any of my late husband s books on mining or kindred subjects which they may care to have and the sum of Three thousand Pounds for the purpose of founding or establishing a fund to provide Scholarships in Mining to be called 'The Matthew Henry Habershon Scholarships', and a further sum of One thousand Pounds for coal dust research work

Mr M H Evans has resigned his post of lecturer in physics, and Dr E Seddon his post of lecturer in glass technology and research physicist

Science News a Century Ago

The Zoological Society

At a meeting of the Zoological Society on October 23, 1838, letters from three corresponding members were read. M. Julian Desjardins, secretary of the Natural History Society of Mauritius, wrote saying that it was his intention to leave that island on January 1 of the following year for England, with a large collection of objects on natural history, many of which he intended for the Society; Colonel P. Campbell wrote from Alexandria that he had not yet succeeded in gaining any further information respecting the possibility of procuring some white elephants for the menagerie in Regent's Park, and Lieut.-Colonel Doherty, governor of Sierra Leone, wrote that he was using every exertion to procure for the Society a male and female chimpanzee.

Statue of Watt at Greenock

"The statue of James Watt, by Sir Francis Chantrey, is now placed in the building erected for it in Union-street. It is an 8 feet figure, of statuary marble, and weighs upwards of 2 tons, and the pedestal, which is of Sicilian marble, weighs about 3 tons. On the front of the pedestal is the following inscription, from the classic pen of Lord Jeffrey: 'The inhabitants of Greenock have erected this statue to James Watt, not to extend a fame already identified with the miracles of steam, but to testify the pride and reverence with which he is remembered in the place of his nativity, and their deep sense of the great benefits his genius has conferred on mankind. Born XIX January MDCCXXXVI. Died at Heathfield in Staffordshire, August XXV, MDCCCXIX.' On the right of the pedestal is a shield containing the Arms of Greenock, and on the left strength and speed." (*Mechanics' Magazine*, October 27, 1838.)

Airy's Compass Experiments

Throughout 1838, the Astronomer Royal, Airy, was much occupied with the improvement of compasses for iron ships, and, at the instigation of the Admiralty, in the summer made experiments in the steamer *Rainbow*. On October 5 he received an application from the owner of the iron sailing ship *Ironsides* to correct her compasses. He accordingly went to Liverpool where he, as he said, "made a very important improvement in the practical mode of performing the correction". On October 28 he wrote to his wife referring to the *Ironsides*: "I worked up the observations so much as to see that the compass disturbance is not so great as in the 'Rainbow' (35° instead of 50°), but quite enough to make the vessel worthless; and that it is quite different in direction from that in the 'Rainbow'—so that if they had stolen one of the 'Rainbow' correctors and put it into this ship it would have been worse than before." Again, on November 1, he wrote, "On Wednesday I again went to the ship and tried small alterations in the correctors. I am confident now that the thing is very near, but we are most abominably baffled by the sluggishness of the compass." Airy reported on his experiments to the Admiralty and on December 4 had an interview with Lord Minto, the First Lord of the Admiralty, and Mr. Wood (afterwards Lord Halifax), the secretary, but "they refused to sanction any reward to me". His experiments, however, led to a great extension in the building of iron vessels.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 207, 437–456, August 29, 1938).

H. Lebesgue: Equivalence of regular polyhedra.

P. Lejay: Method of calculation of the coefficients characterizing atmospheric obscurity. Variations of this obscurity in the neighbourhood of Shanghai.

A. Rosenblatt: Series of univalent powers in the circle of unity.

P. Lévy: Addition of definite aleatory variables of modulus one.

L. I. Gama: Additivity of the *accumulatif*.

H. Bizette, C. F. Squire and B. Tsaï: The transition point λ of the magnetic susceptibility of manganous oxide. Curves are given for the susceptibility at 7,000 gauss and 24,000 gauss from about 40° K. to ordinary temperature.

Mlle. M.-L. Allais: New measurements of the K spectra of arsenic (33), selenium (34) and bromine (35).

A. Dauvillier: The internal structure of the globe, and the genesis of the continents and oceans. An outline of a hypothesis, a feature of which is that the globe, while still incandescent, had five lunar seas which became the basins of the oceans. The atmosphere consisted of hydrogen and helium, and as the temperature decreased, the former reduced metallic oxides of the sial and formed water which eventually condensed and eroded away the lunar relief.

E. Lederer and Mlle. R. Glaser: Echinochrome and spinochrome. The former, a red pigment from the blood corpuscles of a sea-urchin, has been obtained in crystalline form; while the latter, from the violet spines of a sea-urchin, is formed from it by the substitution of a hydroxyl group for a hydrogen atom.

(*C.R.*, 207, 457–468, Sept. 5, 1938).

K. Menger: New basis for the development of the geometry of Bolyai and Lobatchefski.

R. Wavre: A method of Volterra and a theorem of Dive relating to fluid masses.

S. Nikitine: Experimental study of the photodichroism of cyanine.

J. Gautrelet and Mlle. E. Corteggiani: Liberation of acetylcholine from the acetylcholine complex of mammalian brain by cobra venom.

G. Ramon, A. Boivin and R. Richou: Obtaining staphylococcal toxin and anatoxin in a medium of definite chemical composition. The medium does not contain peptone.

(*C.R.*, 207, 469–480, Sept. 12, 1938).

R. Salem: Convergence of Fourier series.

F. Leja: Approximation of continuous functions by certain harmonic functions.

R. Dalmon: Study of the constitution of nitric acid by its absorption spectra.

H. Gault and E. Steckl: Research on the condensation of acyclic aldehydes with certain compounds containing the carbonyl group. Condensation of formaldehyde and acetaldehyde with cyclohexanone.

Mlle. M. Fourcroy: In *Pinus pinea* each convergent conserves its functional individuality during reduction.

(*C R*, **207**, 481 508, Sept. 19, 1938)

S. G Waksman and J. W. Foster. Effect of zinc on the plant body of *Rhizopus nigricans*, and the production of acid by that organism In the nutrition of this organism, zinc acts as a catalyst for the production of fumaric acid

E. Batschelet Hypothesis of M E Lasker relating to polynomial ideals

P Gillis Equations of Haar relative to the calculus of variations

G-A Boutry and R Zouckermann Use of dry [copper-copper oxide] rectifier for the production of continuous high tension [current] An apparatus giving 10 milliamperes at 100,000 volts and utilizing this principle has been constructed A similar machine giving the same current at 500,000 volts is under construction

R Tremblot The quadruple star 59 Serpent This star is usually regarded as a visual binary, spectrograms recently obtained suggest that it is a quadruple star

R de Mallemann and F Suhner Magnetic rotatory power of hydrofluoric acid

M Rossignol and A Riboulleau Action of resorcinol on the bichlorhydrates of the quinine alkaloids

A Boutillier Irregular dilatometric anomalies in the copper aluminium alloys in the region of 12 to 100 aluminium

J Viret. Age of the lignitic clays of Nassiet, near Amou (Landes)

G Dubois and Mlle C Dubois Some peat beds of Haute Tarentaise

D Leroux. Influence of time and variations of temperature on the content of agricultural soils of water-soluble fertilizing principles

G Bronstein. Mechanism of the formation of the polyp of *Membranipora membranacea* L

Brussels

Royal Academy (*Bull Classe Sci*, **24**, Nos 6 7, 1938)

C de la Vallee Poussin. Irregular points Determination of masses from potentials

L Godeaux: Unit points of the second kind of cyclic involutions belonging to an algebraic variety

O Dony-Hénault: Discovery of the thermal metallurgy of zinc in Belgium at the beginning of the nineteenth century Forgotten documents

V Willem: Respiratory movements of the frog A refutation of the conclusions of C P Gnanamuthu

E de Wildeman Movements during their development of certain organs of higher plants

M Brelot Subharmonic functions and balayage

P Defrise Curves possessing a hyper-elliptic, cyclic involution without multiple points

A Festraets: Stroobant's star stream

R Coutrez: Dynamics of spiral nebulæ

R. Defay: Two aspects of the second law of thermodynamics in systems having a non-uniform temperature (1) and (2)

G. Petiau. Eigen functions of the fundamental operators of Dirac's theory of the electron

J. Brachet. Localization of proteins containing the sulphhydryl group during growth of amphibians

R. Vandendries. Homothallism in *Octojuga*

L. Derwidué Fundamental elements of the birational transformations in four-dimensional space.

Z. M. Bacq: Distribution of acetylcholine in the potato plant.

Cape Town

Royal Society of South Africa, August 17

P W Laidler The morphology and classification of ground and polished stone artefacts of South African origin

J C Middleton Shaw Growth changes and variations in wart-hog third molars, and their palæontological importance

H Zwarenstein Seasonal variations in sensitivity to progesterone-induced ovulation

H A Shapiro The biological standardization of certain steroids (1) Seasonal changes in response of *Xenopus lævis* to methyl testosterone Methyl testosterone can induce ovulation in *Xenopus lævis* The ovulation response of the animals to different doses of this steroid was investigated in July 1937 and in January, April and August 1938 At least forty animals were injected for each dose-level The dose in γ was plotted against the response per cent

September 21

W G Sharples A *coup-de-poing* factory site in the Nieuwveld

Raymond A. Dart Population fluctuation over 7,000 years in Egypt

Moscow

Academy of Sciences (*C R*, **19**, No. 8, 1938)

I D Papanin Conquest of the Pole

P P Shirshov Oceanological observations

E K Fedorov Geophysical and astronomical observations

W N Shoulejkin The drift of ice-fields

S P Kachurin Frozen grounds recede

N E Kotchin Movement of a heavy liquid in a channel with a step on its bottom

B G Fessenkoff Astrophysics at the North Pole

A A Grigorev Main physico-geographical features of land in the arctic belt

A D Arkhangelsky Principal features of the tectonics of the northern part of the Atlantic Ocean and the Arctic

S L Kushev and J A Liverovsky Principal points in the evolution of the physico-geographical conditions prevailing in the central depression of Kamchatka during the Quaternary

A E Fersman Geochemistry and mineralogy of polar regions

V I Vernadsky Some current problems in the study of ice of the arctic regions

M. V Klenova Colouring of the Polar Sea sediments

N I Tchigirin Concentration of calcium carbonate in the waters of the polar basin

S. W Brujevicz Oxidation-reduction and the *p*H of sediments of the Barentz and Kara Seas

B. G Bogorov Biological seasons of the arctic seas.

P I Usachev. Biological analysis of ice-floes

A A. Egorova: Thermophile bacteria in the Arctic.

V S. Butkewitch: Bacteria in the seas of the high-latitude arctic regions

P J Schmidt: Three new deep-sea fishes from the Okhotsk Sea

Forthcoming Events

[Meetings marked with an asterisk are open to the public]

Monday, October 24

University of Leeds, at 5 15 Prof H Dingle The Social Relations of Science *

Tuesday, October 25

Royal Horticultural Society at 3 30 —F J Chittenden The Behaviour of Plants (Master s Memorial Lectures Succeeding lecture on November 8)

Wednesday, October 26

Iron and Steel Institute (at the Institution of Civil Engineers) at 10 a m Autumn Meeting

Thursday, October 27

Birkbeck College, at 5 30 —Prof R Blanchard 'Habitat in the Northern French Alps (succeeding lecture on October 26) *

Chadwick Public Lecture (at the Royal Sanitary Institute), at 5 30 —Norman Macfadyen 'The Evils of the Congestion of Population and the Way Out *

Friday, October 28

Geophysical Discussion (at the Royal Astronomical Society), at 4 30 — The New Triangulation", to be opened by Major M Hotine

Bedson Club King s College, Newcastle upon Tyne, at 6 45 —Prof Max Born Statistics in Chemistry and Physics (Bedson Lecture)

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Lecturer in Mathematics and Geography in the County Training College Crewe—The Director of Education County Education Offices City Road Chester (October 11)

Scientist for work in connexion with hydrogen production at the Balloon Development Establishment Cardington—The Under Secretary for State Air Ministry (S 2 D) Adastral House Kingsway W C 2 (ref B 135 October 29)

Superintendent of the Engineering Department of the National Physical Laboratory The Director National Physical Laboratory Teddington Middlesex (November 7)

Lecturer in Engineering and Lecturer in Building Trades in East London Technical College South Africa —High Commissioner for South Africa Trafalgar Square London W C 2 (November 11)

Deputy Director of the Imperial Bureau of Animal Nutrition Aberdeen—The Secretary Imperial Agricultural Bureaux 2 Queen Anne s Gate Buildings London S W 1 (November 19)

Deputy Director of the Imperial Bureau of Animal Breeding and Genetics Edinburgh—Prof F A E Crew Institute of Animal Genetics West Mains Road Edinburgh (December 1)

Assistant Lecturer in Psychology in the University of Western Australia—The Secretary to the Agent General for Western Australia Savoy House 115 116 Strand W C 2

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1937 with Report of the Geological Survey Board and Report of the Director Pp iv+109 (London H M Stationery Office) 2*s* net [510

Transactions of the Royal Society of Edinburgh Vol 59 Part 2, No 14 An Analysis and Comparison of the Structural Features of *Dactylotheca plumosa* Artis sp and *Senftenbergia ophiodermatica* Göppert sp By Norman W Radforth Pp 385-396+2 plates 2*s* 3*d* Vol 59 Part 2, No 15 On *Rhamphodopsis* a Ptyctodont from the Middle Old Red Sandstone of Scotland By Prof D M S Watson Pp 397-410+1 plate 2*s* 3*d* (Edinburgh Robert Grant and Son Ltd , London Williams and Norgate, Ltd) [510

Imperial Forestry Institute Institute Paper No 14 A World Tour for the Study of Soil Erosion Control Methods By Dr A Grasovsky Pp vi+76+5 plates (Oxford The University) 5*s* [1010

Other Countries

Southern Rhodesia Meteorological Report for the Year ended 30th June 1937, by the Department of Agriculture Pp 90 (Salisbury S Rhodesia Government Stationery Office) [410

U S Department of the Interior Office of Education Bulletin 1937 No 2 A Survey of a Decennium of Education in Countries other than the United States (Being Chapter VII of Vol 1 of the Biennial Survey of Education in the United States 1934 36) By James F Abel Pp vii+97 15 cents Bulletin 1937 No 18 Preparation for Elementary School Supervision (Project in Research in Universities) By Mary Dabney Davis Pp vi+76 15 cents Leaflet No 30 Federal Aid for Education 1935 36 and 1936 37 with a Brief History and Bibliography By Timon Covert Pp iii+24 10 cents Pamphlet No 83 Handbook for Compiling Age Grade Progress Statistics By David Segel Pp iii+31 10 cents (Washington D C Government Printing Office) [410

Kungl Svenska Vetenskapsakademiens Handlingar Serien 3 Band 16 No 6 Litorale Amphipoden des tropischen Pazifiks nach Sammlungen von Prof Bock (Stockholm) Prof Dahl (Berlin), und Prof Pietschmann (Wien) Von A Schellenberg Pp 105 Serien 3 Band 16 No 7 Über die oxydation von Zinkblende Einkristallen an Hand von elektroneninterferenzen Studiert Von G Aminoff und B Broomé Pp 12+2 plates (Stockholm Almquist and Wiksells Boktryckeri A B) [610

U S Department of the Interior Geological Survey Bulletin 886 C Geology and Ore Deposits of the Southwestern Arkansas Quicksilver District By John C Reed and Francis G Wells (Contributions to Economic Geology, 1937) Pp vi+17 90+plates 2 17 75 cents Bulletin 893 Metalliferous Mineral Deposits of the Cascade Range in Oregon By Eugene Callaghan and A F Buddington Pp viii+141+22 plates 1 25 dollars Bulletin 900 A Subsurface Geology and Oil and Gas Resources of Osage County Oklahoma Part 1 Townships 22 and 23 North Ranges 10 and 11 East By N W Bass I E Kennedy W R Dillard Otto Leatherock and J H Hengst Pp iv+45+1 plate 30 cents Professional Paper 189 A Species and Genera of Tertiary Noetinæ By F Stearns MacNeil (Shorter Contributions to General Geology 1937) Pp ii+49+6 plates 20 cents Professional Paper 189 C Pliocene Diatoms from the Kettleman Hills California By K E Lohman (Shorter Contributions to General Geology 1937) Pp ii+81–102+plates 20 23 15 cents Professional Paper 190 Lower Pliocene Mollusks and Echinoids from the Los Angeles Basin California and their Inferred Environment By W P Woodring Pp ii+67+6 plates 30 cents Water Supply Paper 810 Surface Water Supply of the United States 1936 Part 10 The Great Basin Pp iv+90+1 plate 20 cents Water Supply Paper 820 Drought of 1936 *with Discussion on the Significance of Drought in relation to Climate* By John C Hoyt Pp iv+62 15 cents (Washington D C Government Printing Office) [1010

Smithsonian Institution United States National Museum Bulletin 170 Life Histories of North American Birds of Prey Part 2 Orders Falconiformes and Strigiformes By Arthur Cleveland Bent Pp viii+482+92 plates (Washington D C Government Printing Office) 60 cents [1010

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations Expenditures and Condition of the Institution for the Year ending June 30 1937 (Publication 3451) Pp xv+580 (Washington D C Government Printing Office) 1 dollar [1910

Smithsonian Institution Bureau of American Ethnology Bulletin 118 An Archæological Survey of the Norris Basin in Eastern Tennessee By William S Webb Pp xv+398+152 plates (Washington D C Government Printing Office) 1 dollar [1010

U S Department of the Interior Office of Education Pamphlet No 84 Safety and Sanitation in Institutions of Higher Education By Dr James Frederick Rogers Pp v+22 (Washington D C Government Printing Office) 10 cents [1010

League of Nations Advisory Committee on Social Questions Enquiry into Measures of Rehabilitation of Prostitutes Part 1 Prostitutes their Early Lives (Official No C 218 M 120 1938 IV) Pp 140 (Geneva League of Nations London George Allen and Unwin Ltd) 3*s* [1010

Journal of the Faculty of Agriculture Hokkaido Imperial University Vol 43 Part 2 Studies on the Agaricaceæ of Hokkaido II By Sanshi Imai Pp 179 378 (Tokyo Maruzen Co Ltd) [1010

Indian Forest Records (New Series) Silviculture Vol 3 No 3 An Investigation into the Relative Merits of Planting Teak (*Tectona grandis*) Stumps in Pits and in Crowbar Holes in Areas having a West Coast Type of Climate By A L Griffith Pp ii+47-60 (Delhi Manager of Publications) 6 annas 8*d* [1010

Annales Bryologici a Year Book devoted to the Study of Mosses and Hepatics Edited by *Fr* Verdoorn Vol 11 (1938) Alexander W Evans Dedicatory Volume Pp vi+160 (Leiden Chronica Botanica Co *London* Wm *Dawson* and Sons *Ltd*) 6 guilders [1010

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 119 The Wood Structure of some Australian Cunoniaceæ with Methods for their Identification By H E Dadswell and Audrey M Eckersley (Division of Forest Products Technical Paper No 27) Pp 23+7 plates Pamphlet No 80 The Storage of Oranges with Special Reference to Locality Maturity, Respiration and Chemical Composition By Dr S A Trout G B Tindale and Dr F E Huelin Pp 59 Pamphlet No 81 The Properties of Australian Timbers Part 3 *Pinus radiata* D Don (*Pinus insignis* Doug) Insignis Monterey or Remarkable Pine A Report prepared by the *Division of Forest Products* (*Division of Forest Products* Technical Paper No 28) Pp 31 Pamphlet No 82 The Humidity of the Atmosphere and the Moisture Conditions within Mounds of *Eutermes exitiosus* Hill By R V Fyfe and F J Gay Pp 22 Pamphlet No 83 *Fleece* Investigations *By F G Lennox* Pp 27 (Melbourne Government Printer) [1010

Publications of the Dominion Observatory, Ottawa Vol 12 Bibliography of Seismology No 18 Items 3903-4020 , April, May June, 1938 By Ernest A Hodgson Pp 367-382 (Ottawa King s Printer) 25 cents [1010

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Social Science Problems and Programme

WHEN the Council of the British Association meets next month it will have before it the approval by the General Committee at the Cambridge meeting of the recommendation to create a new Division to deal with the social and international relations of science So far during the century or more of its existence the work of the Association under the administration of the Council and subject to the approval of policy by the General Committee has been carried on through the Sections each dealing with a particular branch of science and meeting only once a year As is implied by the deliberate choice of the term Division the new organization is intended to operate on somewhat different lines being intimately affiliated with the Association but semi-autonomous Much preliminary work will be required before the precise form and activities of the Division can be determined but the main object of the Division to further the objective study of the social relations of science offers ample scope for undertaking research including factual studies on the organization of science and its social and economic relations for discussion of the social aspect of science the consideration of the public relations of science and for consultative work or as a co-ordinating centre and information bureau

The science of society is still embryonic and though the British Association may well prove to have taken a decisive step in accelerating its development even the main lines of organization or activity of the new Division will probably require some time to determine Apart from anything else the relative merits of various lines of work such as the actual initiation of research on particular subjects and the various possibilities in regard to consultative or co-ordinating work as well as to the importance of implementing means for bringing the findings of science more effectively before the general public must be determined before the new Division can well allocate its resources and activities Nor can it be indifferent to such recent developments as the founding of Nuffield College Oxford and the recently established National Institute for Economic and Social Research London

The extent and character of the investigations provided by such bodies will obviously be a matter of prime concern to the new Division in considering the initiation of any research project of its own In considering the initial activities of the Division however especially in regard to factual research the plan adopted by the Committee on Science and its Social Relations (C S S R) of the International Council of Scientific Unions should be of some assistance This Committee is endeavouring to collect material for the preparation of a report and of bibliographies on the social relations of science to be presented at the next meeting of the International Council of Scientific Unions in 1940 The report is designed to cover outstanding developments in the various branches of science new applications of science in human society the organization of scientific investigation and its application with summaries of interpretative work on the world picture as given by science and its social relations

In pursuance of this plan the Committee has approached national academies and a number of international scientific organizations for assistance by the supply of relevant information A number of correspondents have in this way been appointed to whom have been forwarded a questionnaire covering points in science in general and in special branches of science upon which information is required These questionnaires should be of value in framing the initial policy of the new Division of the British Association Obviously, as is implied in what has already been written, the Division should first have regard to the existing position of social research in Great Britain It must have before it accurate information as to the extent and resources of the research effort in this field Something of the nature of what may be termed a map of social research is called for at an early stage To meet this requirement the Division might well decide to attempt to develop co ordinating functions and activities and to establish a co ordinating committee or information bureau, and also to establish relations with institutions dealing with social relations of science at home and abroad

The required picture of research however cannot be limited to social research alone Its significance can only be assessed when it is seen in its proper perspective in the general map of research effort, both scientific and industrial For this reason, the Division might well consider implementing an inquiry into the nature extent and resources available for scientific and technical research in Great Britain generally on larger and more authoritative lines than the inquiry initiated some years ago by the Association of Scientific Workers

Acquisition of precise data in this manner is undoubtedly an essential preliminary if the new Division is to utilize to the best advantage such resources as may be at its disposal for factual research in social sciences Moreover, it can scarcely be doubted that apart from the researches actually initiated by the Division, its influence could most valuably be exerted to assist in such a reorientation or diversion of research effort from the physical to the biological sciences as has been urged by Prof W McDougall Dr Julian Huxley and others Such representations would gain immensely in authority if supported by data drawn from such a survey as we have indicated

The activities we have just suggested are of themselves likely to require the institution of effort or the establishment of organization to deal with many other matters contemplated in the memoranda submitted to the General Committee of the Association at Cambridge such as the establishment of consultative machinery, the supply of material for the information of the public, and so on Moreover, the appointment of research committees similar to those constituted by the various sections of the Association must be one of the functions of the Division

The initiation of research by the new Division requires, however, not only a survey of existing activities and resources but also the elaboration of an adequate plan of research It is not essential to assume that the Division should alone be responsible for the actual initiation of research One of its valuable functions, if it develops into the co ordinating institution that is desired, may well be that of providing an authoritative plan of research desirable in the social field, the execution of which in detail is carried out by consultation with the various research institutions as well as by research committees of the Division

What may be termed the research programme of the new Division might thus consist of a broad and long range plan conceived in relation to the needs and opportunities as revealed by the information available, which would form the basis of detailed programmes some of which might be executed by the Division itself and others by other institutions or some of the professional associations whose contribution at present is insignificant Possession of a broad and long-range plan would moreover, enable the Division to take the detached view essential if its recommendations from time to time regarding the diversion and re orientation of research effort are to carry due weight and authority

An admirable exposition of possibilities for basic research in this field has been given by Prof H Levy in a chapter on the scientific study of social development in his recent book A Philosophy for a Modern Man" Indeed, many of the features of social life which he enumerates as requiring quantitative measures constitute a programme which might with advantage be considered by the Division These variables fall into three main groups There are first the qualities which determine the technological level of the community within which group are included all types of business and industrial enterprise Then there are the qualities defining the physiological level of the population In this group are included all those factors that determine the conditions under which people live The third group comprises the qualities which define the cultural level of the population and includes all those mental and æsthetic qualities that thrive or are frustrated by the conditions imposed in the other two fields.

Prof Levy's approach is, indeed, very similar to that adopted by Lord Stamp in the programme of research outlined in his "Science and Social Adjustment" which also claims the attention of the new Division Prof Levy, indeed, reiterates in somewhat different form a number of Lord Stamp's proposals He suggests, for example, the construction of an index of the degree of research activity in the community, and sub indexes showing how this is composed of research in fields ranging from highly industrial and engineering to highly abstract, mathematical or logical He suggests further a special index to measure the degree to which research is directed towards destructive ends rather than constructive progress

Again, indexes are required to measure the general technical level of commodity production or the social waste in the distributive and productive processes, particularly in relation to the effect of intensive advertisement Similarly, it should be possible to establish some standard of maximum social efficiency in shelter and housing provided for the community at any given time This would imply a relative index of efficiency of housing and accommodation for various social classes Like Lord Stamp Prof Levy directs attention to the need for a fundamental study of invention clearing in relation to patents and some index which would take account of factors hindering the assimilation or development of inventions Technological unemployment is another topic presenting problems demanding quantitative study, while on the physiological side Prof Levy urges the elaboration of an index of physical fitness applicable not only to individuals but also to social classes, as well as an environmental index, a food value level based on the biological value of the food consumed by the individual, to be taken in association with the cost of living index figure, as well as a resistance index to measure the extent to which the individual can withstand the onset of various illnesses, diseases or epidemics

Here alone indeed there is outlined a programme which the new Division might at first well find overwhelming If, however, its organization and activities are conceived on broad, fundamental and long range lines, there need be no fear of its being so immersed in the detail of a few investigations that it fails to exercise the co ordinating and stimulating effect over the whole field that is desired So far as specific researches may be concerned, its contribution, apart from the formulation of a broad plan may well be in just those borderline problems, at the growing points of research in different departments of science which involve organized and many-sided efforts for their solution While, therefore the new Division may appoint research committees to report upon these and other matters, it will be desirable at an early stage to examine the data which must form the basis alike for a comprehensive plan of social research or for any representation designed either to re orientate research effort or to stimulate fresh effort in professional or other quarters

A History of Bacteriology and Bacteriologists

The History of Bacteriology

By Prof William Bulloch (University of London, Heath Clark Lectures, 1936, delivered at the London School of Hygiene and Tropical Medicine) Pp xii+422+16 plates (London, New York and Toronto Oxford University Press 1938) 10s 6*d* net

SINCE the appearance of Löffler's fragmentary and otherwise faulty "Lectures" in 1887, students of the history of bacteriology have had no guide-book to this intriguing and complicated subject They will all, therefore, welcome the present volume—written by the foremost living authority, who has lived through the heroic age and was personally acquainted with many of the heroes It is true he had given us a foretaste of his knowledge in the 'System of Bacteriology" (vol 1, 1930) published by the Medical Research Council but this larva is now metamorphosed into an imago which will surely serve the most exacting needs of historical students for at least another generation Though originally delivered—like Loffler's essay in the form of lectures, this final product is actually a well documented contribution to science

The book is divided into eleven chapters dealing respectively with ancient doctrines of contagion , *contagium animatum* , *fermentation* , *spontaneous generation and heterogenesis* , *putrefaction and putrid intoxication* , *pyæmia, septicæmia, and surgical sepsis* *specific element in disease* , *classification of bacteria* , *cultivation of bacteria* , *Pasteur's work on attenuation of virus* , *history of doctrines of immunity* These chapters are amplified by copious and detailed individual bibliographies (64 pages) and a concise international biographical dictionary (58 pages) of "some of the early workers in bacteriology"—which is as remarkable for its inclusions as for its omissions Sixteen inserted plates of portraits and other illustrative matter with two full indexes of persons and subjects round off the work

No man, living or dead, has ever before attempted to cover all this ground with the same thoroughness As the author says, in his short preface if the task had been easy it would not have been left so long undone Consequently this book is incomparable in every sense , and for this reason there is probably no man now alive who is competent to review or criticize it in its entirety The following remarks therefore merely record the impressions which it has made upon another and less experienced labourer in neighbouring historic fields who can make no claim to first hand knowledge of all the sources and materials which are here so ably expounded and summarized

My first impression—for what it may be worth after a single perusal—is one of unqualified admiration for the author's solid learning I was already aware, of course that he had studied the subject all his life, and I have ever admired and respected his dogged devotion to facts yet I now appreciate once more, as though they were something new, the sterling qualities displayed in this book The data are presented concisely and fairly , and the author's own comments and conclusions appear, to me, almost invariably just and judicious A young man could not have composed such a book, and few older men could have compressed their ripe knowledge and experience into so small a compass Yet there is here no parade of erudition most of the real work was obviously done—as it should be—before the book was written In other words, the recorded facts have been ascertained verified, and properly digested, before presentation Many a simple sentence in this treatise must have taken years to evolve

With so much to choose from, it is difficult to notice any one section particularly , but for my own part I find the chapter on spontaneous generation especially pleasing as it reviews most satisfactorily and adequately almost the whole of this complex and previously misreported subject The account of Pasteur's work—not only here but also elsewhere—is masterly.

In a work of this scope and size it is obviously impossible that no faults should be discoverable The half dozen typographical errors which I have noted should probably be laid to the charge of the printers (for example 'lave' for have' (p viii), 'penicillium' for '*Penicillium*' (p 92), 'Willnan' for 'Willnau' (p 417) etc) But a few other slips also require amendment Those old familiar friends "the two Janssens" crop up again, regrettably, on p 19 (Zacharias is properly styled Janssen because his father was named Johannes—*alias* Hans or Jan but Johannes was not a 'Janssen', but Zachariassen as Zacharias was his father In this case Janssen was not a surname but a patronymic) The statement, on the same page, that "the solar microscope invented by Leeuwenhoek was perfected by J N Lieberkühn in 1739" is incorrect for Leeuwenhoek never invented a solar microscope, and the prevalent belief that he used a concave mirror magnifier of the Lieberkuhn type appears to be based merely upon a misunderstanding of his own words and pictures It is also incorrect to say that O F Müller—the "great Danish naturalist", as he is rightly called—was born of German parents' (p 384) His father's family, it is true were German immigrants into Denmark , but his mother was a Dane (*née* Margrethe Henriette Udsen) The title of Le Leu's ' Life" of that singular character Dr David Gruby is not "*Le David Gruby*" (p 370) but "*Le Dr Gruby* I have noted a few other mistakes of the same order of triviality, but can detect none of major magnitude in matters with which I am specially familiar

Although it covers so vast a field, this 'history of bacteriology is primarily a history of the medical aspects of the subject and of those engaged in it Even on the medical side, moreover there is a striking omission those interesting and important organisms the spirochætes are barely mentioned The history of iron-bacteria, sulphur bacteria, nitrifying and other soil bacteria of great physiological and economic importance is also almost excluded Winogradsky (who was awarded the Leeuwenhoek Medal for his researches in 1935) is given three lines in the biographical section, but his work is practically ignored in the text I regret to note also that the earliest English observers and illustrators of bacteria have likewise been strangely overlooked Edmund King (1693), John Harris (1696), and the celebrated "Anonymous of 1703" were surely worthy of note Robert Hooke is included, however among the "early workers" in the biographical notices , but his observations on bacteria are nowhere recorded And it is a pity, I think, that quotations are not always given with the exact spelling, punctuation, and other typographical peculiarities of their prototypes (see for example the citations from Leeuwenhoek and Benjamin Marten) To my mind quotations—especially in a historical work—should always be given in their original form exactly But these are clearly trifles in comparison with the immense mass of accurate facts and critically sifted data here impartially recorded and analysed

This is manifestly an important book but one which as I have already indicated I am not competent to judge—indeed I should be the last man to judge or criticize it as a whole All who are personally acquainted with its author and who are truly interested in its theme must simply rejoice to see these mature judgements and records preserved in print for all time Some of us had previously been privileged to hear them—at least in part—more racily recounted by his own lips in his native Doric yet even those who have not had this advantage must now recognize that this work is the outcome of a lifetime devoted to the pursuit of naked truth Apparently nothing in it is given at second hand all its information is fearlessly and faithfully chronicled from original sources It is scientific history in the best historical tradition—accurate objective and honest—and can therefore be copied with complete confidence Consequently I foresee a great popularity for this monograph among lesser writers of historical sections and introductions to all manner of future articles Seldom can one buy such an almost miraculous haul of historical fish for half a guinea

Nevertheless this admirable book is not merely a paradise for poachers it will also be used and trusted and acknowledged by every serious student who henceforth attempts to explore any of the same territory and will undoubtedly remain an everlasting inspiration to all future workers Incidentally and appropriately it illustrates anew the truth in a saying of Leeuwenhoek (the first genuine bacteriologist as he is here justly acclaimed) that *de vrugten die in den herfst rijp werden langst konnen duuren* —those fruits which ripen in autumn can last the longest

Clifford Dobell

British Mosquitoes

The British Mosquitoes
By J F Marshall Pp xi + 341 + 20 plates (London British Museum (Natural History) 1938) 20s

IN 1920 the British Museum published a Handbook of British Mosquitoes by Dr W D Lang it set up a new standard in its figures attention to early stages and in other ways That book has now been replaced by Mr Marshall s which though it owes much to its forerunner is definitely a new book and in many ways an advance on extant works on mosquitoes It is a matter of some interest to notice that both these books have been written by men who might claim the distinction of being amateurs The author of the first a palæontologist was asked under the stress of war to produce a monograph on these insects The author of the second an engineer who found that salt marsh mosquitoes were uncomfortable neighbours turned his mind first to control and through that to scientific study

In 1920 the British list of mosquitoes included twenty species the present work includes twenty nine About half these additions are due to more careful collecting the remainder to the recognition of species previously undetected or not regarded as separate

The general structure of the book is on accepted lines Mr Marshall tells the reader how to recognize a mosquito and introduces him to classification and nomenclature One may feel perhaps that though this is well done it is scarcely necessary for it has been done so often before and a reader quite ignorant of mosquitoes is not likely to use this serious work as a primer The general account of the biology of British mosquitoes at all stages includes an ingenious calendar showing what stage of each species may be found month by month For some of the species this has been elaborated to show the seasonal occurrence of each of the four larval stages separately One may here remark on the ingenuity with which the author sets out information as tables and diagrams The account of the early stages of adults of British mosquitoes deals particularly with those anatomical points which are used in classification and the information is so full that one may separate the four larval stages of almost all the species There is no other part of the world for which this detailed information is at present available

Leaving general topics Mr Marshall then gives a review of the British Anophelines and Culicines In each of the descriptions attention is first directed to the chief distinguishing features of the adult the hypopygium and the larva In some cases a description of the pupa or of the egg has been included in addition This morphological information is followed by a short account of the life history ecology etc of the species concerned and also (in most cases) by a list of its British records The description of each species concludes with a brief summary of its foreign distribution This part of the work is fully and beautifully illustrated the majority of the text figures being by Terzi An account of methods of control and some general notes on biology bring the book to an end

It need scarcely be said that different authors would emphasize rather different parts of the subject The present reviewer thinks that the account of those races of *Anopheles maculipennis* which do not occur in Britain might well have been omitted particularly as the subject has received such full attention elsewhere It seems also that some reference should have been made to the British record of the yellow fever mosquito (*Aedës argenteus*) No one supposes that the insect occurs wild in Britain but there is a printed record of it being found in Epping Forest which should perhaps have been mentioned if only to point out that it might have been based on an error

The book as a whole is remarkably up to date even on matters about which many entomologists are not well informed such as the relation of species of *Anopheles* to malaria and the physiology of mosquitoes The great majority of the figures are line drawings by Mr Terzi many of them having already appeared in the previous book There are also some remarkably successful photographs of adult mosquitoes taken by the author and his assistant Mr Staley The few coloured plates are perhaps unnecessary and not particularly successful

P A BUXTON

Relative Abilities in Primitive Groups

Primitive Intelligence and Environment
By Dr S D Porteus Pp ix+325 (New York The Macmillan Co 1937) 15*s* net

DR S D PORTEUS has an honourable record of studies in the comparative psychological endowment and capacities common in different social groups It is therefore the more to be regretted that this particular book is rather hastily thrown together and falls far short of what should reasonably be required in any scientific treatise Two thirds of it consists in theoretical discussion and in interesting but superficial descriptions of the social and material environment of the various groups the members of which Dr Porteus has directly studied

In the theoretical discussion the author shows himself to be alive to the difficulties of the type of comparisons which he is attempting to make and he states those difficulties fairly and well But that small portion of the book which is devoted to facts is poor The evidence brought forward is not impressive in amount the methods employed —all consisting in the application of mental and physical tests —are not adequately described and the statistical form in which the results of the tests are presented is thoroughly unsatisfactory Very nearly half this factual section is devoted to a study of results secured from some form or forms of the author s well known maze test here treated without anything like sufficient justification as an index of capability to adapt to the demands of an encroaching white civilization If the test can be treated in this way it is certainly a most extraordinary thing to find that various groups of Australian aboriginals score more highly at it than do groups of Bantu natives But as only average scores are presented with no measure whatsoever of dispersion and no indication of the distribution of scores it is actually impossible to draw any sure conclusion

Other comparisons are made on the basis of psychophysical factors brain capacity right and left hand grip and right or left hand dominance of grip Apart from the fact that here also only average measures are presented nobody knows yet what conclusions if any of a psychological nature can be drawn from these particular characteristics

Finally there is a short chapter on Tests of Learning Capacity These are in this book rather a mixed grill They are made up of form board and assembling tests a footprints test—in which duplicate photographs of footprints on a dusty road have to be matched with the originals —tests of auditory and visual rote memory and a small battery of intelligence tests of the routine kind From the application of these little is concluded

Dr Porteus says that he will present the whole of the statistical detail later and fully Until he does so a final judgment of the value of his work as recorded in this volume must be suspended When he does so it is greatly to be hoped that he will consider fully what precise criteria both of a statistical and of a general psychological kind must be satisfied if the results of the application of psychological tests are to be used seriously for the purpose of comparing the relative abilities common in differently organized groups

F C B

The Reverse Notation

Introducing Negative Digits with Twelve as Base By J Halcro Johnston Pp x+74 (Glasgow and London Blackie and Son, Ltd , 1938) 3s 6d net

IN this interesting book the author explains a new notation which he has devised to remove the main defects of the Arabic notation The two main characteristics of the system, called the reverse notation, are the introduction of negative digits and the adoption of 12 as the radix or base The consecutive sequence of digits is written $\bar{6}$ $\bar{5}$ $\bar{4}$, $\bar{3}$, $\bar{2}$, $\bar{1}$, 0, 1, 2, 3, 4, 5, 6 so that any number like 8 is denoted by $1\bar{4}$, whilst $1\bar{5}4$ represents seven dozen and four The notation is applied to the ordinary rules of arithmetic and the author claims that the numbers of the reverse notation are balanced about their *centres of gravity* , which is not the case with the Arabic system

The whole scheme is undoubtedly very ingenious, but when judged impartially, there appear to be far more difficulties in the notation than there are disadvantages in the existing Arabic system The initial trouble that teachers have in introducing and working with negative characteristics in logarithms is well known Indeed, to arouse a true concept of a negative number is by no means an easy problem either in psychology or pedagogy Yet in the system before us, negative digits abound , for example, log $3 = 0\ 54\bar{4}0$, log $6\ \bar{3}35 = \bar{1}\ 320\bar{4}$, $\pi = 3\ 2\bar{4}5\bar{4}$ and on page 47, the number of days in the year is represented as $265\ 3\bar{1}\bar{1}\bar{6}3$!

The author fully realizes that the introduction of such a notation is far from being a practical proposition, but hopes that it will be judged by the principle of the survival of the fittest It is, nevertheless, very difficult to see how the system can first be introduced Are accountants, scientific and technical computors, business men, etc , expected to incur the expense of changing the basic notation upon which they have made their calculations for so long ? If they were sufficiently convinced of the advantages of the system to try the experiment, would this ultimately lead to the introduction of the notation into schools, where it should logically begin to evolve ? One wonders, however, in this eventuality, what the teachers of arithmetic, especially in primary schools, would say to such a suggestion F G W B

The Macaulay Institute for Soil Research

Collected Papers, Vol 1 Edited by Dr W G Ogg Pp 16+54 papers (Aberdeen Macaulay Institute for Soil Research, 1938) 21s

THE Macaulay Institute for Soil Research was founded for the purpose of studying possibilities of land reclamation on the Island of Lewis, and of raising the standard of agriculture and living of its inhabitants Sir Robert Greig states in the preface that, since the foundation of the Institute, which is in Aberdeen, and of its experimental farm near Stornoway, Lewis has become more than self supporting in milk and eggs, and fine pastures have appeared and are extending over the formerly worthless peat bogs The Institute has justified its existence, and has tended inevitably to extend its research activities beyond its original field of peat land reclamation

These fifty four reprints of papers by members of the staff indicate the steady growth in the scope of the Institute s work The Macaulay Institute is the only British station devoted entirely to soil research From peat studies it has branched out into the chemistry and physics of mineral soils and latterly into soil classification and survey One can trace in these papers the gradual evolution of a still incompletely formed Macaulay school of thought in soil science in which modern Russian and ancient Scottish beliefs are struggling for mastery The papers themselves naturally vary in quality , some have obviously been included in order to make the collection complete rather than for their intrinsic value, but, omitting these, a high standard is maintained It is noteworthy that most of the recently published papers deal with soil chemistry classification and survey, rather than peat land reclamation This indicates a welcome development Should Britain ever decide to take stock of its land the Macaulay Institute would have an important part to play in the stock taking This collection of papers shows that it is already equipped for the part and can play it without detriment to the original purpose for which the Institute was founded

Pyrenean Festivals

Calendar Customs Music and Magic Drama and Dance By Violet Alford Pp x+286+16 plates (London Chatto and Windus, 1937) 15s net

MISS ALFORD is well known as a student of the folk dance and song of European peasantry, but the Pyrenees is a region which in this subject she has made peculiarly her own province In this volume, æsthetically delightful, as well as scientifically valuable, she has reviewed the results of some years of observation on both sides of the political frontier among the inhabitants of the Pyrenean regions from Catalonia on the east to the Basque country in the west Nor has she confined her studies to dance and song, for she deals here with some remarkable forms of custom and magical belief which serve to throw light on the main theme

The ethnological character of the peoples, as well as the geographical conditions of their habitat, have made for an intense conservatism in the past, which undoubtedly has led to the preservation in the dances of religious and cultural concepts, which in their origin are probably older than anything found elsewhere at present in Europe Such, for example, is the remarkable cult of the bear , while an apparent transformation into animal form represented in the dance recalls the fact that it is in this country that there occurs the palæolithic painting of the animal-magician in the cave of Trois Frères of Ariège

Miss Alford s work is a veritable gold mine for evidence of survivals of primitive modes of thought, and as such needs no further commendation to students of folk lore and primitive religion

Diffusion und chemische Reaktion in festen Stoffen
Von Prof Dr Wilhelm Jost (Die chemische Reaktion, herausgegeben von K F Bonhoeffer und H Mark, Band 2) Pp viii+231 (Dresden und Leipzig Theodor Steinkopff, 1937) 20 gold marks

THE present book deals with a number of phenomena which are of importance in modern physical chemistry The chapters deal with diffusion processes in the solid state, irregularities in lattices (*Fehlordnung*) the elementary processes in solid reactions, tarnish and general reactions in the solid state Although the literature is fairly well covered, there is more emphasis on modern work, including English and American The field covered is limited, so that many topics such as recrystallization are excluded but those parts selected for treatment are chosen judiciously and are dealt with in a very critical and systematic way A good feature is the close relation which is established between the theoretical principles (which are very clearly stated) and the experimental results The book is a well presented and accurate survey of an interesting subject

Reagent Chemicals and Standards
with Methods of Assaying and Testing them, also the Preparation and Standardization of Volumetric Solutions and Extensive Tables of Equivalents By Joseph Rosin Pp x + 530 (London Chapman and Hall, Ltd, 1937) 30*s* net

THERE are comparatively few books which deal with the standards and specifications for chemical reagents and, if only for this reason, the treatise under review would be acceptable, it is, however, doubly welcome in that it provides the most complete treatment of the subject hitherto produced Nearly five hundred substances are listed, these including many of the newer organic chemicals and indicators Assays are provided in most cases for the major constituent as well as for the likely impurities, while tables are given of the maximum tolerance permitted for the latter There is also a useful section on the preparation and standardization of volumetric solutions, together with extensive tables of equivalents and gravimetric factors

A Note-Book of Tropical Agriculture
Compiled by Prof R Cecil Wood Second edition Pp iv+147 (Trinidad Imperial College of Tropical Agriculture, 1937) 5*s*

THIS is a small book that can be wholeheartedly recommended It is a development of a small compilation which the author made while he was in India, and now he has added the results of his experience in Africa and in the West Indies Of course, many of the data given have no special reference to the tropics but the really valuable part of the book is that dealing with tropical materials and especially with tropical crops, about which it is somewhat difficult to get information The book cannot fail to be of value to all who are proceeding to positions connected with agriculture in any part of the tropics H H M

Florae Siamensis Enumeratio
a List of the Plants known from Siam, with Records of their Occurrence By the late Prof W G Craib Edited by A F G Kerr Vol 2, Part 4 Vacciniaceæ to Styraceæ Pp 311–393 (Bangkok The Bangkok Times Press, Ltd, London Luzac and Co, 1938) 7 tcs, 12*s* 10*d*

STUDENTS of Asiatic botany will welcome the appearance of Vol 2, Part 4, of this work The Enumeratio was commenced in 1925 by the late Prof G W Craib, and since his death Dr A F G Kerr has carried on the work

The present volume, which is arranged on the Bentham and Hooker system, contains the families Vacciniaceæ to Styraceæ A glance at the names of the collectors and of the authors of new species shows how greatly we are indebted to Prof Craib, Dr Kerr and their co workers for our knowledge of the flora of Siam The issue of further parts will be awaited with interest

Nationalism and the Communal Mind
By Dr E Hanbury Hankin Pp xv+199 (London Watts and Co Ltd, 1937) 7*s* 6*d* net

DR HANKIN S approach to the problem of nationalism and his examination of the causes which underlie the sporadic and periodic outbursts of this expression of the communal mind, are of considerable interest to the anthropologist and the alienist Like other inquirers, he traces it to the blood bond, but in a different sense He associates it with the group of customs of primitive peoples at the head of which are cannibalism head hunting and the like, and behind which are the magical or mystical conceptions of assimilation of power, whether from enemy or friend In support of the contention that primitive ideas of this type may survive deep down in the subconscious of the communal mind, the sporadic resurgence of cannibalism and other forms of the blood lust would appear to lend a measure of support

Die Leuchtmassen und ihre Verwendung
eine Einfuhrung in Fluoreszenz und Phosphoreszenz der festen Körper Von Dr Henriette Rupp Pp vi+163+2 plates (Berlin Gebruder Borntraeger, 1937) 8 gold marks

PHOSPHORESCENCE has so many modern applications and is of such fundamental significance in connexion with the theory of the solid state, that the appearance of this well written and comprehensive account of it is very welcome Dr Rupp describes the methods used to excite and analyse phosphorescent light, and gives an outline of the principal uses of phosphorescent bodies and the theories of phosphorescence Her book is particularly valuable from the orderly way in which phenomena are classified, permitting of quick reference to any particular aspect of the subject, and for the detailed accounts provided of the preparation of some materials of technical importance It includes a short history of phosphorescence, and a bibliography of recent publications

Oceanography and the Fluctuations in the Abundance of Marine Animals*

By Dr Stanley Kemp, F R S

A MOST important feature of animal life in the sea is the constant occurrence of large variations in abundance and these though they may not be greater appear to be more general in their incidence than in land animals One year may be exceptionally favourable with production far above normal to be followed perhaps by several years of scarcity and it is not uncommon to find that fish belonging to one year class are fifty times as numerous as those of another It is on these great variations in abundance that fishery prediction is based

Some very valuable information on fluctuations in year classes of fish has recently been collected by the International Council for the Exploration of the Sea The object of the Council was to summarize data on good and bad survival years in some of the principal food fishes and the reports from the specialists who were appointed to undertake the work are of particular interest For some fish the available information was found insufficient but for cod haddock herring and plaice the data are adequate at least for some areas The results show that in different parts of the north east Atlantic there are with rare exceptions no coincidences in good or bad spawning seasons even if one species only is considered and the evidence thus is that the fluctuations which are observed are regional in their incidence

Of recent years however it has become increasingly apparent that in addition to the annual fluctuations there are other over riding influences at work which not only affect the abundance of marine animals but also may bring about great changes in their distribution For the past thirteen years Mr F S Russell has been studying the young fish taken in the plankton at Plymouth and has made regular collections by standard methods in the neighbourhood of the Eddystone He finds that from 1931 onwards there has been an alarming decrease in the abundance of larval fish At first this decrease occurred in the comparatively small number of summer spawning fish but it has now extended to the spring spawning fish also If we compare the average numbers for the four year period 1934 37 with those for the same period ten years ago 1924–27 we find that the larvæ of summer spawning fish have now been reduced to little more than one fifth of their former abundance while the numbers of the young of spring spawning fish have dropped to one third It is particularly to be noted that all species of fish are similarly affected and bearing in mind the evidence I have already mentioned on good and bad survival years this fact alone is sufficient to show that the decrease is not due to a chance coincidence in annual fluctuations

This change which has come about in recent years is unfortunately apparent also in the Plymouth herring fishery which has declined to such an extent that it is now virtually non existent As with herring fisheries elsewhere the catch has shown marked fluctuations—the seasons 1924–25 1927 28 and 1929 30 were much above the average These however are normal annual fluctuations and they are due as Mr Ford has shown to the great abundance of five year old fish there were specially successful spawning seasons in 1920 1923 and 1925

The significant feature is however the marked change in the composition of the catch which began in 1931 32—that is to say in the winter of the year in which the summer spawning fish larvæ showed their first signs of decline Prior to 1931–32 the younger herring not more than six years old always formed at least two thirds of the catch In that season the younger fish were only 52 per cent of the total and from then on there has been a rapid deterioration until to day there are less than 20 per cent of the younger and more than 80 per cent of the older

The change found by Mr Ford in the constitution of the herring shoals was not immediately reflected in the size of the catches which for some years were maintained at a good level by the considerable stocks of older fish But as these passed out they were not replaced by any adequate numbers of the younger year classes and in recent years the fishery has been profoundly affected Formerly the number of Lowestoft drifters which visited Plymouth for the herring season rarely fell below 75 and was sometimes well over 100 during the past season only one came

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*From the presidential address to Section D (Zoology) of the British Association, delivered at Cambridge on August 18. The complete address contains several tables of data upon which the argument is based.

It is interesting and perhaps significant to note that, as Mr G P Farran has shown the stock of herring on the north coast of Donegal has shown a pronounced decline in recent years The decline began in 1930, some eighteen months before the change in the constitution of the Plymouth shoals was first seen and the industry based on this fishery has suffered greatly Mr Farran tells me however, that the shortage of herring in recent years has been accompanied, just as at Plymouth, by a great reduction in the numbers of the earlier year classes and it is thus possible that the same long period fluctuation is affecting both areas

FACTORS IN LONG-PERIOD FLUCTUATIONS

Since 1931, when the depression in the Plymouth area began there has been a marked change in the amount of phosphate in the offshore waters Records made by Dr W R G Atkins and Dr L H N Cooper show that the phosphate is at its maximum in the winter in December and January, and since the phytoplankton crop is limited by the amount of phosphate in the water the winter records give a good indication of the quantity of food which will be available for fish larvæ The records show a heavy decrease in phosphate beginning in 1931 If the average values for the two four year periods 1924–27 and 1934–37 are compared, we find that the decrease has been about 35 per cent The fact that the larvæ of summer spawning fish were the first to feel the adverse conditions and that those of the spring spawning fish were not seriously affected until 1935, can in theory at least be explained in terms of nutrient salts a reduced crop of phytoplankton will mean a smaller supply of zooplankton and this will mostly be consumed by the spring larvæ leaving little or none for those that come later in the year

Renewal of the phosphate in the Channel appears to be largely dependent on an inflow of mixed Atlantic water which is rich in phosphate because it contains water that has upwelled at the edge of the continental shelf and it seems probable that the normal water movements off the mouth of the Channel have undergone marked alteration in recent years Direct proof of this is lacking, for we have no observations in the waters to the west of the Channel but evidence of it is afforded by the very interesting discovery which Mr Russell has made that certain planktonic species may be used as indicators of water masses A relation of this kind has been found in a number of plankton species, but it is here only necessary to refer to those belonging to the genus *Sagitta*, and these owing to their abundance are the most useful

Of the species of *Sagitta*, *S serratodentata* is typical of the open Atlantic, *S elegans* of the mixed Atlantic water and *S setosa* of the Channel water The first of these is only to be found on rare occasions off Plymouth when the inflow of Atlantic water is exceptional Mr Russell's data only began in 1930, and the records are therefore not as complete as could be desired It is however, known that for some years prior to this date the offshore plankton in the neighbourhood of Plymouth was of the kind characteristic of the mixed Atlantic water it was a very rich plankton with such forms as *Meganyctiphanes* and *Aglantha* It was this type of plankton which was found in 1930 and in the regular series of tow net hauls made in that year, Mr Russell found that there was 94 per cent of *S elegans* and only 6 per cent of *S setosa* In the following year when the deficiency of phosphate and of summer spawning fish larvæ first became manifest, there was a conspicuous change in the *Sagitta* population of *S elegans* there was only 17 per cent, while there was 83 per cent of *S setosa* Since then *S setosa* has always greatly preponderated in the catches with a percentage of 93 or more with the single exception of 1936, when there was 60 per cent of *S setosa* and 40 per cent of *S elegans* There is no doubt there was a small incursion of mixed Atlantic water in the Channel in this year, but it was apparently insufficient to alter the trend of events

We thus have evidence from four separate sources of the changed conditions which have prevailed in the Channel since 1930–31 These sources are (i) the winter phosphate maximum, (ii) the numbers of fish larvæ, (iii) the constitution of the spawning herring shoals, and (iv) the predominance of one or other species of *Sagitta* The picture, to my mind at least, is convincing one gains the impression that if only we had fuller knowledge corroborative data from many biological sources would be forthcoming

We may suppose that this long period fluctuation at the mouth of the Channel will end in due course but we have no means of knowing when this will happen When the change comes it will be heralded, we believe, by the return of *Sagitta elegans* in large numbers, and by a marked increase in the winter phosphate maximum The fisherman will presumably not find any immediate improvement in the bottom fish As yet he has perhaps scarcely realized the full extent of the depression which started some years ago, and when there is a return to better conditions, he must wait until the increased numbers of larvæ grow to fish of marketable size It is possible, however, that bottom living fish have been migrating into the area and that he may thus in some measure escape the worst effects of the depression If the younger herring have forsaken their spawning grounds and gone elsewhere we may hope that they will at once return in force when conditions improve and that the Plymouth fishery will rapidly be re established If however they have throughout held to their former migration routes and the present dearth is due to lack of suitable conditions for the larvæ, they are in the same position as the bottom fish and a number of years must elapse before the fishery can be resumed

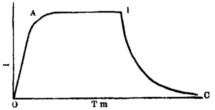
(*To be continued*)

Luminescence

An important series of discussions arranged by the Faraday Society took place in the Biochemical Theatre of the University of Oxford on September 15–17 on the subject of Luminescence A more appropriate time for the discussion of work in this field could scarcely have been chosen and in spite of recent events a surprisingly large number of visitors from overseas was present The discussions were formally divided into three parts luminescence of vapours liquids and solutions luminescence of solids chemiluminescence The subject of luminescence is of particular interest at the present time for two reasons First it forms an excellent testing ground for some of the more recent theories particularly with respect to the physical properties of solids and the nature of chemical reactions Secondly a good deal of stimulation has been given by the technical interest in the subject The use of fluorescent solids in discharge tubes as a means of modifying the colour of the light or increasing the efficiency of such devices is undoubtedly leading up to new work of interest and contributions to the meeting were made by more than half a dozen industrial laboratories

The first two parts of the discussion dealt essentially with the absorption of radiation by matter and its emission in the form of light the final section was concerned however with the radiations emitted as a result of chemical reactions The now classical experiments of Polanyi and his collaborators on the characteristics of the reaction between streams of halogen and sodium vapour at low pressure are a specially interesting example of chemiluminescence in that they are providing the basis for theoretical work in this field

A valuable feature of the earlier parts of the meeting was the way in which ideas concerning the precise meaning of the terms fluorescence and phosphorescence were brought out If a luminescent compound is first illuminated at *O* (see accompanying graph) with radiation of constant intensity, an appreciable time may elapse before the luminescence reaches a constant value as along *AB* If the exciting radiation (for example ultra violet) is removed at a time corresponding to *B* a rapidly falling curve of intensity *BC* follows Many and in fact most of those engaged in experimental work in this field have usually referred to the part *AB* as fluorescence and the part *BC* as phosphorescence This usage is undoubtedly convenient from the experimenter s point of view since the time constant of the luminescence has usually been measured during the period *BC* It has of course been realized that the electrons returning to the ground state during the equilibrium period *AB* do so only after a finite and possibly considerable time after the absorption process It was suggested in the course of the discussion that definitions based on the type of electron transition would be more fundamental than those already described On this basis the term fluorescence should be reserved for all processes in which electrons are returning from *excited* energy states of parent atoms and the term phosphorescence used only in those cases where the luminescence is dependent on temperature and is a result of electrons being involved in metastable states or completely removed from the parent atoms It is likely that the older definitions will continue to be used on account of their convenience and because of insufficient data concerning processes Further progress along these lines can only be made by a study of the time dependent effects of luminescence and the corresponding photo conductivity properties



Very many substances both liquid and solid are capable of absorbing some part of the ultra violet spectrum but comparatively few are luminescent It is to be assumed that the non luminescent substances convert this absorbed energy into heat in the form of elastic vibrations of much smaller quanta than visible light, and the important theory of Peierls developed some years ago on the problem of radiationless transitions in solids is now receiving much attention This problem of radiationless transitions is of obvious importance to all branches of the subject In liquids and solutions, for example the fluorescence may be 'quenched' by increasing concentration of the luminescent centres, or by the addition of oxygen The problems associated with the quenching of luminescence by a close coupling between the excited molecules and the surrounding solvent on one hand, and the question of internal quenching on the other, were made clearer by pictorial representation in intersecting curves of potential energy as a function of atomic or molecular separation The work on liquids is concerned chiefly with organic solutions and the complexity of the problem involved is shown by the fact that some organic solids show a large drop in the quantum efficiency of fluorescence when put into solution, while others show an equally sharp rise

Almost a whole day was given up to the discussion of luminescence in solids and on the whole this was the most successful feature of the meeting It is now clearly recognized that there are two chief classes of luminescent solids The more restricted class contains pure solids and it is sometimes possible to recognize these by the fluorescence of their solutions , notable examples of this kind are the uranyl salts the platinocyanides, and certain rare earth compounds The fluorescence in the first two examples appears to be associated with co ordination groups , in the rare earths the sharp line spectra are connected with transitions within the 4*f* shell, but it has not been explained why only certain of the rare earths are fluorescent

Most luminescent solids, however, owe their properties to the deliberate addition of some impurity But between the two well defined groups of pure and deliberately impure solids are a number of others, the cause of luminescence in which is still in some doubt Zinc oxide, for example fluoresces in the near ultra violet with an easily recognizable spectrum and while it is assumed that the luminescence is linked up with the 'self impurity of excess zinc, no direct proof of this has yet been obtained The presence of *foreign* metal atoms in a solid may be made a matter of direct spectroscopic or chemical test, but other means will have to be adopted in cases such as that of zinc oxide Calcium tungstate is also fluorescent when free from other metallic impurities, and it has been suggested that the WO_4 co-ordination group is of fundamental importance to the luminescence , it may well be, however, that the excess or defect of one of the lattice constituents has a bearing on this problem also 'Pure' zinc sulphide presents a problem of even greater difficulty Zinc sulphide has been prepared by several workers during the last few years in a state apparently free from foreign metallic impurity, and the fluorescence is a bright blue The precipitation of zinc sulphide free from oxide is, however, a matter of great difficulty if not impossible, and experiments have yet to be carried out to prove whether the luminescence is a property of the pure ZnS lattice or of a lattice containing (*a*) excess zinc or (*b*) some oxygen replacing sulphur atoms These points have been mentioned merely to indicate that the problems of interpreting the luminescence of solids are by no means confined to the theoretical side

The discussions at Oxford showed also the importance of low temperatures in the investigation of luminescence in solids The spectra are apart from a few exceptions generally of a continuous nature at room temperature The use of temperatures in the neighbourhood of 90°–20° K has shown that many new features may be brought out, either in resolution, or in the comparison of various substances with a common activator In quite a number of solids luminescence is apparent only at these low temperatures The difficulties of measuring the absorption spectra of solids in powder form are well known, but the discussion brought to light a new technique that will doubtless be of value in this field Single crystals will, when obtainable, be of value, but the distinction between surface and volume luminescence was emphasized as a point of importance

The theoretical aspects of this part of the discussion were of value in making clear the advance in ideas from the rather restricted zone theory as applied to semi conductors a few years ago On this theory the sharp energy levels of an isolated atom were converted in the solid to a series of possible energy bands, separated by 'forbidden regions In a pure insulating solid, it might be possible to raise an electron from the highest full band to the next possible empty band When this happened, the electron would be free to move through the crystal under an applied field , such a case would correspond to the ionization of the parent atom, and the recombination of the electron with its positive 'hole' would give rise to the emission of radiation The advance in theory is concerned with a possible series of excitation levels lying between the highest full band and the lowest conduction band The 'forbidden' zone on these ideas no longer exists in simple form, and it is possible, as might be expected, to excite electrons in solids without making them free for photo conduction An important feature of the newer theoretical ideas is that it should be possible to distinguish between excited and ionized atoms in the solid by tests on photo conduction and on phosphorescence In the simplest cases the phosphors with a hyperbolic decay law should be photo conducting, while those with exponential decay laws should not The well known high efficiency of alpha particle excitation of luminescence in zinc sulphide phosphors, it was pointed out, is not due to the absorption of energy by the whole lattice and its subsequent transfer to the activating impurity atoms, but to the production of numbers of fairly high energy electrons (δ rays) colliding directly with the impurities

The last part of the meeting was occupied with chemiluminescence, which is usually concerned with the production of light during chemical reactions, more recently, it has been shown that some reactions produce feeble radiations in the far ultra violet Bioluminescence is now generally regarded as a chemiluminescence in which the luciferin is oxidized in the presence of molecular oxygen and the enzyme luciferase The work of Polanyi and Evans on sodium and chlorine vapour reactions is typical of one type of chemiluminescence and indicates that the production of light is a consequence of the following steps

$$\begin{aligned}
\mathrm{Na} &+ X_2 = \mathrm{Na}X + X\\
X &+ \mathrm{Na}_2 = \mathrm{Na}X^* + \mathrm{Na}\\
\mathrm{Na}X^* &+ \mathrm{Na} = \mathrm{Na}X + \mathrm{Na} + h\nu
\end{aligned}$$

where X is Cl Br or I, rather than one involving a neutral halide molecule and an excited sodium atom Bawn has recently extended this type of work to reactions involving organic halides such as CH_2Cl_2, $CH_3CCl_2CH_3$, etc

The other type of chemiluminescence to be discussed was the oxidation process appearing in the luciferin reaction already mentioned, the oxidation of the Grignard reagents the dimethyldiacridylium salts and many others Two methods of approach were apparent at the discussions Weiss adopted the more physical method and discussed the cases where the chemiluminescence can be regarded as the reverse of photochemical dissociation ($A + B \rightleftharpoons AB + h\nu$) and the quantum conditions associated with this type of reaction Drew, on the other hand has attacked the problem of chemiluminescence in the phthalic hydrazides from the purely chemical point of view of investigating the reactions that lead to their formation, the effects of the nature and position of substituents, and the interaction of the hydrazides with hydrogen peroxide

The discussions as a whole were of value in making clear the precise nature of some of the important problems to be solved and both the official meetings, and the more informal exchanges of views that inevitably take place on occasions of this kind played their part

J T Randall

The State and Medical Research in Great Britain*

THE annual Harveian Oration was delivered by Sir Edward Mellanby, secretary of the Medical Research Council, on October 18 at the Royal College of Physicians, London, the subject of his discourse being "The State and Medical Research"

Sir Edward first paid a tribute to Harvey, who "stands out as one of the greatest investigators, and his work—a wonderful combination of observation and experiment—is an example of the finest achievement of the human mind" Harvey's election in 1630 as physician in ordinary to Charles I brought him into close association with the head of the State, and one result of this association was permission to make use of deer and other animals in the royal demesnes for study—probably the first instance, with certain legendary exceptions, of State support for medical research Harvey's example has induced more and more individuals to take up research, and the revolutionary changes in medicine during the past sixty years only increase the appreciation of his foresight and skill These revolutionary changes include the introduction of new methods for the diagnosis, treatment and prevention of disease, the enormous increase in hospital accommodation the formation and development of the clinical laboratory and radiological department and the expansion and multiplication of the public health services

Increase of knowledge has been mainly responsible for these developments and it has come to be realized that health and disease are not conditions conferred upon man for his humble acceptance, but that by a certain method (Harvey's method) disease may be controlled and death itself warded off, and more and more men and women proceed to investigate and to accumulate knowledge

The acceptance in Great Britain of the new urge for research has been comparatively recent The late Earl Balfour said in 1896 "I have all my life been an ardent believer in a cause which is often laughed at—the cause of the endowment of research I think there is no branch of knowledge in which it may find a more useful field of application than in that of advancing medical knowledge " Again, in 1900, Earl Balfour pointed out how meagre was the equipment for medical research in Great Britain compared with Germany, France, Switzerland and Italy Medical research in these countries was undertaken for its own sake, and not necessarily for the elimination of disease though the leaders of industry there and in the United States soon realized that it was to their advantage to devote some expenditure to the furtherance of research

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* Substance of the Harveian Oration before the Royal College of Physicians, delivered by Sir Edward Mellanby, K C B F R S on October 18

It has been said that Great Britain needed the stimulus of the Great War to realize the importance of research, resulting in the setting up of the Department of Scientific and Industrial Research in 1915 Actually, the Medical Research Committee came into being somewhat earlier, in 1913, under the National Health Insurance Joint Commission, to administer funds provided by the National Insurance Act of 1911 This arrangement terminated in 1919, and in 1920 the Medical Research Council took the place of the Committee, funds for the work of which were provided directly from the Treasury in the form of a Parliamentary grant in aid

Sir Edward Mellanby then discussed the possible sources that might be anticipated for the endowment of research, medical or industrial Had funds, private or otherwise not been available, such men as Darwin, Newton, Humphry Davy and Faraday could scarcely have pursued their work and made their discoveries On the other hand, it is true that some of the best work has been done by those labouring under conditions of extreme simplicity, notable instances being those of Claude Bernard and Louis Pasteur Endowment of research, medical or industrial, by private individuals has been the exception in Great Britain, but the American record in this respect during the past twenty years has been a fine one, and the extensive support given to British medical research by the Rockefeller Foundation may prove a stimulus to private munificence here, of which the Nuffield scheme at Oxford is possibly an indication

The ability to discover, Sir Edward remarked, is present in all grades of society , but the real discoverer is rare in all classes, and it should be the object of civilized communities to find him and to foster his activities Failing adequate private endowment, all will agree that there is justification in Great Britain for State support for research State support must, however, be associated with State control, a condition disagreeable to many owing to the fear of loss of freedom for the investigator History, however, has clearly demonstrated that State endowment is compatible with the best type of medical research, and indeed Sir Edward stated that one of the main objects of his discourse was to show how State control of medical research can be associated with freedom to the investigator

It is true that State control may have certain dangers, such as political influences, implicit in any State activity , not only has political influence been absent, but even political interest has been uncommon in the affairs of the Medical Research Council While Parliament possesses ultimate control, the Council has been given great latitude in its policy and finance, and the disposal of the funds supplied is at its complete disposal Of the present eleven members of the Council, eight are chosen for their scientific and medical attainments, each one approved by both the Lord President of the Privy Council and the president of the Royal Society political influence has had no detrimental effect upon the medical researches controlled by the Council A safeguard against bias and dictatorship on the part of the Council is the fact that there is constant change of personnel, each individual term of office being limited to four years

The appraisal of a new discovery is clearly difficult and mistakes are inevitable from time to time, it is seldom in the facts of a discovery, but rather in their interpretation, that mistakes are made, and in the Council's work more mistakes are due to benevolence than to harshness

After this statement of the case for State support of medical research, and vindication of its impartiality in Great Britain, Sir Edward proceeded to describe the general principles guiding the actions, and the work, of the Medical Research Council For general guidance of detailed work, the Council relies on the advice of special committees, of which there are twenty-seven at present, some being appointed conjointly with other bodies, for example with the Royal Society of Medicine (anæsthetics), the Lister Institute (vitamins), the British Empire Cancer Campaign (radiology) and others The Industrial Health Research Board, a subsidiary of the Medical Research Council, also receives advice from committees dealing with its problems The services of all members of these committees are given voluntarily Sir Edward also paid a tribute to the willing co-operation of the Royal Colleges of Physicians and of Surgeons

With regard to finance, the present annual income of the Council amounts to about £220,000, of which the State contributes £195,000, a sum that has recently been criticized as being meagre in view of the possibilities through research of the reduction of expenditure on the country's toll of sickness, which costs the Government between 200 and 300 million pounds annually In addition, private funds held by the Council contribute £13,000 per annum, and a sum amounting to £12,000 is derived from grants made by certain bodies for special purposes, including the Rockefeller Foundation, the Leverhulme Trustees, the British Empire Cancer Campaign and others

The principal factor limiting research activity is personnel, and one of the endeavours of the Council is to increase the number of research workers, but more funds will be necessary when more trained investigators become available Some system is also required for financing sudden important calls for organized research when these arise

The Council has also established and maintains the National Institute for Medical Research at Hampstead and Mill Hill, supports a growing number of research units both clinical and laboratory, and provides grants for individual workers At the National Institute for Medical Research, under the direction of Sir Henry Dale, work is done in two main divisions, one including researches coming under physiology, pharmacology, and biochemistry, the other those under experimental pathology and bacteriology Here in addition to research, the standardization of biological products, such as antitoxins, certain drugs, vitamins, and hormones, is undertaken, whereby the exact strengths of these products may be described in terms of units, and the doctor is thus able to prescribe known amounts of their active principles

The Medical Research Council also maintains at the Lister Institute a National Collection of Type Cultures, so that any medical man in the world can obtain at nominal cost a culture of almost any known micro organism At the Pathological Laboratory of the University of Oxford a Standards Department is maintained, from which preparations of bacterial suspensions and sera are supplied for use in the diagnosis of diseases, such as enteric and undulant fevers, and dysentery

The placing of units of research in different institutions has developed with much success in recent years The Council provides the salaries and the actual cost of the research the institution furnishing the accommodation There have thus been established the neurological research unit at the Hospital for Diseases of the Nervous System, Queen Square London, the research department on puerperal infections at Queen Charlotte's Hospital, London, the clinical research department at University College Hospital, London, and others Research grants to individuals are also made, such personal grants being usually limited to three years, and the worker is given full freedom to develop his problem A third activity of the Council is the award of travelling fellowships in research, and a number of the younger medical men of Great Britain have been past holders of those fellowships Assistance is also given to Government departments on problems of health and disease

After some remarks regarding initiative in research, and a reply to criticisms respecting the type of medical research supported by the Council, Sir Edward Mellanby had something to say about the future, observing that the difficulty he foresaw was not that of obtaining knowledge, but of its application to human needs He concluded his oration by pointing out that it is the function of the Medical Research Council to promote discovery, not to implement its application He made an appeal to the Royal College of Physicians of London suggesting that the College as a body and through its fellows and members might use its prestige and influence in guiding the profession and the public to appropriate action if such be needed, when scientific discovery has supplied new knowledge of importance to public health Finally, he submitted that the entry of the State into the field of medical discovery has been both stimulating and fruitful

Obituary Notice

Sir Basil Mott, Bart, C.B, F R S

BY the death of Sir Basil Mott on September 7, a pioneer in engineering practice, the Royal Society loses one of the few engineers who have been admitted to its fellowship He formed a link—one of the very few remaining—with those great figures whose names became almost household words in the latter part of the nineteenth century as the creators of outstanding engineering works—Benjamin Baker, Wolfe Barry, Charles Hawksley, Douglas Fox and others When a young man he gained experience, as a mining engineer, in work underground, which was invaluable in the pioneering work involved in deep tunnelling with the Greathead shield, the use of which has revolutionized the solution of transport problems in crowded cities The first use of this method on a large scale was in the construction of the City and Southwark Subway', which formed the first part of the 'City and South London Railway' and was taken in hand in October 1886 Basil

Mott became assistant to Greathead on this work and, so much was his skill and energy relied on, that he became Greathead's partner. He had the further valuable experience of operating the railway for the first eighteen months after it was opened in December 1890.

The difficulties attendant on maintaining electric traction underground—the first time that this had been attempted—were such as to call forth to the utmost Mott's natural ingenuity and resource, and this experience proved invaluable when, some years later, he joined Sir Benjamin Baker for the construction of the Central London Railway, the first Twopenny Tube from Shepherd's Bush to the Bank which was opened in 1900. These works and others which followed were the means of establishing the practice of deep tube tunnelling as an engineering method, and the process was thereafter applied in many other cities throughout the world, where it is probable that the public who make daily use of the transport facilities provided, have little recollection of what they owe to British engineering practice in general, and to Greathead, Baker and Mott in particular.

Mott was, however, a civil engineer in the widest sense, and there are few branches of the profession in which at one time or another he did not exercise his skill. For example, he gained an outstanding reputation as a great bridge builder. He was responsible, at first in partnership with Benjamin Baker and later in sole charge, for the widening of the Blackfriars Bridge, completed in 1909. In later years, with his partners in the firm of Mott, Hay and Anderson, he was responsible for many important bridges, the Queensferry Bridge at Chester, the Wearmouth Bridge at Sunderland, Boothferry Bridge near Goole, the Newport Bridge, the Tees Bridge at Middlesbrough, and the Tyne Bridge at Newcastle, completed in 1928. Possibly the greatest of the works with which he was associated and one which very fully absorbed his time and energies in his later life, was the Mersey Tunnel, connecting Liverpool and Birkenhead, the largest under-water tunnel in the world, completed in 1934.

During the Great War, Sir Basil rendered notable service to the Government in many directions, visiting both France and India. For his services he was made a C.B. Later, his experience was of great assistance to the Ministry of Transport in connexion with the Charing Cross Bridge scheme. He also gave advice on the Channel Tunnel project and the Severn Barrage. In 1925 he was chairman of a committee of engineers and architects which took the necessary steps for the preservation and safety of St. Paul's Cathedral.

Sir Basil was born on September 16, 1859, and was educated at Leicester, in Switzerland and at the Royal School of Mines, where he won the Murchison Medal. He became a member of the Institution of Civil Engineers in 1895 and was president of the Institution in 1924. He was elected to the Royal Society in 1927, and was also an associate of the Royal School of Mines, a fellow of the Imperial College of Science and Technology and a member of the Société des Ingenieurs Civils de France. He is succeeded in the baronetcy, conferred on him in 1930, by his eldest son, Adrian Spear Mott.

CLEMENT D. M. HINDLEY.

We regret to announce the following deaths:

Prof. L. S. Dudgeon, C.M.G., C.B.E., professor of pathology in the University of London and dean of St. Thomas's Hospital Medical School, on October 22, aged sixty-two years.

Sir Robert Mond, F.R.S., known for his researches in pure, applied and electro chemistry, and for his archæological investigations in Egypt, Palestine and elsewhere, on October 22, aged seventy-one years.

News and Views

Mr. Sidney Smith

Mr. Sidney Smith, whose appointment to the recently instituted chair of Near Eastern Archæology in the University of London (Institute of Archæology) is announced (p. 806), has been keeper of the Department of Egyptian and Assyrian antiquities in the British Museum (Bloomsbury) since 1930, when he succeeded the late Dr. H. R. Hall. Mr. Smith was educated at the City of London School and Queens' College, Cambridge, of which he was a scholar and is now an honorary fellow. He took the Classical Tripos in 1911, and proceeded to Berlin for further study in 1912. In 1914 he was appointed an assistant in the British Museum, but during the Great War he was commissioned in the Middlesex Regiment, and while on active service was mentioned in dispatches. On his return to the British Museum he continued his studies of cuneiform texts, and between 1921 and 1927 published a number of volumes of texts from Cappadocia, as well as from the Babylonian historical records. In 1921 he also published an account of the first campaign of Sennacherib. Mr. Smith was a member of the British Museum's expedition excavating at Ur in 1922–23, and in 1929–30 he served as director of antiquities in Iraq. Among much other work, Mr. Smith has contributed to the Cambridge Ancient History, and initiated and edited *Iraq*, the publication of the British School of Archæology in Iraq. Since 1923 he has been lecturer in Assyriology at King's College, London.

Prof. D. H. Robertson

Dr. D. H. Robertson has been appointed to the Sir Ernest Cassel chair of economics, with special reference to banking and currency, tenable at the London School of Economics. He will take up his duties on January 1, 1939. The Sir Ernest Cassel chair of economics, instituted in 1920, was previously occupied by Prof. T. E. Gregory, who resigned in December 1937 to take up the office of economic adviser to the Government of India. Dr. D. H. Robertson is at present reader in economics in the University of Cambridge, and has been a fellow of Trinity College since 1914. His work on industrial fluctuation and on the theory of money has given him an international reputation, recognized by the conferment on him of honorary degrees by the Universities of Amsterdam and Harvard. He has been a member of the Economic Advisory Council since 1936. He co-operated with Prof. A. L. Bowley in the Economic Survey of India, 1934. Among his published works are "A Study of Industrial Fluctuations" (1915), "Money" (1922), and "Banking Policy and the Price Level" (1926).

New Wing of Queen Mary College, London

On October 12, the Chancellor of the University of London formally opened the new west wing of Queen Mary College which has been erected upon the site of the Winter Garden of the old People's Palace. The spacious Zoology Department, fully equipped for modern requirements, occupies the top of the new wing and apart from the usual laboratories, museum, etc., possesses a special aquarium room with marine and freshwater aquaria, and two animal rooms. The removal of the Arts Departments to the lower floors of this new wing has provided room for considerable extensions of the Departments of Botany, Geology and Physics, which occupy the east wing, although the completion of the Physics Department awaits the third and final phase of the building programme. The College is now provided nearly throughout with up-to-date modern laboratories, several of which are equipped for special lines of research. In declaring the new buildings open, the Chancellor expressed the hope that funds would soon become available for completing the building programme of the College.

Rothamsted Centenary: Inaugural Meeting

While the experimental fields at Rothamsted are probably the best known and the most interesting in the world, the laboratories, farm buildings and equipment are admittedly not up to the standard of many of the Continental or American stations and do not allow of anything like so much scientific assistance to the farmer as should in these difficult times be available. The Committee of Management is taking advantage of the approaching centenary to remedy these various deficiencies and is hoping to raise a fund of £125,000, of which £80,000 would be used for buildings and equipment and £45,000 for addition to endowment so as to provide for upkeep of fabric and salary augmentations. The work will proceed in three stages. The first is the building of the new chemical and bacteriological laboratories, pot culture houses and farm buildings; this will cost about £45,000, of which, however, only £30,500 is drawn from the centenary fund, the remainder being provided by the Ministry of Agriculture. The second stage will be the building of the library at a cost of £20,000, and the third the erection of a new block to house the Imperial Soil Bureau, the Statistical Department, the administration and extension staff, a conference hall and staff common rooms: this will cost about £30,000. It is hoped to complete all three parts before the centenary occurs in 1943; hence the work is being put in hand as early as possible. This is being done partly also for the convenience of those who wish to spread their donations over a period of years. The scheme is being inaugurated at a meeting to be held on November 1 at the Royal Society's rooms, when His Royal Highness the Duke of Kent will preside, and when it will be announced that His Majesty the King, through the Duchy of Cornwall, will open the subscription list.

Tide Mills of England and Wales

In a very well illustrated lecture to the Newcomen Society on October 12 entitled "The Tide Mills of England and Wales", Mr. Rex Wailes gave a survey of all the mills of which he had been able to find any traces. In the course of two years he had visited the sites of twenty-three mills and of these ten were still worked by the tides. Starting with the county of Suffolk he described the mill at Woodbridge on the Deben Estuary, first mentioned about 1170. This mill is served by a 3,100,000 sq. ft. pond with a six-foot head. The water wheel is 20 ft. in diameter and 5 ft. 10 in. in width and it is mounted on a 22 in. square oak shaft. It drives four pairs of mill stones controlled by a single pair of governors, the only instance of its kind. There are early references to several tide mills in London, but the only ones at work are at the Three Mills Distillery, Bromley-by-Bow. Here in the House Mill are four water wheels, and in the Clock Mill, three water wheels, all about 20 ft. in diameter, driving in all eighteen pairs of stones for grinding maize, barley and other cereals for the production of spirits. The mills are semi-tidal, being worked as the water flows outward from the River Lea. Other mills still working are at Stambridge, in Essex; Beaulieu and Eling in Hampshire; Carew and Pembroke in Wales; and Emsworth in Sussex. The paper is printed and illustrated in *Engineering* for October 14.

Associated Learned Societies of Liverpool

The triennial public exhibition and soirée organized by the Associated Learned Societies of Liverpool and District to illustrate the progress in science and education since their last exhibition in 1935 was held in the City Technical College on October 22. During the course of the exhibition, Prof. E. W. Marchant gave a lecture on 'Television', H. Kendrick on "Changing India", W. H. Watts on "The

Moon , D Caradog Jones on The Changing Population of Merseyside Prof J T Craig on Veterinary Pathology , and a number of shorter talks were given in the individual rooms The Institute of Chemistry and the Society of Chemical Industry exhibited process demonstrations of artificial silk spinning, products obtainable from cotton seed, demonstrations of the action of dirt particles under the influence of electrical forces dyeing and armour plate glass , the British Association of Chemists exhibited a combined temperature and humidity recorder smoke density determination apparatus and samples from the plastics industry The Liverpool Biological Society s room included a demonstration exhibit by Prof J H Orton on his Dee fisheries work Dr R J Daniel on pearl formation and Mrs Bisbee on the ductless glands Mr Eric Hardy had arranged a special Country Side Room with Nature films photographs habitat groups of British birds and mammals bird migration (ringing) and flight (bird wing) displays illuminated natural colour lantern slides bird sanctuary devices and maps of local bird distribution The exhibition also included natural colour films an ingenious micro projector by Mr A V Wilkinson Dr Glynn Morris s geological collection and in the Engineering Society s room a trafficator for cyclists invented by Mr A Robins

Indian Adult Education

FROM the National Adult School Union we have received a copy of an appeal by its International Committee for funds to assist in the development of adult education work in India The appeal is countersigned by Mr Banning Richardson, as president of the Indian Adult Education Society and honorary general secretary All India Adult Education Conference Committee This committee has undertaken to investigate all the adult education activities which are being carried on in India and to call a conference for the early part of 1939 Annexed to the appeal is a leaflet which mentions as indicative of the character of the work now carried on by the Indian Adult Education Society the teaching of improved methods of handicrafts to undergraduates of the University of Delhi with the intention that during the vacations this instruction should be passed on to their rural relations and friends , literacy work a regular service of rural broadcasting the teaching of scholastic subjects to matriculates, who have not been able to continue their studies at a university and the giving of instruction to members in their own religion by the most capable believer in that faith available Of this last it is claimed that an improved relationship between the followers of the different religions has resulted Nothing is said about the utilization of the movement as an instrument of political propaganda, but reference is made to the fact that in the Central Provinces recently described in *The Hindu* as a thoroughly congress minded province , the Minister of Education and Vice Chancellor of the University have associated themselves with it

Royal Society of Science, Bombay

SINCE its opening in 1920, the Royal Institute of Science, Bombay, has been recognized as the foremost college in the Presidency for the training of science students The late Dr A N Meldrum the first principal and professor of organic chemistry, realized the importance of its being not merely an institution for the training of undergraduate students, but that it should also be an active centre of research He was fortunate in having the support of an enthusiastic staff and during the period of his principalship a large number of students were trained in the methods of research both in the physical and natural sciences We have now before us the triennial report of the Institute covering the years 1934–37, and we note with pleasure the continued advancement of the Institute under the energetic and enlightened leadership of its present principal Prof T S Wheeler The total number (315) of full time students is not large and of these no fewer than 94 are engaged in post graduate work which indicates the importance attached to original work

DURING the triennium dealt with in the report 159 original papers have been published of which the majority (102) come from the two departments of chemistry Whilst as is natural their contents are of varying value Prof T S Wheeler s contributions to the theory of liquids and Prof R H Dastur s work on plant metabolism have attracted widespread attention In its recent visit to Bombay, the British science delegation had the opportunity all too short of visiting the Institute and of seeing something of the work which is being so actively pursued Contrary to the experience elsewhere in India no difficulty has been encountered in finding employment for students, of whom only 0 6 per cent were unemployed, whilst 21 8 per cent had obtained industrial posts It is very much to be hoped that no considerations of economy will be allowed to weaken the activities of the Institute since to the students now under training there the industries of the Bombay Presidency must largely look for their future advancement

Acquisitions at the British Museum (Natural History)

THROUGH the kindness of the Rev I H Wilson of Inkongo in the Sankuru district of the Congo the Museum has received a female specimen of the recently discovered peacock like bird, *Afropavo congensis* This bird was first discovered by Dr James P Chapin, of the American Museum of Natural History, New York, in 1936, who found two mounted examples in the Ethnological Department of the Tervueren Museum Brussels, where they had been overlooked Later the authorities of that Museum received further specimens from the Congo Dr Chapin visited the area and his native hunters brought in two more, while he himself had a fleeting view of one bird in the forest The interesting feature of this bird is that in some of its characters it resembles the peacock a bird which is confined to Asia Specimens of diamondiferous gravels and concentrates have been received from the Geological Survey of the Gold Coast Colony, and Prof Takeo Watanabé has presented a specimen of the new mineral kotoite—a magnesium borate occurring as a rock forming mineral in limestone in Korea A magnificent group of yellow and green zoned crystals of fluor from a mine in Weardale has been purchased and the opportunity has been taken to re arrange the exhibit of fluor in the pavilion of the Mineral Gallery Mr P M Game, a member of the staff of the Department of Minerals, who recently returned from an expedition to West Greenland under the leadership of Dr H I Drever, has brought back a collection of about three hundred specimens of rocks and minerals from Ubekendt Island, Umanak Fjord, a region in which no previous geological work had been done

The Department of Botany has received two collections of plants from expeditions made by students of Imperial College The first is from Jan Mayen, and contains 427 numbers mostly collected by Mr R S Russell The collection is a very valuable one as each number usually contains ample material The Department now has practically a complete representation of the species recorded from the island, which is of special interest in view of its position in mid ocean between the Old and the New Worlds The second is from Finmark, and consists of 350 numbers of dried plants and some fungi in spirit, collected for the most part by Mr H D Jordan The specimens are mainly from the base camp area at the head of Lakse Fjord and in the still incompletely mapped hinterland, which was crossed up to a little beyond River Tana The Oxford University Expedition to the Cayman Islands obtained 678 numbers of flowering plants and 614 numbers of cryptogams for the Department, collected by Mr W Kings The specimens are well preserved, and, as the islands are little known botanically, the collection should prove an interesting one Mr C A Lister accompanied the Public Schools Exploring Society s Expedition to Newfoundland and collected 173 phanerogams and 34 cryptogams These have been presented to the Department and supplement the previous collections made in these expeditions The specimens are very well preserved The British herbarium of the late Mr F J Hanbury, which was bequeathed to the Museum, contains more than 20,000 sheets As Mr Hanbury always aimed at a large series of specimens and as he was responsible for a considerable number of records to the Supplements to Topographical Botany", the material is especially useful The chief value of the herbarium is probably in the fine collection of *Hieracium*, for Mr Hanbury began the publication of a monograph of the genus and compiled the account in the ninth edition of Babington's 'Manual", it contains the *Hieracia* of James Backhouse, the first monographer of the genus in Britain The Department has also acquired Lieut -Colonel A H Wolly Dod's collections of *Rosa* Colonel Wolly-Dod is the recognized British authority on the genus, and many of the specimens have been examined by other specialists

Philosophy and History

In the annual philosophical lecture on 'Some Problems of the Philosophy of History' delivered under the Henriette Hertz Trust before the British Academy on March 16 (London Oxford University Press 1*s* 6*d* net) Prof G C Field urged that all serious philosophical thinking must be based on an examination of the assumptions actually made in the other established forms of thinking If the philosopher wishes to proceed eventually to a general theory of knowledge or reality he must take this as his foundation and evidence Prof Field suggested that among the established forms of thinking history holds an important place and deserves serious consideration in view of the tendency to suggest that the assumptions of physical science must be the assumptions of all valid thinking History forms a coherent body of thought in which mutual understanding and cooperation between large numbers of people are possible and has independent claims to consideration as an essential part of the evidence on which our final theories must be based Prof Field distinguishes three main elements in the general structure of historical thinking imaginative reconstruction of past events or situations, the belief that this imaginative reconstruction is correct, corresponding to, or being like in some degree what really happened, and the evidence on which our conclusions are based Discussing the dependence of our historical beliefs on narrative, he referred to the question of selection in imaginative reconstruction and its bearing on the understanding rather than the mere recording of what happened

University of Manchester and its Alumni

The second number of the *Journal* which the University of Manchester has established as a means of keeping its members in touch with its activities and plans maintains the high standard of its predecessor A message and appeal to its graduates by the Vice Chancellor is followed by a number of articles of more than local or passing interest The School of History, the Physics Department, the University Settlement and Halls of Residence are discussed by Profs E F Jacob and W L Bragg, Mr Pilkington Turner and the wardens of two of the Halls Mr John Coatman North Regional director of the B B C, writing on The Significance of a Lancashire University in the Community argues ingeniously that the circumstances of to day call for a vision of international economic and political relations as clear and fruitful as that which gave Lancashire its greatness a century ago and that, to meet this need, its universities, the county s great intellectual power houses', should devote themselves increasingly to the philosophical study of the principles of human association, examination of the economic and political forces at work inside and between nations, and clear sighted, intelligible analysis of the forces which mould public opinion determine national policies, and thus in the end control international relations Furthermore, he urges that in the systems of education which come within their influence they should give an increasing bias to such studies and especially the study of the British Commonwealth of Nations, as an example of a new kind of political association between free and independent peoples, based on principles which are universally and permanently valid.

Beneficial Employment and Vocational Guidance

LOCAL education authorities will, next year, be called upon to consider applications for exemption from compulsory school attendance of children between fourteen and fifteen years of age and to determine in each case whether the employment proposed will be 'beneficial' to the child. The Board of Education has suggested to local authorities, among other measures for qualifying themselves for determining these difficult questions, the requirement of a school report indicating the child's good, average and weak subjects and information regarding manual or domestic training received, and a medical report expressing the doctor's opinion as to the types of occupation unsuitable for the child—hence a widespread stimulation of interest in the principles and practice of vocational guidance, a subject in which there has been a large amount of research in America. The United States Office of Education, with the assistance of the National Occupational Conference, has prepared bibliographies of current literature in this field and recently published a "Guidance Bibliography" (Bulletin No. 37. Washington, D.C.: Supt. of Documents. 10 cents), an annotated list of 442 books, pamphlets and periodical references classified under the headings: elementary schools, secondary schools, colleges, adult and out-of-school youth, and techniques and procedures. Information as to careers is published monthly by the National Occupational Conference in an Occupational Index.

The English Sprat Fishery

THE Ministry of Agriculture and Fisheries paper by Mr. J. Armitage Robertson on "The Sprat and the Sprat Fishery of England" (Fisheries Investigations, Series 2, 16, No. 2) deals with the economic importance of the sprat, the location of the fishery, behaviour and geographical distribution, life history, age, sex ratio and food. Even the health of the sprat is treated in a section devoted to 'parasites and disease', from which the sprat seems tolerably immune. The fishery is a localized inshore winter one, confined to the south coast and East Anglian seaboard, and is prosecuted in a variety of ways: by drift nets, stow nets, trawls and seine nets. The possibility that the shoals are 'driven' shoreward by the incursion during the winter months into the Southern Bight of the North Sea of water of a higher salinity (greater than 35 per mille) than that to which they are accustomed is discussed, but Mr. Robertson is insufficiently convinced by the available data on this point and considers "that these hydrographical conditions and the circumstances of the fishery do not bear the relation of cause and effect, but are merely due to some general and common cause such as 'Winter Conditions'." In spite of a Norwegian authority's statement that English sprats are "tough, coarse and unpalatable", Mr. Robertson finds nothing to support this, and recommends as beneficial both to the fishery and to the country the development of the already existing small sprat canning industry in Great Britain. English prices vary between 3s. and 16s. per cwt., whereas the average cost of imported canned brisling, mostly from Norway, is £6 13s. per cwt., so that the industry should have an ample working margin.

Radio Interference by Electro-Medical Apparatus

IN a recent article in NATURE (May 21, p. 941), attention was directed to the widespread interference caused to radio reception by various classes of electrical apparatus. One of the sources of such interference and also one of the most difficult to mitigate is a certain type of electro-medical apparatus used for diathermy treatment. With the view of securing an amelioration of conditions in this field, the Postmaster General has asked the Minister of Health to direct the attention of local authorities to this matter. Accordingly a circular letter has been issued by the Ministry of Health to all local councils including welfare and local education authorities (Circular 1695). With this circular was enclosed a memorandum prepared by the Radio Branch of the Post Office on the prevention of interference with radio reception from certain types of electro-medical apparatus. This memorandum has been reprinted from *The Hospital*, the official organ of the British Hospitals Association. It is to be noted that modern valve-rectified X-ray apparatus is not likely to cause interference, and the memorandum is primarily concerned with certain diathermy installations working on medium waves, short waves, and ultra-short waves which can only be prevented from causing interference by the addition of an electrical screen or Faraday cage capable of enclosing not only the apparatus but also the patient and the operator. Since no other effective method of prevention has yet been discovered, it seems desirable that for new hospital buildings or extensions of existing hospitals or other new buildings in which these forms of apparatus are likely to be used, the inclusion of screened rooms should be considered. Attention is directed to the fact that the Radio Branch of the Post Office is prepared to advise on any problem arising and also on the prevention of interference from existing plant.

The Cheshunt Research Station

THE annual report for 1937 of the Experimental and Research Station at Turner's Hill, Cheshunt, Herts, announces a new auxiliary venture. It was recognized that the control of virus diseases of cucumbers and tomatoes could only be accomplished by the use of seed from disease-free plants. A Seed Growers' Association is therefore to be formed to carry on this commercial side of the Station's activity. A capital of £3,000 has been subscribed, and will enable the venture to start. Many experimental trials which have been prosecuted in previous years are continued to give conclusive results. Such are the effect of restricted rooting upon early fruiting of the tomato, the use of electric light to hasten growth of cucumber seedlings, the use of soil heating for several crops, and the use of a surface rooting medium for tomatoes Entomological investigations have included studies of rose thrips and onion thrips and the use of a species of *Scolothrips* as a predatory control of red spider mite Extensive mycological researches include the record for the first time in Great Britain, of a leaf spot of marguerite caused by the fungus *Ramularia bellunensis* Physiological estimations of tomato seedlings have also been accomplished, and more general problems of soil nutrition have been studied

Lighting and Speed of Seeing

A RECENT article (*Brit Eng Export J* , September) describes practical advances that have recently taken place in lighting An interesting experiment is described which shows a relation between illumination and the speed of vision The apparatus used was a heavy pendulum on which a test object was exposed to view when swinging between two screens The speed of movement of the object was directly proportional to its distance from the pivot At high illuminations the test object could be seen when it was placed at the lowest point of the pendulum At intensities not exceeding two foot candles, it was only visible when it was placed at a distance not exceeding a quarter of the way down, when its speed is only a quarter of what it is at the lowest point After an increase to five foot candles the speed of seeing was increased by about 60 per cent

Model Chinese Junks

A COLLECTION of large scale models of Chinese junks, which is said to be unique has been presented to the nation by Sir Frederick Maze, inspector general of Chinese customs, for exhibition in the Science Museum, South Kensington The models, ten in number, were built in Hong Kong or Shanghai by Chinese craftsmen, and are accurate replicas of these sailing craft in every detail, down to the shrines and household gods They include examples with the magical eye on the prow These boats, which are now giving place to steam in Chinese waters, and have also suffered many casualties during the present warfare, are of two main types, a northern and a southern Except for details of rigging, they have not altered in principle over a prolonged period —at least a thousand years and some authorities would hold for perhaps twice as long before that Of these types, one has bluff bows and a flat bottom adapted for sailing in shallow waters The other type has a sharp bow, with sheer lines and a deeper draught Details of construction and rig in use among Chinese sailors at an early date are shewn in these models, which did not appear in Western ships until a very much later period Such, for example, are the water tight compartment, the battened sail used in yacht racing, lee boards of the keel and rudder types, and multiple sheets for independent handling of the upper and lower parts of the sails

Sternberg Astronomical Institute

ACCORDING to Russia Today' Press Service, buildings for the Sternberg Astronomical Institute of Moscow will be commenced early next year in the vicinity of Butovo Station, one of the highest points on the outskirts of Moscow The observatory, laboratory mechanical workshops and blocks of flats to house the staff of the Institute will occupy a site of 14½ acres The main part of the Institute's building will contain accommodation for research workers, lecture rooms a library for 100 000 volumes and a storehouse for the 60 000 photographic negatives taken by the Observatory and by the Southern Astronomical Station in Tajikistan Underground in the same block will be situated the time service with its astronomical clocks and a gravimetric laboratory A tower to be erected over the main body of the building is to be used for solar work The removal of the Institute from Moscow is necessitated by the traffic and the reflection of the city s electric lights in the sky, which interfere with astronomical observations

Centenary of the Greek Archæological Society

CELEBRATION of the centenary of the Greek Archæological Society began at Athens on October 23 The proceedings were opened in the Parthenon by the King of Greece president of the Society, who delivered an address of welcome to the delegates and representatives of Greek and foreign universities and learned societies Great Britain was represented by Mr William Miller, of the British Academy, Mr R D Barnett of the Society for Hellenic Studies and Mr Gerald Mackworth Young who was present on behalf of the Society of Antiquaries of London and the British School of Archaeology at Athens The programme of the celebration, it is reported in *The Times* of October 24, includes excursions to Delphi Eleusis and Epidaurus, the conferring of academic honours on distinguished archæologists, the laying of wreaths on the Cenotaph and the statue of the late King Constantine, a former president of the Society, the performance of the *Electra* of Sophocles and *King Lear* an official banquet given by the Government, and a number of receptions

The Night Sky in November

THE moon is full on November 7 at 22 4^{h} and new on November 22 at 0 1^{h} U T On November 7, there will occur a total eclipse of the moon under favourable conditions—given fine weather—for observation in Great Britain Contact of the umbra with the moon s limb at position angle 94° from the north point, measured towards the east, occurs at 20^{h} 41^{m} , total eclipse begins at 21^{h} 45^{m} and ends at 23^{h} 8^{m} , the moon leaves the umbra at 0^{h} 12^{m} November 8 the position angle of the last contact being 243° Lunar conjunctions with the planets occur on November 1^{d} 19^{h} (Jupiter) 5^{d} 18^{h} (Saturn) 18^{d} 18^{h} (Mars) 23^{d} 21^{h} (Mercury) and 29^{d} 8^{h} (Jupiter) There is a conjunction of Mercury and Venus on November 8, but both planets set very shortly after the sun As the sky darkens, Jupiter is seen as a very bright object rather low near the meridian Saturn souths shortly after 21^h in mid November Mars is a morning star rising at $3\frac{1}{2}^h$, on November 28, the planet passes 3° north of Spica Uranus, in the constellation Aries, is in opposition on November 8, its distance from the earth being nearly 1,736 millions of miles The Leonid meteors should be looked for on November 15–16 the χ Taurids on November 14–16 and the Andromedids from November 17 to 23 The light change of the variable star, Algol, should be seen about one and a half hours before and after the following times of primary minima November 9^d 6 0^h 12^d 2 8^h 14^d 23 6^h 17^d 20 4^h 20^d 17 2^h and 29^d 07 7^h

Announcements

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following Council was elected *President* Sir D Arcy Thompson *Vice Presidents* Prof F A E Crew Lieut Col A G M Kendrick , Principal J C Smail Prof J Walton , Dr James Watt , Prof F T Whittaker *General Secretary* Prof James P Kendall , *Secretaries to Ordinary Meetings* Dr A C Aitken and Dr C H O Donoghue , *Treasurer* Dr E M Wedderburn , *Curator of Library and Museum* Dr Leonard Dobbin , *Councillors* Dr J E Mackenzie , Prof Sydney Smith Prof R Stockman , Prof Lancelot Hogben , Prof James Ritchie , Dr G W Tyrrell Prof C T R Wilson , Prof R C Garry , Prof R J D Graham , Prof D Murray Lyon , Dr J E Richey and the Hon Lord Robertson

JUNIOR research fellowships in tropical medicine have recently been awarded by the Medical Research Council to the following Dr S G Cowper, A J Haddow, and W H R Lumsden The fellowships are tenable for three years, during the first two of which the holders will undergo training in Great Britain in tropical medicine and in the use of research methods

AN inscribed stone has been fixed at No 32, Soho Square, W 1, recording the fact that Sir Joseph Banks, president of the Royal Society, and Robert Brown and David Don, botanists, lived at the house which formerly stood on the site, and that the Linnean Society met there from 1821 until 1857 (see also NATURE, 139, 280 , 1937)

AN earthquake of moderately large proportions was recorded on seismographs in England on October 19d 4h 22m 54s G C T Mr J J Shaw's record was uncertain owing to interference by the wind The Kew record indicates an epicentral distance of approximately 53 3°, but the azimuth is uncertain No damage has been reported

ON October 22, Lieut Colonel Mario Pezzi regained for Italy the height record for aeroplanes by flying to a height of 17,074 metres The previous record, held by England, was that of 16,440 metres, attained by the late Squadron Leader M J Adam The Italian flight was made in a Caproni machine fitted with a specially constructed Piaggio engine, details of which are not disclosed

PROF F F NORD, of the University of Berlin, known for his contributions to the chemistry of enzymes, heterogeneous catalysis and cryolysis of colloids, has accepted the chair of organic chemistry in Fordham University, New York, N Y Prof Nord will continue to be editor of *Ergebnisse der Enzymforschung*

THE following have recently been elected members of the Imperial Leopold Caroline German Academy at Halle Dr Philipp Stohr, professor of anatomy at Bonn Dr Richard Siebeck, professor of internal medicine at Berlin , Dr Paul Wels professor of pharmacology at Greifswald , Dr Georg Stetter, professor of physics at Vienna Dr Abraham Esau, professor of technical physics at Jena , Dr Fritz Kohlrausch, professor of physics at Graz , and Prof Walter Schoeller of Berlin

AN industrial fellowship has been established by the Elgin National Watch Company, Elgin, Illinois, at the Mellon Institute, Pittsburgh, Pa The research programme will cover broadly the chemical aspects of technical problems in the watch industry One of the first subjects of investigation will be watch lubrication Dr George E Barker, of the Massachusetts Institute of Technology, has been appointed to the fellowship Before joining the Institute s research staff, Dr Barker spent several years in the synthetic organic chemical industry

THE foundation stone of an institute of hygiene, social medicine and industrial pathology has recently been laid at Brussels

ACCORDING to the National Safety Council of the United States, in the first four months of 1938 there were 2,060 fewer traffic deaths than in the corresponding months of 1937, or a reduction of 19 per cent

OWING to the recent crisis, the second International Congress of Radio Æsthesia which was to have been held in Paris on October 17–19 has been postponed to November 7–9 Further information can be obtained from the Secretariat, 9 rue Etex Paris 18

THE third Italian Congress of Medicine and Sport will be held at Genoa on November 12–14, when discussions will be held on the reduction of professional capacity from internal lesions following sport and reduction of working capacity from injury to the locomotor system

THE Congress of Rheumatism organized by the French League against Rheumatism, which was to have been held on October 8, has been postponed until December 3 Further information can be obtained from the Secrétariat de la Ligne française Centre le Rhumatisme, 23 rue Cherche Midi, Paris, 6e

Letters to the Editor

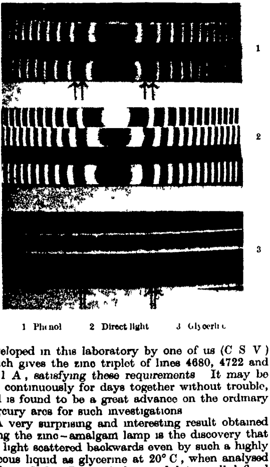
The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 799

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Debye Heat Waves in Highly Viscous Liquids

FOR the spectroscopic study of the light scattered in solids and fluids using interferometers of high resolving power, it is very important to be able to work with a light source giving sharp and intense spectral lines without accompanying hyperfine structure components or continuous spectrum A zinc-mercury amalgam lamp in Pyrex glass has been developed in this laboratory by one of us (C S V) which gives the zinc triplet of lines 4680, 4722 and 4811 A, satisfying these requirements It may be run continuously for days together without trouble, and is found to be a great advance on the ordinary mercury arcs for such investigations



1 Phenol 2 Direct light 3 Glycerine

A very surprising and interesting result obtained using the zinc-amalgam lamp is the discovery that the light scattered backwards even by such a highly viscous liquid as glycerine at 20° C, when analysed with a Fabry Perot étalon, exhibits well-defined Brillouin components on either side of the incident lines, along with a continuous background A similar result is also shown by liquid phenol at room temperature These facts are illustrated in the accompanying reproductions (1 and 3), 2 being the corresponding pattern for the zinc triplet in the incident light It will be noticed that the undisplaced lines in the scattered light are very intense relatively to the accompanying Brillouin components The failure to observe these latter components with glycerine and phenol at room temperatures in earlier investigations[1] with the mercury arc is readily understood, with the mercury radiations the hyperfine structure of the undisplaced central line would completely overwhelm the much feebler displaced components in the scattered light

The viscosity of glycerine at 20° C is 8 3 poises and if this viscosity were effective in the propagation of compressional waves having a wave length comparable with that of the incident light these waves would be so highly damped that they could have no physical existence and the corresponding Brillouin components would therefore be unobservable The fact that the latter are actually to be seen and indeed are quite sharply defined seems to indicate that the usual hydrodynamic viscosity has little influence on the propagation of thermal sound waves of very high frequencies

C V RAMAN
C S VENKATESWARAN

Department of Physics
Indian Institute of Science,
Bangalore
Sept 20

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[1] Raman C V and Rao B V R NATURE **139** 585 (1937) **141** 242 (1938)

Mathematics of Air Raid Protection

IN view of the discussion which is occurring on this subject, it seems desirable to have some quantitative measure of the degree of protection afforded by a given shelter In order to limit the problem we may consider only risks of death, and further confine ourselves to high explosive bombs Incendiaries have proved a negligible danger to life in Spain and gas is also negligible except for babies and those whose respirators do not fit

Consider a given type of bomb, say a 250 kilo bomb, which is commonly used on central areas of Spanish cities and a man in a given situation, whether in the street or in a shelter Let n be the expected number of bombs falling in his neighbourhood (say, 1 square kilometre) during a war the distribution of bombs over this area being supposed even since aim is poor when cities are bombed Let p be the probability that a single bomb falling at the point (x,y) in this area will kill him Then the probability that he will be killed in the course of the war is $P = \frac{n}{A}\int p dx dy$ integration being taken over the whole neighbourhood of area A

The values of n and p will, of course, be different for each type of bomb, and the different expressions so obtained must be summed Further, the man will be in different places during the war, and thus another summation is necessary Finally, P must be summed for the whole nation

The policy of evacuation is intended to reduce the value of n, even though it may increase that of p, as when a child is evacuated from a fairly solid house into a flimsy hut The policy of dispersal within a dangerous area does not, of course, reduce either n or p It merely ensures that no single bomb will kill a large number of people, while increasing the probability that any given bomb will kill at least one It is likely to save a few lives by equalizing the numbers of wounded to be treated in different hospitals, and the psychological effect of having 20 killed in each of 10 areas may perhaps be less than that of 200 killed in one area But as it may actually increase the mean value of p by encouraging people to stay in a number of flimsy buildings rather than one strong one, it is at least as likely to increase the total casualties as to diminish them The argument that a number of people must not be concentrated in one place in order that a single bomb should not kill hundreds is clearly fallacious when applied to a war in which the total casualties will be large It is, however, true that a small group of key men each of whom can replace another should not be grouped together

The effect of shelters is to diminish the mean value of p, which approaches zero in a deep tunnel, and is maximal in an open space with a hard surface which bombs will not readily penetrate The component of p due to splinters is large in the open, but negligible in any shelter worthy of consideration, though not so in the average brick house In general the construction of shelters should have two aims, namely, to diminish p in the immediate neighbourhood where a bomb falls, and to diminish the area over which p has a value large enough to be taken into consideration

With a good many types of shelter, p approaches unity within a certain area, and zero outside it Thus in a trench with protection from falling splinters p is nearly unity if a bomb falls in the trench, and nearly zero if it does not In these cases it is clear that P depends mainly on the area of a straight section of trench, and is about seven times as great in a trench 70 feet long by 6 feet wide as in one 16 feet long by 4 feet wide This fact has largely been neglected in the construction of trenches in our parks

Again, a shelter with a roof of concrete one foot thick will give $p = 0$ for very light bombs, a fractional average value of p for medium bombs which will not penetrate the roof before explosion, but will knock down a portion of it on explosion, and $p = 1$, or nearly so, for heavy bombs with delayed action, which will penetrate the roof and burst in the shelter It follows that the area of such shelters should be minimized, or they should be divided up by very stout walls, for example, reinforced concrete walls at least a foot thick This is not in order to diminish the number who may be killed by a single bomb, but to diminish the area within which a bomb must fall so as to kill a given individual

It would seem that, in the design of many shelters, too much stress has been placed on vertical protection, that is to say, protection from bombs falling immediately on the individual's protection, and not enough on horizontal protection, that is to say, protection from bombs falling at some distance from them

I suggest that, for each type of shelter, it should be possible to arrive at a rough value of P/n per square kilometre, and that such values would be of great utility in the design of shelters, though I regard any shelters for which this value is not very close to zero as inadequate Thus, to take definite examples, the value of P/n for a straight covered trench 5 metres by 1 metre would begin at about 9×10^{-4} for 20 kgm bombs, supposing that such a bomb would kill everyone in the trench if it fell within 30 cm of it It would rise to about 4×10^{-4} for a bomb making a crater of 10 metres in diameter The same value, for a square shelter of 100 square metres with a concrete roof 30 cm thick but thin walls, would rise from nearly zero for a 20 kgm bomb to about 8×10^{-4} for a heavy bomb making a 10 m crater These figures could, of course, be improved, and are only presented as approximations But they suggest that in an area where heavy bombs are likely to be used the trench is to be preferred On the other hand, were the concrete shelter divided into a number of cells by stout walls, it would be safer than the trench

Only by such quantitative treatment can we expect to avoid mistakes in policy and design of shelters such as have occurred and are still occurring It is, however, to be hoped that these calculations may be rendered needless by the provision of completely bomb-proof shelters such as exist in some Spanish towns

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Oct 14

The Arms Race of 1909–13

THE interaction of fear with cost and with grievances was represented in a letter in NATURE (Dec 25, 1935) by the equations

$$dx/dt = ky - \alpha x + g\ , \quad dy/dt = lx - \beta y + h, \qquad (1), (2)$$

in which t is time and α, β, k, l are positive constants, and g and h are positive or negative constant grievances In that publication, x was described as the variable preparedness for war of the first group of nations, y that of the second But on further consideration, it appears that the description of x given in 1935 needs to be modified by taking into account the co-operation between the groups of nations which goes on as trade, travel and correspondence concurrently with their mutual threatenings The improved description of x is in general terms

$$x = \text{threats minus co-operation}$$

In the hope of reaching quantitative measures, let us try

$$x = U - U_0\ , \quad y = V - V_0, \qquad (3), (4)$$

in which U is the annual defence budget for the first group of nations, V that for the second group, and U_0, V_0 are measures of co-operation U, V, U_0, V_0 are all here expressed in million pounds sterling As a tentative assumption, let U_0, V_0 be regarded as constants during the arms-race (5)

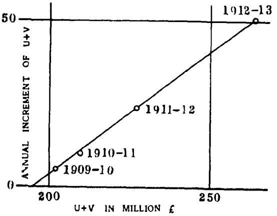
In 1909 France was allied with Russia, Germany with Austria-Hungary These two pairs of nations were very roughly equal, so that we may simplify (1) and (2) by putting $k = l$, $\alpha = \beta$ Then, by addition, it follows that

$$\frac{d(x+y)}{dt} = (k-\alpha)(x+y) + g+h\ ,$$

and by substitution of (3), (4), (5)

$$\frac{d(U+V)}{dt} = (k-\alpha)(U+V) + \{g+h - (k-\alpha)(U_0+V_0)\}.$$

This implies that when $d(U+V)/dt$ is plotted against $U+V$, we should expect a straight line of slope $k-\alpha$ The statistics for Austria Hungary have been taken from the "Statesman's Year Book', those for the other countries from a pamphlet by Per Jacobsson[1] The accompanying diagram shows that the four points lie close to a straight line of slope $k-\alpha = 0\ 73$ year^{-1} Furthermore, by a short extrapolation, the line cuts the axis of zero $d(U+V)/dt$ at $U+V = 194$ This 194 million sterling is the amount of defence expenditure, by the four nations concerned, that would just have been mutually forgiven in view of the amount of goodwill then existing



It is, to say the least, a remarkable coincidence that the trade between these opposing pairs of nations was on the average 206 millions sterling, close to 194

A much fuller discussion is due to appear under the title "Generalised Foreign Politics In particular, the assumption that U_0, V_0 were constant cannot be expected to remain valid for long periods of time Also the budgets are variously stated

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[1] Jacobsson ' Armaments Expenditure of the World *The Economist* London

Resonance Absorption of Slow Neutrons

We have made measurements of the position of the resonance levels of some heavy elements for slow neutrons The method is a development of that of Preiswerk and v Halban[1], and depends essentially on finding how much paraffin must be traversed by neutrons in order to have their energy reduced from that of the resonance level of the element under investigation to that corresponding to known periods of silver or rhodium In this way definite evidence has been obtained for resonance levels in cobalt, bismuth, lead, thorium, uranium, besides the known ones of silver and gold The most interesting result is that two levels can be detected in bismuth, the first at about 1 volt, the second at about 11 volts As bismuth is a pure element, both levels represent high excited states of radium E Preliminary experiments with thorium and uranium give similar results, showing for thorium two levels, in the neighbourhood of 2 and 18 volts respectively, and for uranium levels about 5 and 30 volts With cobalt we find a level at about 1 volt and nothing else of any intensity up to 40 volts While it will require a careful study of the experimental conditions before these resonance energies can be fixed with certainty, we think these results give a trustworthy picture of the separation of energy levels in heavy elements Such values are quite compatible with current theoretical ideas as is also the suggestion of greater separation for the lighter element cobalt and an increase in the separation as the first level goes to higher energies

It seems likely that the interesting anomalous absorption of slow neutrons in boron recently reported by Michiels[2] can be explained by the existence of two resonance levels in iodine He finds, using iodine as a detector that the absorption coefficient in boron is greatly altered if iodine is used as an initial filter instead of boron If we assume to a first approximation that energy losses are unimportant then the use of a sharply resonating detector effectively reduces the experiment to the investigation of the absorption of a heterogeneous beam consisting of as many homogeneous components as the detector has resonance levels Suppose I_1 and I_2 are the initial intensities of the low and high energy components, τ_1 τ_2 and μ_1 μ_2 their absorption coefficients in iodine and boron respectively, and d_1 and d_2 the thicknesses of the iodine and boron filters, then the smaller boron absorption coefficient with iodine filtering means that $(\tau_1-\tau_2)d_1$ is greater than $(\mu_1-\mu_2)d_2$ The approximate constancy of the boron absorption coefficient with increasing boron filtering and on the other hand its decrease with increasing iodine filtering means that $\tau_2 I_2/\tau_1 I_1$ is much less than $e^{(\mu_1\ \mu_2)d_2}$ but comparable with $e^{(\tau_1\ \tau_2)d}$ Such relations are quite plausible but a closer analysis is not justified unless great care is taken to allow for the scattering The pronounced effect of different arrangements is shown by the divergence between Michiels' results for iodine filtering and those of Ruben and Libby[3] On the evidence available, it appears as if iodine has two levels, one in the neighbourhood of 40 volts and the other of several hundreds of volts

The significance of the change in activity when two filters of boron and iodine were used simultaneously first in one order and then reversed, can only be appreciated when all scattering effects and losses of energy in any hydrogenous material present are carefully taken into account but it must be remembered that similar effects were found in the early days in the experiments on the absorption of heterogeneous γ ray beams

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[1] Preiswerk and v Halban *C R* 201 722 (1935)

[2] Michiels Nature 142 431 (1938)

[3] Ruben and Libby *Phys Rev* 51 774 (1937)

Viscosity of Light Hydrogen Gas and Deuterium between 293° K and 14° K.

In connexion wit' previous systematic investigations[1] on the viscosity of gases at low temperatures, we have studied hydrogen and deuterium gas As is well known, such investigation is interesting in connexion with the theoretical calculations made respectively by Uehling[2] and Massey and Mohr[3]

As in our previous investigations, we used the oscillating disk method, with very small plate distances Considering the results obtained for light hydrogen (T = 293° K , $\eta \times 10^7$ = 882 7 , 89 4°, 387 1 , 77 3°, 345 8 , 20 3°, 108 8 , 18 5°, 102 4 , 16 7°, 90 3 , 15 1° 80 8 , 14 1°, 74 5), it will be observed that our results are in good agreement with the results obtained by Kamerlingh Onnes, Dorsman and Weber[4] and by Sutherland and Maass[5] The values published recently by Keesom and Macwood[6] for the viscosity of light hydrogen at liquid hydrogen temperatures are about 20 per cent higher On the other hand, the values obtained by Vogel[7] and Gunther[8] are about 10 per cent smaller than our values and those of Kamerlingh Onnes Dorsman and Weber

From our measurements on the two kinds of hydrogen we determined the ratio η_{D_2}/η_{H_2} as a function of temperature So we obtained at T – 293° K η_{D_2}/η_{H_2} – 1 39 , 90° 1 34 , 80°, 1 35 75°, 1 35 , 20° 1 24 , 17°, 1 24 , 15°, 1 24 , 14°, 1 25

Thus at room temperature the ratio η_{D_2}/η_{H_2} is in good agreement with the ratio of the square root of the molecular masses of the two molecules At lower temperatures there is a regular decrease in this ratio This decrease cannot be attributed to the presence of a small per cent of H_2 in the D_2 gas

More details on these measurements will be published shortly

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[8] Günther P *Z phys Chem* **40** 626 (1924)

Absorption of Gases by Tantalum

Hydrogen A number of workers have measured the absorption of hydrogen by tantalum , thus Pirani[1] found a large absorption at yellow heat, Moers[2] measured the quantity taken up at higher temperatures, while Fetkenheuer[3] found a maximum in the absorption at about 600° C On the other hand, Sieverts showed a curve[4] in which the quantity taken up was greater at 20° C than at higher temperatures The clean up at low pressures does not appear to have been discussed in detail, although Balke stated[5] that below 1 micron the clean up was very small

We have studied the clean up of hydrogen at pressures from 1 micron to 30 microns on a tantalum strip of area 2 cm ^{2} and mass 50 mgm If the strip was degassed at temperatures below 1,500° C , surface oxide remained present In this state the clean up was as found by Fetkenheuer[3] It was negligible below 400° C , reached a maximum at 600° C , and decreased again, becoming very small at 1,000° C The absorption at 600° with a pressure of 1 micron was only about ½ cu mm measured at S T P If, however, the strip was run in a very high vacuum for a long period at 1,900° C or for a short period at 2,200° C , further gas was evolved, the strip became cleaner in appearance, and the clean up of hydrogen was profoundly modified The maximum absorption now occurred at 20° C as found by Sieverts[4], while there was a continuous decrease in absorption from 100° C to 1,000° C as in Sieverts curve The clean up was very rapid, the total quantity cleaned up at 1 micron pressure and 20° C being about 20 cu mm measured at S T P The clean up was proportional to $\sqrt{P}$ from 1 micron to 30 microns , if proportionality continued to atmospheric pressure, the absorption at that pressure would be 17 5 c c If this is expressed in c c of hydrogen per gm of tantalum, the figure is 350 c c /gm , which is about seven times Sieverts figure It is probable, however, that saturation occurs below atmospheric pressure All the gas cleaned up at 20° C was liberated again at 950–1,000° C , and was partially liberated at lower temperatures

Above 1,200° C absorption appeared to increase again although measurement was difficult on account of the rapid formation of atomic hydrogen at the higher temperatures There appeared to be an increase to about 1,700° C and a decrease above absorption becoming negligible above 1,900° C The maximum absorption was however, much less than that at 20° C

Exposure of the strip at room temperature to small pressures of oxygen restored the first type of behaviour Exposure at 600° to oxygen led to this type of behaviour in a more marked degree, with a very small clean up of hydrogen at 600° Prolonged running at 2,200° C was then necessary to restore the second type of behaviour

Nitrogen Variable results have also been obtained on absorption of nitrogen by tantalum[6 7] We have found that after running at 2,100° C in high vacuum, clean up of nitrogen at 1 micron appears at 700° C , and is very rapid at 1,000° C , it remains constant from 1 000° to 1,500° C , and decreases at higher temperatures All the gas cleaned up at 1,000° is liberated at 2,100° C and is partially liberated above 1,900° C The absorption at 1,000° C was not determined exactly, but was certainly greater than 25 c mm measured at S T P when the pressure was 3 microns

A strip in the oxidized condition after degassing at 1 500° only showed no absorption of nitrogen below 850° C , while absorption only became rapid above 1,200° This result is that obtained by Moissan[7] Thus in the case of both hydrogen and nitrogen, the earlier variable results have been due to contamination of the tantalum surface by oxide Similar degassing treatments were found necessary in work on the thermionic and photo electric properties[8 9]

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[1] Pirani *Z Elektrochem* **11** 555 (1911)

[2] Moers *Metallwirt* **13** 640 (1934)

[3] Fetkenheuer *Siemens Z* **12** 168 (1932)

[4] Sieverts *Z Metallkunde* **21** 37 (1929)

[5] Balke *Ind and Eng Chem* **21** 1002 (1929)

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[7] Moissan *C R* **134** 1911 (1902) *Bull Soc Chim* (3) **28** 434 (1909)

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Variation in the Longitudinal Incremental Permeability due to a Superimposed Circular Field

During the course of an investigation of the variation of the longitudinal incremental permeability by a superimposed circular magnetic field some rather interesting results were obtained with certain iron nickel alloys The ferromagnetic materials under investigation were of wire form and served as the core of a long slender solenoid Direct current was passed through the core to produce the circular field, and the longitudinal permeability was calculated from inductance measurements on the solenoid

Using well annealed alloys, it was found that rather large increases in the longitudinal incremental permeability could be obtained as a function of a relatively small superimposed circular field while upon twisting the conducting core a gradual change from an increase to a decrease in the incremental longitudinal permeability as a function of a superimposed circular field was obtained

These effects are shown in Fig 1 where curve (*a*) gives the variation of the inductance of the solenoid as a function of the direct current through the conducting core of an unstrained sample Curve (*b*) is that obtained after the core has been twisted through 120° Here the inductance of the solenoid without any core is 1 3 millihenries In all measurements the effect of the earth s field was reduced to a minimum and the samples were completely demagnetized before each run

Fig 2 shows the variation in longitudinal incremental permeability of the core as a function of the degree of twist when a current of 0 5 amp passes through the core Variations in permeability thus obtained on the samples were much greater than those obtained by twisting when no current passes through the core

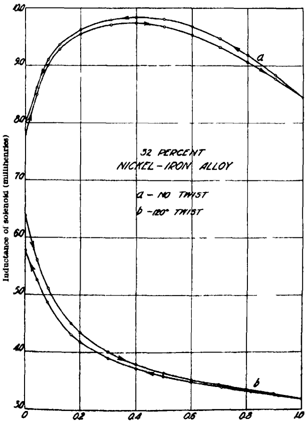

Fig 1

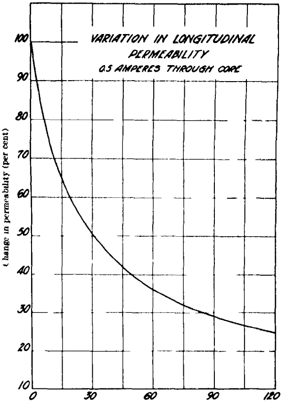

Fig 2

These large variations in inductance obtained as a function of the current through the core or as a function of the degree of twisting of the core while carrying a definite current appear to have many possible applications

A complete account of this work covering all of the more common ferromagnetic materials will be given elsewhere

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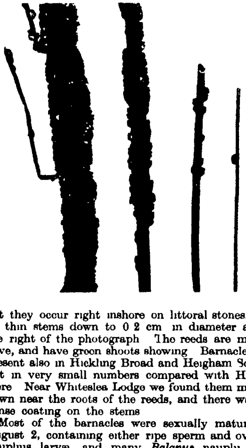
Barnacles in Horsey Mere

On July 15, 1938, it was discovered that there were large numbers of the barnacle *Balanus improvisus* Darwin, living on the stems of the reeds in Horsey Mere, Norfolk The water of Horsey Mere and Hickling Broad has been very saline since the sea broke through last spring on February 12, March 1 and April 4 and estimations of the salinity of the surface water on August 6, made by Mr A J Rudd of the Norfolk Fishery Board were Horsey 18 19 per mille, Hickling varying from 21 0 per mille (north end) to 17 5 per mille (Whiteslea)

The fauna of the area is now an interesting mixture of brackish water and freshwater species On August 2, the following species were found amongst the reeds on which the *Balanus* occurs *Hydrobia jenkinsi* Smith*, *Bythinia tentaculata* (L)*, *Theodoxus fluviatilis* (L)*, *Gammarus zaddachi* Sexton*, *Corophium volutator* (Pallas)*, *Sphaeroma* sp , *Membranipora monostachys* Busk, var *fossularia* The only aquatic insects found were larvæ and pupæ of *Donacia cinerea* Herbst, which were fairly numerous on the roots of the reeds

In Horsey Mere the barnacles appear to be distributed all over the reed beds and are very abundant The greatest density occurs next to the open water, where thick stems and rhizomes of *Phragmites communis* and *Typha* are often completely covered in barnacles from a depth of six inches downwards, as on the left of the accompanying photograph Inside the reed beds they become more scattered, but they occur right inshore on littoral stones, and on thin stems down to 0 2 cm in diameter as on the right of the photograph The reeds are mostly alive, and have green shoots showing Barnacles are present also in Hickling Broad and Heigham Sound, but in very small numbers compared with Horsey Mere Near Whiteslea Lodge we found them mainly down near the roots of the reeds, and there was no dense coating on the stems



Most of the barnacles were sexually mature on August 2, containing either ripe sperm and ova, or nauplius larvæ, and many *Balanus* nauplii were found in the plankton of Horsey Mere Taking the carino rostral diameter as the index of size, the specimens are up to 1 1 cm , and the average of fifty examples, which were chosen as not being deformed through overcrowding, is 0 83 cm The maximum size of the specimens collected on July 15 is 0 9 cm , but the average of fifty is only 0 57 cm A few young individuals, less than 0 3 cm , were found on both dates, and these must represent the first of the second generation

Gurney[1,2] records this species in the Bure opposite Muck Fleet, where the water is 'generally almost fresh" It is possible that the nauplii reached Horsey by the Thurne, which is a tributary of the Bure, on an abnormally high tide, but the fact that the adults are so abundant in Horsey, and comparatively scarce in Hickling, suggests that they came direct from the sea during one of the break throughs in the spring A few *Balanus* nauplii were found in a sample of the plankton from Horsey Mere on February 20. Nauplii of *B improvisus* have been recorded in the Zuider Zee as early as January 6, and so they may have reached Horsey during any one of the three break throughs Breemen[3] has shown that individuals of this species may contain embryos three months after they have settled

It seems that *B improvisus*, which is a southern species, is killed by too low temperatures, so the barnacles may be killed off if there is a sufficiently severe frost at Horsey this winter On the other hand, it is a very euryhaline species, and occurs in Holland in water of salinity down to 1 65 per mille, so that so far as salinity is concerned this species will probably survive in Horsey Mere and Hickling for several years Now that it is so well established, it might even survive there under normal conditions, since the water is always slightly salt

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* Species kindly identified by Mr G I Crawford

[1] Gurney R *Trans Norfolk and Norwich Nat Hist Soc* 7 645 (1904)

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[3] v Breemen L *Zool Anz* 105 247 257 (1934)

Irritant Exudation from a Millipede

WHILE working at Sigi, 1,500 feet below the East African Agricultural Research Station at Amani Tanganyika Territory, one evening in June, I came across one of the giant black millipedes—a species of *Spirobolus*—which are fairly common in this region of tropical evergreen rain forest It was an unusually large specimen, fully twelve inches in length Having no box capable of holding it, I buttoned it up in my hip pocket and continued my work for an hour or so

I felt the millipede moving about in my pocket and noticed that I was becoming rather sore in that neighbourhood, but paid little attention to it However, whilst bathing shortly afterwards I was surprised to find that my skin had become completely blackened over an area of about nine square inches with further red inflammation spreading rapidly down my thigh Four days later all this blackened skin sloughed away, leaving a raw wound This happened in June 1937, at the end of August 1938 the site of the injury is still visible

I have since examined millipedes of the same and other species on several occasions, and noticed that, when one is molested by being turned about in the fingers, small drops of liquid are exuded from pores, one on the side of each segment This liquid is rich yellow brown in colour and stains the fingers like iodine, it has a characteristic pungent odour recalling that of nitrogen peroxide, but is neutral to litmus The fumes cause marked watering of the eyes Mere contact of the fluid with the tough skin of the fingers produces no injurious symptoms, although when some was rubbed on to the skin of the leg, smarting was experienced and the skin eventually became hard and scaly

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Record of *Typhlocaris Galilaea*

Two specimens of the blind prawn, *Typhlocaris galilaea*, were obtained recently from the cistern of the water mill near Tabgha at the north end of the Sea of Galilee This species had been reported as being exterminated by drainage operations It appears probable that the species normally inhabit a dark cave or grotto formed by a hot sulphur spring and the specimens obtained by me were stragglers which were carried out into the cistern

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Blood Groups among the Khasis

THE Khasis are inhabitants of the district of Khasia and Jaintia Hills Assam They are short statured with a high mesocephalic head a meso prosopic face and a mesorrhine nose and in the height of the root of the nose above the level of the orbit they are pro opic The head varies from long to medium and has a high vault The hair is of medium growth straight and black in colour The forehead is vertical and medium in height The depression of the nose is shallow and the nasal bridge is concave The malars are prominent and there is no alveolar prognathism The lips are of medium thickness the chin ordinary and the angle of the lower jaw medium The eye colour is light brown and the eye slit is horizontal

Samples of blood were collected from fifty individuals—male female and children The percentage ratios in groups are given below and compared with others

	O	*A*	*B*	*AB*
Khasis	46 6	15 6	33 3	4 5
Japanese	44 8	29 9	23 7	9 8
Negritoes (Grove)	48	33 3	14 1	4 0
Indians	31 3	19 0	41 2	8 5

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Isolation of an Anhydro *l* Galactose Derivative from Agar

IT has been found possible to methylate agar by direct treatment of the polysaccharide with methyl sulphate and sodium hydroxide solution The product had OMe 33 0 per cent $[\alpha]^{18^\circ}_{D}$ −93 1° in chloroform and it contained no sulphur

Methylated agar is easily hydrolysed by boiling with 2 per cent methyl alcohol hydrogen chloride and the hydrolysate contains little or no methyl lævulinate Thus, the hydrolytic products from methylated agar (14 gm) contained only a very small amount of ester which was separated as the barium salt (0 18 gm) The mixture of glycosides was separated, by distillation into three fractions Fraction 1 was a mixture of the α and β forms of 2 4 6 trimethyl methyl-*d* galactoside identical with that already separated by Percival and Somerville[1] from methylated agar Fraction 2 was a mixture of 1 and 3 Fraction 3 was collected in five successive fractions the constants of which were sufficiently close to warrant the assumption that no great difference in composition existed among them OMe 37–40 per cent On further methylation with methyl iodide each of these sub fractions yielded a crystalline derivative which had the composition of a dimethyl anhydro methylhexoside It is recognized as 2 4 *dimethyl* 3 6 *anhydro methyl* l *galactopyranoside* for the following reasons

It shows the properties characteristic of 3 6 anhydro methylhexosides (cf Peat and Wiggins[2]) in that it is hydrolysed by cold acid and is unaffected by prolonged boiling with sodium methoxide solution It was possible to compare the substance with 2 4 dimethyl 3 6 anhydro methyl *d* galactopyranoside which had been synthesized in this laboratory for another purpose (Haworth Jackson and Smith unpublished work) The comparison established that the two were optical enantiomorphs

	Product from agar	Synthetic product
Melting point	82 83	8 83
$[\alpha]_D$ in chloroform	+8 3	86 6
$[\alpha]_D$ in water	+73	76
$[\alpha]_D$ in cold dil sulphuric acid	7 8 → 1	69 4 → +20

Dr L G Cox of this Department reports The complete identity of the X ray photographs of single crystals of the two substances coupled with the rotational data given above shows that the two are enantiomorphs Further calculation of the molecular weight from the X ray data indicates that the substances are monomeric in the crystalline state

Hydrolysis of the galactoside from agar yields 2 4 *dimethyl* 3 6 *anhydro* l *galactose* m p 114° The corresponding product from the synthetic *d* galactoside has m p 11 °

The existence of *l* galactose in agar was demonstrated by Pirie[3] who isolated hepta acetyl *dl* galactose by the acetolysis of agar, and experiments are now in progress to determine whether the 3 6 anhydro ring structure which is present in methylated agar exists preformed in the original polysaccharide

S HANDS
S PEAT

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Birmingham
Sept 22

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[1] *J Chem Soc* 1615 1937)
[2] *J Chem Soc* 1088 (1938)
[3] *Biochem J* **30** 369 (1936)

Isolation of an Anhydro-Sugar Derivative from Agar

SINCE by the kindness of Prof W N Haworth we have learnt that a publication on agar is shortly to appear from the Birmingham laboratories* we feel it desirable that one aspect of our researches on the subject should be communicated here

Accompanying the 2 4 6 trimethyl methyl galactoside obtained by the hydrolysis of methylated agar with methyl alcoholic hydrogen chloride, we reported[1, 2] the presence of a syrup (c 25 per cent) which appeared to be a dimethyl methylketoside Further work has now shown that this portion is not homogeneous since it can be partially separated into two fractions by extraction with boiling light petroleum, and these fractions in turn are also mixtures The portion insoluble in light petroleum ($[\alpha]^{20°}_{D} = -20°$ in chloroform), on complete methylation can be divided into two fractions, a crystalline body (X), and an oil, whilst the soluble portion ($[\alpha]^{20°}_{D} = +40°$) can be distilled in a high vacuum to yield two fractions (A) of b p 160°/0 09 mm (bath temp), $[\alpha]^{18°}_{D} = +59°$ in chloroform, and (B) of b p 178° (bath temp)/0 09 mm $[\alpha]^{18°}_{D} = +25°$ Complete methylation of these subfractions gave rise to a mixture of (X) and an oil from (A) and a large yield of the crystalline material (X) from (B) In the same way the syrup obtained from the mother liquors after recrystallization of the 2 4 6 trimethyl methylgalactoside was partially transformed by methylation into (X)

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* Added on proof Hands and Peat *Chem. and Ind* **57** 937 (1938)

On account of the difficulties in manipulation it is not easy to estimate precisely the yield of this substance (X) but it appears to be about 16 per cent of the weight of methylated agar employed It is non reducing and has b p 85–90°/0 05 mm , m p 81° and $[\alpha]^{20°}_{D} = +75°$ in water and $+85°$ in chloroform Analysis showed it to have the composition $C_6H_7O_3(OCH_3)_2$ and it is therefore a dimethyl anhydro methylhexoside It gave a strong Seliwanoff test and simulated a furanoside on account of the ease of removal of the glycosidic residue by dilute mineral acid , it was found that hydrolysis to the free anhydro sugar ($[\alpha]^{17°}_{D} = -23°$) took place by contact for 24 hours with N sulphuric acid This resembles the behaviour of the 3 6 anhydro 2 4 dimethyl methylglucoside of Peat and Wiggins[3], so that although the positive Seliwanoff reaction seemed anomalous, the chance that it might be a 3 6 anhydro galactose derivative was considered By the direct methylation of 3 6 anhydro α methyl galactoside prepared by the method of Ohle and Thiel[4], the corresponding 2 4 dimethyl derivative was prepared This substance was obtained as an oil, b p 90°/0 05 mm , $n^{18°}_{D} = 1\ 4640$ and $[\alpha]^{20°}_{D} = +87°$ in chloroform It is important to note that both these 3 6 anhydro galactosides give the Seliwanoff reaction

Although hydrolysis of the 2 4 dimethyl 3 6 anhydro α methylgalactoside in cold N sulphuric acid was complete in 24 hours the equilibrium value reached was $[\alpha]^{18°}_{D} = +22°$ instead of $-23°$, and although the general properties of the two substances are so similar that it is probable that the natural product is a 3 6 anhydride, it is clearly not 3 6 anhydro 2 4 dimethyl α methyl *d* galactoside, and further synthetic experiments will be necessary to decide its constitution The fact that the specific rotations of the free dimethyl anhydro sugar from agar and of 2 4 dimethyl 3 6 anhydro *d* galactose are approximately equal and opposite in sign makes it possible that the sugar concerned is not *d* but *l* galactose , this sugar has already been found in agar by Pirie[5]

These experiments fail to support the suggestion previously advanced[2] that a ketose is present in the hydrolysis products of methylated agar, although accompanying (X) is an oil of high methoxyl content which may be a fully methylated ketose , but little reliance can be placed on colour reactions in this case since the syrup may still contain a quantity of (X)

It is impossible at present to decide whether the anhydride ring is preformed in agar or whether it is the result of side reactions However, the former view is considered to be the most likely because of the low methoxyl and acetyl contents of methylated and acetylated agar, which can be explained by the presence of the anhydro hexose residues in the chain form each carrying only one hydroxyl free for substitution The anhydro hexose is clearly not an 'end group since if it were, simple hydrolysis would set free the dimethyl anhydro methylhexoside, whereas actually further methylation is necessary after hydrolysis It is hoped to report upon the precise nature of the supposed 3 6 anhydro dimethyl hexose and of the other unidentified products in due course

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Percival Munro and Somerville NATURE **139** 512 (1937)
[2] Percival and Somerville *J Chem Soc* 1615 (1937)
[3] Peat and Wiggins *J Chem Soc* 1088 (1938)
[4] Ohle and Thiel *Ber* **66** 525 (1933)
[5] Pirie *Biochem J* **30** 369 (1936)

Multiplanar Cyclohexane Rings

ON bromination, the isomeric forms of 1 carboxy 4 methyl*cyclo*hexane 1 acetic acid (m p 173° and 137°)[1] furnished monobromo acids, which gave the corresponding hydroxy acids on being heated with aqueous sodium carbonate Oxidation of the hydroxy acids with alkaline permanganate gave rise however, to isomeric forms of 4 methyl*cyclo*hexane 1 1 dicarboxylic acid, which depressed each other s melting points Similar observations were made in the 3 methyl*cyclo*hexane series

A full report of these experiments will be published in due course

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Desai Hunter Ghulam Khan and Saharia *J Chem Soc* 416 (1936)

Combustion Pressures in Spark-Ignition Engines

IT has come to the notice of investigators interested in combustion and detonation in spark ignition engines that the combustion pressures may attain values which even when no heat losses are considered appeared to surpass those found by calculation making use of the normally accepted data for such processes The inadequacy of pressure indicating apparatus, especially when measurements were made under conditions of incipient or even persistent detonation, has for long prevented adequate attention being paid to this phenomenon

Repeated measurements on different engines with Farnboro quartz and capacity type indicators have now shown that the pressure rise over the compression pressure *may in several cases be up to 50 per cent* higher than is accounted for by classical calculations The extreme cases occur when there is a certain degree of detonation, the phenomenon being then sometimes, though not always accompanied by superimposed pressure vibrations , when these vibrations occur, the value cited relates to the mean value of the pressure

These pressures being sustained beyond the period of vibration either of the gas mass or of the indicator they must be considered as static pressures, to be accounted for by external energy of the combustion gases, for which it may be assumed that temporarily the specific heat of the combustion gases is much lower than normal This may be explained by an excitation lag theory[1], which states that in the case of combustion imparting chemical energy to a gas other than monatomic, this energy is first absorbed as translatory energy It may be thought that this would apply especially in the case of the nitrogen of the charge Both the pressure of the gas and its rate of heat transfer to the combustion chamber walls being dependent on the translatory energy, these findings may explain to some extent the mechanical and thermal damage due to detonation

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L A Peletier
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N V De Bataafsche Petroleum Maatschappij
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Sept 15

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[1] Lewis B Z phys Chem B **19** 536 (1932) Lewis B and von Elbe G J Chem Phys Feb 1935 see also discussion on paper by Rassweiler Withrow *SAF Journal* April 1935

Vitamin E Deficiency in the Suckling Rat

In a paper recently published[1] I have shown that the characteristic defects in the offspring of vitamin E deficient rats may be cured by administering to them concentrates of the vitamin It seemed important to confirm that this curative action is due to vitamin E and not to some other constituent of the concentrates derived from natural sources This I have now done by administering 2 milligrams of synthetic *d l* tocopherol (Roche) to the offspring of vitamin E deficient rats

This further observation that the synthetic vitamin produces the same curative effects as the concentrate from natural sources taken in conjunction with my previous publications shows conclusively that the missing factor in the milk of vitamin E deficient does is vitamin E

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[1] Barrie M M O *Biochem J* **32** 146 14 4 (1938)

Points from Foregoing Letters

By means of a zinc mercury lamp which gives sharp spectral lines without accompanying hyperfine structure components or continuous spectrum Sir C V Raman and C S Venkateswaran find that the light scattered backwards by glycerine and by phenol exhibits well defined Brillouin components on either side of the incident lines The authors infer that the viscosity of glycerine, as usually measured has little influence on the propagation of thermal compression waves of very high frequencies

Prof J B S Haldane gives a formula for the probability that a given individual would be killed by an explosive bomb and calculates roughly the efficiency of various types of shelters and trenches against light and heavy bombs

A graph is submitted by Dr L F Richardson showing that during the arms race of 1909–13 the increase in expenditure for armaments of France Russia, Germany and Austria combined followed a linear relation with reference to time Dr Richardson connects this with his previously deduced formula expressing the interaction of fear with cost and with grievances in international relations

By means of paraffin absorption measurements, A E Downing and Prof C D Ellis estimate the position of the resonance levels for slow neutrons in several heavy elements In bismuth they find two levels (at 1 and 11 volts respectively) corresponding to high excited states of radium E Thorium and uranium likewise show two resonance levels each while with cobalt only one (at about 1 volt) was observed Iodine appears also to have two resonance levels, which might explain the anomalous results recently reported by Michiels

The viscosities of hydrogen and heavy hydrogen gas at various temperatures between 293° K and 14° K have been determined by A van Itterbeek and Miss A Claes They find that at room temperature the ratio between the viscosities is proportional to the ratio of the square roots of the molecular weights of the two molecules but at lower temperature the ratio decreases

The absorption of hydrogen and nitrogen gas by tantalum at very low pressures (clean up) at different temperatures is described by D A Wright The absorption is considerably modified by the presence of surface oxide which explains the various results reported by previous investigators

Large increases in the longitudinal incremental permeability of a wire made of iron nickel alloy (serving as core of a solenoid) is found by J S Webb, when a direct current is passed through the wire so as to produce a superimposed circular field The author submits graphs showing the variation of the *inductance of the solenoid as a function of the direct* current through the conducting core and also the variation of the longitudinal incremental permeability when the core is twisted through various angles

P E Holmes and M G M Pryor report the presence of large numbers of the barnacle *Balanus improvisus* upon reeds in Horsey Mere Norfolk following upon increased salinity of the water brought about by the temporary break through of the sea during the storm of last spring

The percentage ratio of various blood groups among the inhabitants of Khasia and Jaintia Hills Assam derived from an examination of fifty individuals, is given by Captain R N Basu and compared with the blood group distribution among Japanese Negritoes and Indians

S Hands and Dr S Peat report the presence in methylated agar agar of a derivative of 3 6 anhydro *l* galactose which is isolated as the crystalline dimethyl 3 6 anhydromethyl *l* galactoside Evidence is given in support of the constitution assigned to the latter substance E G V Percival, J C Somerville and I A Forbes have likewise isolated from agar an anhydro sugar derivative which preliminary investigations indicate to be *l* galactose

Research Items

Possession Rite in a Deccan Village

BARA GARI, ' the Dragging of the Twelve Carts a village ceremony, was witnessed by Mr K de B Codrington at Fardapur, a Mahratti speaking community in the Deccan, India, in 1932 (*Man* October 1938) An engagement is made before the shrine of the goddess Marimata, ' the Mother of Pestilence , that the rite will be carried out, if certain prayers are granted This is usually on account of prolonged illness, on behalf of children, or above all because of barrenness In the last event, one of the men of the household must shoulder the undertaking, as only men take part, though the women are profoundly interested, and ceremonially prepare the participants by rubbing them with turmeric The women also make offerings at the shrine The ceremony is evidently a family rite On this occasion six carts only took part They were tied head to tail, the first being an old fashioned field cart with long shaft, obviously necessary for the ceremony At sundown the protagonists were led by their womenfolk to the Hanuman temple, from which all village ceremonies begin Thence they were conducted back to the Marimata shrine by one of its guardians Of the participants two were boys of about nine or ten years old, the third a youth of eighteen Each protagonist was escorted to the shrine between two men holding his arms The youth was already under the influence of possession They entered the shrine, then each came out in turn with his escort and circumambulated the line of carts at a run Each bore a tray with a number of lighted cotton wicks The upper part of the body was then rigid and the eyes fixed The boy on reaching the head of the first cart was lifted in the air by his supporters, and the cart affixed to his waist cloth and waist rope by the loop on the cart shaft, to which two hooks had been fastened The cart then moved forward towards the shrine for about ten yards, accompanied by frenzied shouting and drumming The boy s feet were not on the ground and his body took the strain, while the main motive power was supplied by men pulling on the wheel spokes and others behind the yoke

Prehistoric Cave Men in Texas

A CAVE 45 miles north of the town of Dryden in the West Texas Big Bend country, which was occupied by man at some remote period, has been excavated by Mr Frank M Setzler, of the Smithsonian Institution, Washington, D C In a preliminary report issued by the Institution, it is stated that the evidence of occupation suggests that the cave may have been used for ceremonial brewing It was discovered by Mr Setzler when searching for evidence of an ancient people—the longest headed people yet recorded The slope at the front of the cave was covered with talus which contained large fragments of fire cracked limestone These had been used by the inhabitants of the cave for heating in the fire for cooking purposes and then thrown out The cave was explored by a trench seventy feet long, which was carried to a depth of six feet The deposits included an unusual number of cooking stones, pointing to an exceptional use It is thought this unusual feature of the deposits may have been occasioned by the use of the cave for brewing the juice of the sotol plant to make a fermented drink which the Indians were found to use when the white man first penetrated this country In the deposits were also found cooked animal bones, though these were not so numerous as might have been expected, and hundreds of characteristic arrow heads, scrapers, drills and stone knives

Social Motives in Economic Activities

CLASSICAL economics is largely based on the psychological premise that in their economic activities people shall be considered as solely actuated by the motives of personal material gain During the period of the greatest industrial expansion ever known, this theory expressed and co ordinated the thinking of industry and trade for more than a century , but it has now exhausted much of its usefulness, and in so far as it tends to direct attention away from other factors it has become a danger According to T N Whitehead (*Occupational Psych* , 12 No 4 , 1938), it is necessary to develop an organic conception of society in which economic activities take their place as one important aspect of the whole social process It is impossible to be acquainted with the intimate working of an industrial plant without becoming aware of a complex network of human relations which have no place in the formal organization of the plant and yet without which co ordinated human activity could not take place There is no human motive more widely found or more constantly active than the desire to have a significant place in the group for which the member has a high regard Fundamentally, the urge is to be doing significant things together with other people To insist on the importance of social motives is not to deny the existence of those motives that are predominantly individualistic The writer illustrates by a consideration of the failure of so many wages' schemes based on a too simple application of one motive, and also of high pressure emotional advertising If a small part of the money now spent in industrial research were devoted to the methodical observation of human relations in business, then a social science might be developed of vital importance to our industrial civilization

Secretory Activity of the Liver

THE frog's liver perfused with a saline solution can secrete natural and artificial pigments in concentrations many hundred times those in the perfusate This activity is confined to dyestuffs, some carbohydrates, for example inulin, passing through without any change at all in concentration Höber and Moore (*Proc Amer Phil Soc* , 78, 587 , 1938) have tested the effects of large numbers of organic substances on this secretory function of the liver Sugars, polyhydric alcohols and amino acids inhibit liver function, and can be classed generally as substances having a strong affinity for water, as being surface inactive, and as causing dehydration of hydrophil colloids On the other hand, substances which are surface active, such as the salts of the bile acids, the carbamates and saponin, act as stimulants to hepatic secretion The authors suggest that the activity of the liver cells might be regarded as being increased or decreased according as the condition of the cell colloids is altered in the direction of higher or lower dispersion With this idea in view, they have compared the action of these substances on liver secretion with their effects on emulsions of lecithin and on the injury potentials of muscle and nerve In general, there is good agreement Substances which stimulate the liver have been found to evoke injury potentials, and to increase the dispersion of lecithin emulsions and vice versa

Medical Research in South Africa

The work, research and routine, of the South African Institute for Medical Research, Johannesburg is summarized by the director, Sir Spencer Lister in his annual report for 1937 recently published (Johannesburg South African Institute for Medical Research, 1938) Studies on pneumonia and the types of the pneumococcus that occur in natives on the mines, and on prophylactic immunization against pneumonia have been continued A large number of rodents examined for the presence of plague infection yielded only three positive results, the smallest figure recorded for positive cases since 1920 The preparation of anti plague serum by means of inoculation with avirulent living vaccine has been shown to yield a serum of greater potency than by other methods A search for bovine strains of tubercle bacilli causing tuberculosis in human beings has been continued, but not a single bovine type has been found among ninety eight strains isolated from non pulmonary cases of tuberculosis, cases which in Great Britain not infrequently yield the bovine type of tubercle bacillus

Transference of Induced Food Habit

The third of a series of papers on the transference of induced food habit from parent to offspring by the late Miss D E Sladden has recently appeared (*Proc Roy Soc*, B, 126, 30, September 23, 1938) Owing to the death of Miss Sladden in 1937, the preparation of the manuscript is solely the responsibility of H R Hewer, who also devised the type of experiments carried out by Miss Sladden and discussed in her previous papers (*Proc Roy Soc*, B, 114, 441, 1934, 119, 31, 1935) This paper now records the results of a series of experiments carried out by Miss Sladden over a period of six years Two sets of stick insects, one reared on privet in every generation but tested for their ability to accept ivy in each generation, the other reared on ivy in every generation after having been tested for their ability to accept it by identical tests, have demonstrated different relative tendencies to accept ivy as a food plant Those forced to eat ivy from the first generation onwards rapidly developed an increased ability to accept this food plant Those reared on privet continuously displayed, during the first four filial generations, an increased ability to accept ivy but to a much less extent than did the ivy fed stock In the fifth and sixth filial generations ability to accept ivy displayed a decrease and a distinct annual periodicity which is only slightly shown by the ivy fed stock It is concluded that the forced ivy-feeding has induced in the stick insect the increased ability to accept ivy in succeeding generations

Humus and Plant Resistance to Disease

Under a different title (Insects and Fungi in Agriculture), Sir Albert Howard has recently published a very stimulating discussion of this topic (*Empire Cotton Growing Rev*, 15, July 1938) His thesis is that insects and fungi are not the true causes of plant diseases, these result from poor nutrition, disease resistance being the natural reward of healthy and well nourished protoplasm "The first step is to make the soil live by seeing that the supply of humus is maintained Sir Albert then stresses the significance of the return of humus to the soil by means of the conversion of vegetable refuse into humus as in the Indore process He points out the remarkably rapid improvement resulting when humus is applied to derelict plantations of tea, rubber etc results that are so striking that it is difficult to attribute them to the response of the crop to better soil tilth etc He concludes that the effect must be connected with the proper development of mycorrhiza in the roots, and during a recent tour of tea plantations in India and Ceylon, in co operation with Dr Rayner, he obtained additional evidence pointing in the same direction Sir Albert suggests that the fungus component may enable the rapid transfer of accessory growth substances from the soil to the host plant but this ingenious suggestion remains at present purely speculative

Inducing Polyploidy by the Use of Colchicine

The recent introduction of colchicine as a means of inducing polyploidy has led to many experiments with various plants Dr H Dermen (*J Heredity*, 29, No 6) has recently described experiments and summarized the literature Aqueous solutions of colchicine ranging from 0 1 to 1 per cent were applied to buds of *Rhoeo discolor* with a camel hair brush All parts of the flower were affected, but the effect was most striking in the filamentous hairs on the stamens, the end cells being affected most of all In material collected eight days after treatment, one end cell had undergone three successive doublings of the chromosomes increasing the number from 12 to approximately 96 Other cells in the same hair had only been doubled once or twice In somatic cells of the anther, cells were observed having about 32*n* and in one case 64*n* chromosomes, indicating as many as five successive divisions of the chromosomes without cell division, owing to destruction of the spindle mechanism The meiotic chromosomes normally form a ring or chain of twelve The treatment caused the formation of 4*n* cells with univalent chromosomes and other abnormalities Pollen grains were produced which judging from their size, were *n*, 2*n*, 4*n* and even 8*n* Diploid pollen grains were also obtained by changes of the plants from greenhouse temperature to cold or warm There was a lowering in the viscosity of the cytoplasm, which remained more fluid even after cell division was resumed Suggestions are made for producing polyploid pollen grains, embryos seedlings and growing tips by colchicine or temperature changes

Travel-Times of the Seismic Waves *P* and *S*

Up to, and including, the 1929 readings, the Zöppritz Turner tables were used at Oxford for the reduction of observations and determination of epicentres for the International Seismological Summary For the 1930 readings and afterwards, the Jeffreys Bullen tables have been used The change was necessary on account of errors in the older tables brought into greater prominence by improved instrumental performance at observatories throughout the world Dr A W Lee has now performed a very useful service to seismology by examining critically the I S S published data for well observed 'normal focus' earthquakes for the years 1930–31 (Meteorological Office *Geophys Mem* No 76, 9, 1938) It was found that for the 146 shocks considered, the travel times of the *P* waves agreed well with the Jeffreys Bullen 1935 tables The travel times of the *S* waves were rather different, and departures from the tables were examined for errors in identification, variations in focal depth, and errors in the tables In this work recourse was also made to original seismograms obtained at Kew It was determined that the *S* observations are generally later than the tabulated times at distances less than 28°, but beyond this they agree better with the tables as amended by Jeffreys in 1936 For epicentral distances less than 12° there may be confusion in identification owing to the pulses arising from reflections and refractions within the granitic, intermediate and basic layers of the earth s crust Between 12° and 28° it is now generally agreed that there is often a small pulse preceding that usually called *S* Lee prefers to continue calling the large easily recognized pulse *S*, and, although he does not discuss all the possibilities with regard to the preceding pulse, makes a very important statement that all discontinuities in the earth need not necessarily be horizontal ones In view of the above deviations of the 1930–31 observations from the Jeffreys Bullen 1935 and Jeffreys 1936 tables, Lee gives a new table for *S* His table for *P*, *S*, and *S–P* differences should be very useful to observers at stations who are required to give details of an epicentre quickly without communicating with other observatories

Geocentric Distances in Seismology

Since the advent of frequent radio time signals and greatly improved timekeeping, the arrival times of various earthquake waves at observatories have been much more accurately determined, and at most observatories can now be determined accurately to a fraction of a second This makes apparent certain systematic errors in the determination of epicentres, and one of these is concerned with the departure of the figure of the earth from a true sphere It has been suggested that one method of circumventing this is to use geocentric instead of geographic co ordinates for this work In order to facilitate the change over from geographic to geocentric co ordinates, and afterwards to use geocentric co-ordinates, Dr K E Bullen, of Auckland, New Zealand, has produced in recent years a number of very valuable tables One was ' Tables for Converting Geographic into Geocentric Angular Distances" published by the British Association in 1938 The latest is 'Tables for Reduction of Apparent Travel times of Seismic Pulses PKP, PKP$_2$, SKS (corresponding to the use of Geographic Latitudes) ' This is printed as *Bulletin* No 134 of the Dominion Observatory, Wellington, New Zealand (extracted from *New Zealand J Sci and Tech* , 19, No 11, 708–18 , 1938)

Anomalous Spark Discharges between Large Electrodes

In the official overseas edition (in English) of the September issue of the *Journal of the Institute of Electrical Engineers of Japan*, there is a suggestive paper by Y Ishiguro and Y Gosho on the anomalous spark discharges which sometimes take place between large electrodes when the distance between them is large The curves connecting the disruptive voltages with the distance between the electrodes, instead of being smooth, are sometimes irregular, for which there seems no obvious explanation Until quite recently, it was customary to neglect entirely the anomalous points on these curves From the point of view of ordinary high voltage engineering, a method of computing the potential gradients for anomalous results had not yet been found In 1929, Carrol and Cozzens published through the American Institute of Electrical Engineers some anomalous results obtained with spherical electrodes Ishiguro and Gosho find with disk electrodes of great size very pronounced anomalous results The disks are curved slightly at the edges They have found that the phenomena varied from day to day If the electrodes were left idle for several days, the only treatment received being the wiping away with a clean cloth of the visible dust which had accumulated on them, the experiments showed that the anomalies were greater in some cases than in others In one experiment the maximum anomalous voltage was 124 when the normal voltage was 346 The authors have made an attempt to calculate accurately the maximum potential gradient when anomalies occur. Toepler s explanation given in 1932 applies well to the author s experiment, but unfortunately, in his own experiments in order to obtain larger effects, he had sprinkled dust particles on the electrodes, whilst in the authors experiments they kept the electrodes clean They have found that the anomalous results may be decreased either by coating the electrodes with transformer oil or with carbon tetrachloride liquid

Suggested Relativity Experiment

In Nature of July 2, p 40, a letter was published from Mr F H C Smith suggesting that a test of the relativity postulate that the speed of light is independent of the motions of its source and of the observer, should be made by measuring the speed of light from approaching and receding stars by Anderson's development of the Kerr cell method Sir Shah Sulaiman reminds us that he also considers the use of non terrestrial light as of fundamental importance in testing relativity In his paper (*Proc Nat Acad Sci India*, 7, 85 , 1937) he declared "for this experiment [the Michelson Morley experiment] monochromatic light produced on the Earth has been used so far any experiment in which *terrestrial* light is used is inconclusive and does not therefore prove the postulate of Relativity Light from the Sun should first be passed through a series of prisms (as in a monochromator), then all other light, except that with the chosen wavelength, intercepted by obstacles, and only nearly monochromatic light allowed to fall on a plane reflector and then directed into the Michelson-Morley Apparatus Although the intensity will be diminished, there will be a greater facility to observe the interference fringes I earnestly appeal to experimenters to repeat the experiment with Solar Light I venture to make the prediction that *there will no longer be the null effect* '

Weather Prediction in India

A SYMPOSIUM on weather prediction was held at Poona on July 25–26 under the auspices of the National Institute of Sciences of India The problem was discussed in its various aspects, namely, seasonal forecasting in India, air mass analysis and short period weather forecasting with special reference to the forecasting of nor' westers in Bengal, use of upper air data in weather forecasts, latent instability in the atmosphere and its consequences, rainfall due to western disturbances and the associated upper air temperatures, weather forecasting for aviation with special reference to local forecasts and kinematical methods in weather forecasting

The president, Prof M N Saha in his opening remarks, referred to the development of synoptic charts in India from the time of Blanford and Eliot and to the many new methods in the art of weather prediction introduced in India Dr C B Normand reviewed the complexities of the problem which the meteorologists have to face At one time the practical forecaster could devote most of his time to consideration of rainfall Now airmen want forecasts of upper winds, of height of cloud of fog, dust storms, sudden squalls There is this variety of requirements and yet the decisions of the forecaster have to be made quickly, there is no opportunity for lengthy calculation A hopeful method of analysis one which is now a live issue among meteorologists is to focus attention on the identification of air masses and to picture how the different homogeneous air masses should interact at their boundaries and behave within themselves India is the country in which the subject of seasonal forecasting has been most intensively studied, and yet the utmost one can do at present is to give a very general indication of total rainfall over a large area for a period of 2–4 months The proper assessment of success in weather forecasting is not so easy as one would imagine at first sight Every forecaster—amateur professional or quack—finds some of his forecasts turning out correctly, if he forecasts often enough and yet it is a curious fact, as pointed out by Sir Gilbert Walker some years ago, that 'while the forecasting efforts of a charlatan are judged by their occasional successes, it is the occasional failures of a Government department which are remembered

The first forecast of the monsoon rain which was mainly based on the snowfall on the Himalayas and the Suleman range during the preceding January to May, was issued by Blanford in 1886 Gradually Eliot added other factors, the south east trades at Mauritius, Zanzibar and Seychelles, data from South Australia and Cape Colony, and Nile flood His method involved interpretations that were liable to personal bias The first forecast using a regression equation was made in 1909 by Walker In 1924, Walker worked out six formulæ for forecasting rains in the Peninsula, north east India and north west India, in which use was made of twenty eight factors selected out of a large number after applying his statistical test To these, Field proposed the addition of a factor of special interest, as it indicated the way to a new source of seasonal indicators, namely, the upper winds and the upper air, his prognostic factor for the winter rains over northern India is the upper wind of the autumn over Agra The re examination of the data in recent years, and the application of various statistical tests, have revealed a diminution of the significance of some of the factors Nevertheless, the total correlation coefficient is still 0 63 for the total monsoon rain of the Peninsula and 0 64 for that of north west India and 0 72 for the winter rain of north west India In presenting the above review of seasonal forecasting in India, Dr S R Savur said that the methods of correlation are strictly applicable only when all the quantities correlated are distributed normally To overcome this defect, general methods are being developed The theory, however, is still in its infancy

The method of forecasts for ten day periods developed by Franz Baur of the German Meteorological Service which rests on a combination of statistics and synoptics as well as the composite map method of forecasts developed by Multanovsky and his collaborators, in which the time interval for the forecast is determined by the period which marks the type of the synoptic process involved, were explained by Mr S Basu from the point of view of their possible application to Indian conditions

Air mass analysis received a good deal of attention Dr S N Sen explained the methods adopted in India for the identification of the different air masses, these are, broadly speaking, of two classes, oceanic and continental, but it is possible to divide them into several sub classes He showed certain types of stationary fronts which often develop over the Indian area

A great help in identifying the different air masses is the drawing of stream lines and trajectories of air at different levels deduced from pilot balloon and cloud movements a method which is now in daily use Information about upper air temperatures and humidities whenever available helps to make the identification more certain Dr K R Ramanathan explained how warm fronts somewhat similar to those met with in European latitudes are associated with depressions and storms in the Bay of Bengal The two air masses between which the front forms in the Bay of Bengal are the dry, cold air from north India and the moist equatorial air from the south Bay of Bengal A modified type of front' or partition zone is associated with storms of the pre monsoon season Monsoon depressions tend to form on the zone between fresh monsoon air and old monsoon air, the former behaving as a cold mass and the latter as a warm mass Dr S K Pramanik gave an application of air mass analysis to the problem of forecasting nor' westers in Bengal, and Mr S P Venkiteswaran discussed certain relationships between upper air temperatures over Agra and distribution of rainfall during passage of western disturbances

The role of latent instability in the atmosphere in the development of thunderstorms, dust storms, etc, formed the subject of an interesting communication by Dr N K Sur This term (defined by Normand in Nature of October 3, 1931, p 583) refers to a certain thermodynamical state of the atmosphere in which, in suitable circumstances, an expenditure of a small amount of energy leads to a release of a large amount of energy Absence of latent instability is associated with dry fine weather with occasional high clouds of non convectional type, and its existence usually with convective types of clouds like cumulus or cumulo nimbus or with dust or thunderstorms

Mr Krishna Rao discussed the problems which arise in weather forecasting for aviation, which can be classified into three categories, regional, route and local In forecasting radiation ground fog, the 'Taylor diagram' has not proved very useful in India except that it can be used to rule out days when fog is unlikely Daily tephigrams based on aeroplane soundings constitute the most valuable items in forecasting convectional phenomena, formation, clearing or persistence of clouds

The kinematical methods in weather forecasting developed by Dedebant and Pettersen also received attention Whenever any pressure system, such as a cyclone, an anticyclone, a trough or a front, is in continuous motion, one can, from a knowledge of the changes that have taken place in the system in the previous two or three hours, calculate the velocity and acceleration of each point of the system and thus determine the position as well as the configuration of the system during the next 6 or 12 hours The deepening or filling of pressure over an area bounded by two closed isobars is equal to the planimetric value of the barometric tendency within the same area Dr S K Banerji gave an application of these and other kinematical laws to certain Indian storms, particularly to explain the curvature of their tracks

In winding up the discussion, Dr Normand referred to the future of weather forecasting He said that it seems doubtful whether the statistical methods applied to surface data will result in any appreciable improvement of seasonal forecasting The region where we have to look for the improvement of forecasts of all kinds from short to long range is the upper air More data by aeroplanes, *radio sondes* and balloon meteorographs are needed both in day to day analysis of the weather situation and in the search for factors of use in seasonal forecasting

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Engineering Research and Soil Corrosion

IN February 1935, the Council of the Institution of Civil Engineers adopted a more active policy in regard to engineering research and constituted a Research Committee with wide terms of reference Previously, specific problems had been investigated by committees appointed specially for each case, and their work produced results of great importance The growth in scientific knowledge and in the size and complexity of the problems confronting the engineer and also the great changes which have been effected in the materials with which he has to work, brought about a realization of the necessity for greater understanding of the scientific basis of engineering practice The Committee was entrusted with the duties of making recommendations of subjects for research and investigation, and of maintaining contact with other bodies engaged in similar work While it has mainly limited its activities to problems in branches of engineering not ordinarily included in the programmes of the more specialized institutions, it has actively co operated with many of these in researches of common interest

The report of the Committee for the years 1935–36 and 1936–37 has now been issued[1] The general policy has been to make use of the existing research organizations such as those of the Department of Scientific and Industrial Research, and of the universities and technical colleges, and no attempt has been made to set up an independent laboratory The researches in which the Committee is in this way taking part are classified under the general headings materials, soil mechanics, hydraulics, structures, and specialized engineering practice—and it will be of interest to those engaged in other branches of science to learn of the inclusion of such subjects of investigation as the most desirable types of fish passes in rivers and the practice to be prescribed for the use of self contained breathing apparatus in sewers and other engineering works None of the investigations has as yet been completed but, from time to time, in the *Journal* of the Institution, in the proceedings of other societies and in the technical press, reports of progress or of partial results have been published

Part 2 of the report gives detailed accounts of the progress of the researches undertaken One of these deals with Soil Corrosion of Metals and Cement Products The increasing occurrence of reports of severe corrosion of concrete in clay soils containing sulphate salts has shown the need for more information than is at present available as to the conditions which are potentially dangerous and as to the most effective protective measures After a questionnaire had been circulated to engineers throughout Great Britain inquiring into the prevalence of corrosion and the type of soil in which it was found, it became evident that the research ought to be organized on a wider basis, and a new committee was formed to include members from the Iron and Steel Institute, the British Non Ferrous Metals Research Association, the National Physical Laboratory, the Building Research Station and the Rothamsted Experimental Station Considerable financial support is being given by manufacturers and organizations interested in cement and concrete, and a scheme of research extending over ten years has been envisaged

From a study of the work already recorded, it has been made evident that the corrosion of metals is far more dependent upon the nature of the soil, its composition and physical condition in respect of perviousness, moisture-content, etc , than upon any variations in type of ferrous metal or in the state of a non ferrous metal A necessary preliminary to the consideration of tests on various metals is therefore the decision to concentrate attention on conditions of environment, for which purpose a special subcommittee has been formed

A separate research on the subject of "Vibrated Concrete" has yielded several interesting results From the work so far carried out, it appears that the properties of vibrated concrete are merely those of a concrete in which satisfactory consolidation has been obtained with mixes which are drier than those associated with hand-compacting The method thus extends the range of water/cement ratios towards lower limits than were previously practicable, with the results that strength and density can be improved, shrinkage and creep are reduced, and the bond with reinforcing steel is increased

In 1932, research on the stresses set up during the driving of reinforced concrete piles was commenced at the Building Research Station and was carried on in collaboration with the Federation of Civil Engineering Contractors It was initiated as a direct result of the difficulties experienced under certain conditions of hard driving, where it was found impossible to comply with the specification and at the same time to avoid serious damage to the pile This is one of the investigations in which the Civil Engineers' Committee is now co operating and as it happens, the report of the research work carried out has also recently been issued[2] In and around London there are many building sites where the ground consists of alluvial or made up soil of very low bearing power for a depth of 10–30 ft Below this is a stratum of hard compact gravel the thickness of which on any one site may vary from a foot or two to so much as 20 feet Under the gravel, soft earth of low bearing power is again found and at a still greater depth the hard compact clay is reached The uncertainty of the gravel stratum as a foundation for important structures has made it advisable to found on the hard clay It is in the penetration of the gravel that the difficulties referred to have been experienced, and excavation of driven piles has revealed unsuspected damage underground Uncertainty was, in consequence felt as to the condition of piles driven on such sites The current theory assumes uniform stress distribution through the pile, but, as the velocity of stress propagation in a reinforced concrete pile is approximately 12 000 ft per second, research was necessary This involved an examination of the nature and magnitude of the stresses induced in piles by impact, a study of the effect upon impact resistance of the design and methods of manufacture of the pile, and the development of means of indicating dangerous conditions during driving

In addition to a number of facts of the highest practical importance which have emerged from the research, as to both the conditions which arise and the best methods of driving, a mathematical theory is outlined which is shown to conform to the results of the experimental investigation in all its main conclusions and to be applicable to estimate the stress at any point under known conditions An expression is given for the Young's modulus of an equivalent homogeneous pile, but, as the mathematical expressions for the stresses are too complicated for practical use, the results have been given in the form of charts showing the maximum compressive stresses at the head and foot for different weights of hammer, stiffnesses of cushion, etc Further research is suggested and it is obvious that one of the chief sources of uncertainty and trouble is the unsatisfactory nature of existing methods of cushioning the blow A head cushion of constant properties and capable of ensuring a uniform distribution of stress over the pile head would not only prevent the majority of head failures but also would enable data to be collected on bearing capacity under controlled head conditions Of the packings in common use which were tested in the special impact machine, sackcloth has so far exhibited the best characteristics

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The Institution of Civil Engineers Report of the Research Committee for the years 1935 36 and 1936 37 Published by the Institution Great George Street S W 1

[2] An Investigation of the Stresses in Reinforced Concrete Piles during Driving Building Research Technical Paper No 20 (Department of Scientific and Industrial Research) (London H M Stationery Office 1938) 3s net

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Training and Research in Electrical Engineering

DR A P M Fleming, in his inaugural address to the Institution of Electrical Engineers on October 20, discussed the progress made in the methods of selecting the personnel required for the electrical engineering industry and the methods employed to develop scientific discoveries In former days, ideas were conceived and developed by the individual effort of men of genius, to-day, in the universities and great scientific laboratories, teams of scientific workers are at work, extending the boundaries of knowledge, out of which possible applications in industry may emerge The great manufacturing organizations find it necessary to be continually increasing their technically trained staff and to engage men of wide scientific attainments so as to apply the knowledge that practical research yields

Many of the new discoveries affecting our industry arise from the work of the physicist The field in which the physicist now works has developed in such a manner that, compared with fifteen years ago, he often needs for his researches plant of great engineering magnitude—plant which has to yield hundreds of thousands of kilowatts or many millions of volts On this account, as well as for other reasons, it is probable that the great manufacturing organizations will undertake more and more fundamental research

A pleasing feature during the last ten years has been the tendency towards co operative research whereby problems of common interest to a large number of different organizations are pooled This avoids overlapping of effort and has enabled the smaller concerns to profit equally with the large ones for the knowledge thus revealed is available to all on the same common basis as a raw material supply A great deal of the responsibility for continued technical development falls on the manufacturer The manufacturing branch of the electrical industry now employs 70 per cent of all the workers engaged in electrical applications

There are three principal educational levels of entry into the electrical industry In the lowest of these are those youths who are recruited at ages between fourteen and sixteen years from the elementary, central, junior technical and junior secondary schools, the intermediate level comprises those of sixteen to eighteen years of age, who have reached matriculation or higher school certificate standard in secondary schools, whilst in the highest level are those who enter as graduates from the universities and large technical colleges

The electrical profession is a democratic one, in that no matter what the educational level of the entrant is, he can, if he has the requisite ability and ambition, climb to the highest ranks The importance of attracting the very best recruits from each level and of encouraging, and affording facilities for, the upward mobility of the individual according to his aptitude and capability, cannot be over estimated

The question of the selection of a recruit for a particular post is most important Dr Fleming is of the opinion that for most types of industrial employment the best results are obtained when methods of self selection are employed and the entrant is given an opportunity after he has had some manufacturing experience under sympathetic guidance, of deciding for himself the branch of works to which he is best suited An increasing number of youths entering from the lowest educational level secure promotion through following a course of technical study leading to national certificates There is now an increasing tendency on the part of employers to permit their apprentices to attend equivalent part time day courses in the local technical institutions

This democratic tendency is in sharp contrast to the system in operation in Germany where, for the most part, the upper level attainable even by an ambitious youth is dictated by his starting level This restricting feature must react on the enthusiasm of one forced to resign himself to a predetermined status with little if any prospect of further advancement The U S S R plan has certain political limitations, but it endeavours to select, educate and train its entrants to industry, solely on the basis of merit with a considerable amount of success

University Events

LEEDS—Dr P L Sutherland has been elected to the chair of forensic medicine in succession to the late Prof Maxwell Telling Prof Sutherland, a graduate of the University of Glasgow, has held an appointment in the University as lecturer in the pathology of industrial diseases since 1920 He has been since 1910 pathologist to the West Riding County Council a post which he will continue to hold

LONDON—Dr Harry Jones has been appointed as from October 1 to the University readership in mathematics tenable at the Imperial College—Royal College of Science During 1933–37 he was lecturer in theoretical physics in the University of Bristol, and since October 1937 he has been attached to the Royal Society Mond Laboratory in Cambridge

Mr F W Paish has been appointed as from October 1, 1938, to the Sir Ernest Cassel readership in business finance tenable at the London School of Economics Since 1932 he has been one of the Sir Ernest Cassel lecturers in commerce at the School and also secretary of the London and Cambridge Economic Service

The following titles have been conferred in respect of posts held at the institutions indicated professor of Near Eastern archæology on Mr Sidney Smith (Institute of Archæology), reader in electrical engineering on Dr H E M Barlow (University College)

Science News a Century Ago

The Ashmolean Society

AT a meeting of the Ashmolean Society, Oxford, on October 29, 1838, Prof Baden Powell read a paper entitled 'On Refractive Indices" The object of this communication was to state the results of a series of observations, in which the author had been engaged during the summer, in extension and verification of his former researches Besides the general object of more accurate determination of refractive indices for definite rays in several important media, he had in view the settlement of some points on which questions had been raised, and in some preliminary remarks, he adverted especially to certain objections raised by Sir David Brewster at the Newcastle meeting of the British Association At Newcastle, Powell had read a paper entitled 'On Some Points connected with the Theory of Light while Brewster had read another entitled 'On a New Kind of Polarity in Homogeneous Light" In the discussion on those papers there was a marked difference of opinion and this found expression also in the pages of the *Athenæum* after the reading of Powell s paper to the Ashmolean Society

The Zoological Society

AT a meeting of the Zoological Society on November 1, 1838 the annual report which was read, stated that the receipts for the year up to October 31 amounted to £13,230 and the expenditure to £10,997 leaving a balance of £2,232 The council had determined upon an alteration in the mode of introduction to the gardens on Sundays Each fellow was to have a ticket for his own personal use and two checks for the admission of friends

Henry's Electrical Researches

ONE of the most important memoirs of Prof Joseph Henry of Princeton College, was that On Electro dynamic Induction read to the American Philosophical Society on November 2, 1838, in which he gave the results of his extension of the purely electrical part of Faraday s Admirable Discovery In his experiments, Henry had employed five different sized annular spools of fine wire (about one fiftieth of an inch thick) varying from one fifth of a mile to nearly a mile in length (which might be called intensity' helices), and six flat spiral coils of copper ribbon varying from three quarters of an inch to one inch and a half in width, and from 60 to 93 feet in length (which might be called 'quantity coils)" These he combined in various ways By the alternations of the ribbon and wire coils, the fact was established "that an intensity current can induce one of quantity, and by the preceding experiments the converse has also been shown that a quantity current can induce one of intensity; a result which has had an important bearing on the subsequent development of the electro magnetic induction coil (W B Taylor s discourse on the scientific work of Joseph Henry) In his experiments, Henry used various batteries, one being a cylindrical battery of one and three quarters square feet of zinc surface another a Cruickshanks battery of 60 elements 4 inches square and another Dr Hare s battery, 32 one gallon jars The investigations were fully dealt with by the French physicist, Antoine C Becquerel, in vol 5 of his 'Traité expérimental de l'Électricité et du Magnétisme"

Societies and Academies

Paris

Academy of Sciences (*C R* 207 509–548 Sept 26, 1938)

W **Doeblin** Sums of a large number of aleatory vectors

M **Gevrey** Use of Green s quasi functions for the solution of the problem of Dirichlet relative to the linear equations with regard to the second derivatives only

G **Van der Lyn** Abstract polynomials in general vectorial spaces

S **Stoïlow** A class of Riemann surfaces *régulièrement exhaustibles* and M Ahlfors theorem of disks

M **Schiffer** A theorem of conformal representation

B **Hostinský** A general equation of statistical mechanics

G **Garcia** The general problem of exterior ballistics

J **Solomon** Definition of the neutrino The theory of β disintegration does not necessarily imply the existence of a new particle the neutrino but only a certain number of structural properties necessary for conservation of the total system

C **Beck** Remarks on the characteristic transversal energy of an electron

Mlle M Théodoresco Raman spectrum of molybdic acid in aqueous solution

M **Prettre** Influence of the dimensions of combustion chambers on the speed of oxidation of mixtures of pentane and oxygen

Y **Volmar** and F **Weil** Action of antimony anhydride and of antimony sulphide on thiol acids

A **Willemart** Researches on the dissociable oxides of anthracene photo oxides of cyclohexyl 9 anthracene and of phenyl 9 cyclohexyl 10 anthracene

J **Bricard** Haloes and anti haloes in the natural mist at the summit of the Puy de Dôme

L **Binet** and M **Strumza** Ephedrines as active agents in the fight against anoxyemia

S **Sabetay** L **Palfray** and I **Trabaud** Presence of benzyl cyanide in the semi solid essential oil of Karo Karoundé [a species of jasmin]

P **Chabanaud** The protractor muscle of the hypopharyngeals in the dissymmetric teleosteans

G **Blanc** and M **Baltazard** Vaccination against exanthematic typhus by dried virus of rat typhus from infected fleas

Amsterdam

Royal Netherlands Academy (*Proc* 41 No 7 1938)

J **Clay**, A v **Gemert** and P H **Clay** Decrease of the intensity of cosmic rays in water to a depth of 440 m measured with counters and ionization chamber

J **Clay**, J T **Wiersma** and K H J **Jonker** Distribution of the intensity of cosmic radiation for different directions around the vertical

J A **Schouten** The geometrical interpretation of ordinary *p* vectors and *W* p_r vectors and the corresponding densities

J A **Ninck Blok Kits van Heyningen** and D A **Was** Investigations on thin layers of tin and other metals (5) The corrosion of tin by dilute organic acids (citric lactic propionic and benzoic acids)

R **Dorrestein** and J A **Smit** Determination of the cross section of metastable helium atoms with the aid of their photo electric effect

P P **Bijlaard** A theory of plastic stability and its application to thin plates of structural steel

C S **Meyer** Contributions to the theory of Whittaker functions (2)

J **Buter** Hyper convex aggregates in the plane

A J **Ruigers** E **Verlende** and M **Moorkens** Flow potentials and surface conductivity

H J **Bungenberg de Jong** Complex systems of biocolloids (1) Survey and classification according to colloid chemical and electrochemical points of view (2) Specific factors of importance to the intensity of the complex relations their significance in particular with regard to the formation of the tricomplex systems

Annie M **Hartsema** and **Ida Luyten** Rapid flowering of the daffodil (*Narcissus pseudo Narcissus* var King Alfred)

W H **Arisz** and J **Oudman** Absorption and transport of asparagine in leaves of *Vallisneria*

D F **Reinders** The process of water intake by disks of potato tuber tissue

P H **de Bruyn** and J H C **Ruyter** The influence of pre treatment with or without fixation on the Sudan granulation of leucocytes and the character of phenol granulation in general

G C **Hirsch** The pr substance of the Golgi system

Jean K **Weston** The topographic relations of ganglion cells to the endolymphatic and perilymphatic sense organs of the vertebrate inner ear

A G **van Veen** The isolation of the soporific substance from Kawa Kawa or Wati

Vienna

Academy of Sciences June 30

G **Ortner** and G **Protiwinsky** Reaction of fast neutrons with nitrogen nuclei A nitrogen filled ionization chamber is irradiated with fast neutrons and the ionization produced by the disintegration nuclei is measured as a function of the number of disintegrations per second The results show that in the reaction $^{14}_{7}N + ^{1}_{0}n \quad ^{15}_{7}N \quad ^{11}_{5}B + ^{4}_{2}He + Q$ the intermediate nucleus is in one of the states 15 98 16 91, 17 37 or 17 68 million electron volts above the ground state while the boron nucleus is in the ground state or 2 25 or 4 25 million electron volts above it

R **Grossmann** Effect of the addition of electronegative gases on the current potential diagram of ionized nitrogen From the form of the characteristic the amount of oxygen carbon monoxide and carbon dioxide present may be estimated qualitatively and quantitatively

G **Kürti** Coloration of biotite by α rays

H **Horninger** *Gegenstrahlflache* of ruled surfaces

K **Graff** Colorimetric measurement of stars down to magnitude 6 5 between Declination −10° and +20°

J **Kisser** and L W **Sekyra** (1) Identification of native woods by microscopic examination of their powders (2) Identification of the more important native woods by means of the microscopic structure of their ash

F **Köck** Decomposition of the cellulose molecule

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, October 31

University of Leeds at 5 15 —Prof D T A Townend A New Era in Combustion *

Royal Geographical Society at 8 30 —H W Tilman The Mount Everest Expedition of 1938

Tuesday, November 1

Institution of Civil Engineers at 6 —W J F Binnie Presidential Address

Wednesday, November 2

Geological Society of London at 5 30 —F J Wayland The Face of Uganda

Thursday, November 3

Royal College of Physicians at 5 —Dr Lionel Whitby The Chemotherapy of Bacterial Infections (Bradshaw Lecture)

Royal Society of Medicine at 5 —W M Mollison Laryngology s Debt to Research (Semon Lecture) *

Friday, November 4

Institution of Mechanical Engineers at 6 —Sir Noel Ashbridge The Development of Television

Institution of Gas Engineers November 1 2 Autumn Research Meeting

Appointments Vacant

Applications are invited for the following appointments n or before the dates mentioned

Designer (Ref A 163 O) at the Royal Aircraft Establishment South Farnborough Hants—The Chief Superintendent (November 5)

Lecturer in Engineering in the County Technical College Wednesbury The Director of Education County Education Offices Stafford (November 10)

Lecturer in Mechanical Engineering in King s College Newcastle upon Tyne—The Registrar (November 12)

Lecturer in Geology in the Fouad I University, Cairo—The Dean Faculty of Science Abbassia Cairo (November 17)

Assistant Naturalist for Fishery Research to the Freshwater Biological Association—The Director Wray Castle Ambleside Westmorland (November 19)

Assistant Keeper in the Department of Entomology British Museum (Natural History) The Secretary (December 1)

Head of the Chemical Division and a **Chemist** at the Rubber Research Institute of Malaya—The Secretary London Advisory Committee for Rubber Research (Ceylon and Malaya) Imperial Institute London S W 7 (December 18)

Inspector of Mines in Cyprus—The Director of Recruitment (Colonial Service) 8 Buckingham Gate London S W 1

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh Session 1937 1938 Vol. 58, Part 2, No 14 The Association of Non homologous Chromosomes in Corixidæ (Hemiptera—Heteroptera) By Dr H D Slack Pp 192–212. 2s Vol 58, Part 2 No 15 On Rare Defects in Human Populations with Particular Regard to In breeding and Isolate Effects By Prof Gunnar Dahlberg Pp 213–232 1s 9d (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) [1010

Mines Department Seventeenth Annual Report of the Secretary for Mines for the Year ended 31st December 1937 and the Thirtieth Annual Report of H.M Chief Inspector of Mines for the same Period with a Statistical Appendix to both Reports Pp xx+250 (London H M Stationery Office) 4s net [1010

Transactions of the Royal Society of Edinburgh Vol 59, Part 2 No 16 An Investigation of the Mucorales in the Soil By Dr Marie B Campbell Pp 411–436+3 plates 4s 6d Vol 59, Part 2 No 17 The Actinopterygian Fishes from the Lower Carboniferous of Glencartholm, Eskdale Dumfriesshire By J A Moy Thomas and M Bradley Dyne Pp 437–480+2 plates 6s 3d (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) [1010

Transactions of the Royal Society of Edinburgh Vol 59 Part 2 No 18 The Food and Feeding of the Brown Trout (*Salmo trutta* L) in relation to the Organic Environment By R M Neill Pp 481 520 5s Vol 59, Part 2, No 19 The Female Reproductive System and Corpora Lutea of the False Killer Whale *Pseudorca crassidens* Owen By L C Comrie and Ann B Adam. Pp 521–532 1s 9d (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) [1310

Netherlands and Netherlands Indies Information Bureau Third Annual Report of the Committee for the year ending 30th April 1938 Pp 14 (London Netherlands and Netherlands Information Bureau) [1410

Iron and Steel Institute Special Report No 23 Third Report of the Steel Castings Research Committee being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council Pp vii+294+12 plates (London Iron and Steel Institute) [1710

Other Countries

National Research Council of Canada New Hydraulic Laboratories and their Work By R Ruedy Pp ii+111+18 plates 1 dollar Twentieth Annual Report of the National Research Council 1936–1937 Pp 182 75 cents (Ottawa National Research Council of Canada) [1010

Standards on Electronics 1938 Pp vii+59 50 cents Standards on Radio Receivers 1938 Pp vi+58 50 cents (New York Institute of Radio Engineers Inc) [1210

U S Department of Agriculture Circular No 485 *Tetrastichus brevistigma* Gahan a Pupal Parasite of the Elm Leaf Beetle By P A Berry Pp 12 5 cents Technical Bulletin No 618 Biological Studies on the Leafhopper *Empoasca fabae* as a Bean Pest By Dwight M DeLong Pp 60 10 cents Technical Bulletin No 623 Fumigation of Baled Cotton with Hydrocyanic Acid for the Pink Bollworm By A C Johnson George G Becker and Lon A Hawkins Pp 46 10 cents (Washington D C Government Printing Office) [1310

Zoologica Sinica Series B The Vertebrates of China Vol 15 Fascicle 1 The Birds of Hopei Province By Prof Tsen Hwang Shaw Part 1 Pp xxxiii+528+13 plates Part 2 Pp 529–974+ plates 14 25 (Peiping Fan Memorial Institute of Biology) [1410

Icones Plantarum Sinicarum Edited by Hsen Hsu Hu and Woon Young Chun Fascicle 5 Pp iv+50+ plates 201 250 (Peiping Fan Memorial Institute of Biology) [1410

Carnegie Institution of Washington Publication No 490 Leaf Xanthophylls By Harold H Strain Pp xi+147 2 dollars Publication No 491 Fauna of the Caves of Yucatan By A S Pearse with the collaboration of Nathan Banks, Joseph C Bequaert, Joseph C Chamberlin Ralph V Chamberlin B G Chitwood, William J Clench Edwin P Creaser Norma C Furtos Helen T Gaige, Theodore H Hubbell Carl L Hubbs Libbie H Hyman Wilton Ivie Remington Kellogg Harlow B Mills J Percy Moore C F W Muesebeck *et al* Grace E Pickford Horace W Stunkard George W Wharton William Morton Wheeler Charles Branch Wilson Frederick A Wolf Pp iii+304+8 plates 3 dollars Publication No 497 Hibernation and Marmot Physiology By Francis G Benedict and Robert C Lee Pp x+239 2 dollars Publication No 502 Modern Maya Houses a Study of their Archæological Significance By Robert Wauchope Pp vii+181+38 plates 3 dollars Publication No 503 Vital Energetics a Study in Comparative Metabolism By Francis G Benedict Pp vii+215 2 dollars (Washington D C Carnegie Institution) [141

New Zealand Department of Lands and Survey Annual Report on Public Domains and National Parks of New Zealand Pp 11 (Wellington Government Printer) 6d [171

Canada Department of Mines and Resources Mines and Geology Branch Bureau of Geology and Topography Geological Survey Memoir 207 Cranbrook Map Area British Columbia. By H M A Rice (No 2435) Pp v+67 25 cents Geological Survey Memoir 211 Thetford, Disraeli and Eastern Half of Warwick Map Areas Quebec By H C Cooke, with Chapters on the Beauceville St Francis and Lake Aylmer Series by T H Clark (No 2440) Pp vi+160 50 cents Geological Survey, Memoir 215 Fossil Flora of Sydney Coalfield Nova Scotia By W A Bell. (No 2439) Pp ii+334 75 cents Geological Survey, Memoir 218 Mining Industry of Yukon 1937 By H S Bostock (No 2450) Pp ii+21 10 cents (Ottawa King s Printer) [171

Bernice P Bishop Museum Special Publication 29 Canoes of Oceania Vol 3 Definition of Terms, General Survey and Conclusions By A C Haddon and James Hornell Pp 88 (Honolulu Bernice P Bishop Museum) [1710

Catalogues, etc

English Science and Medicine (List 29) Pp 52 (London E P Goldschmidt and Co Ltd)

Evertebrata. (No 95) Pp 83 (Den Haag Antiquariaat Junk)

The Sea and its Story (Catalogue No 630) Pp 82. (London Francis Edwards Ltd)

The Wild Barfield Heat Treatment Journal Vol 3, No 18, September 1938 Pp 14–25+vi (London Wild Barfield Electric Furnaces Ltd)

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Science in World Affairs

IN recent broadcast addresses Mr Neville Chamberlain and President Roosevelt have pleaded for peace among civilized peoples by consultation instead of force—whether displayed to produce fear or actually used to oppress or subjugate races or nationalities In the speech which the Prime Minister broadcast at the darkest hour of the recent crisis, he affirmed his conviction that any nation which attempted to dominate the world by fear of its force should be resisted, and that under such a domination the life of people who believe in liberty would not be worth living President Roosevelt stated very clearly the basic principles of permanent peace by which alone can we hope for scientific or any other quality of human progress There can be no peace," he said, "if the reign of law is to be replaced by a recurrent sanctification of sheer force There can be no peace if national policy adopts as a deliberate instrument the dispersion all over the world of millions of helpless, persecuted wanderers with no place to lay their heads There can be no peace if men and women are not free to think their own thoughts, to express their own feelings, and to worship God There can be no peace if economic resources which should be devoted to economic reconstruction are to be diverted to intensified competition in armaments—to a competition which will merely heighten suspicions and fears and threaten the economic prosperity of each and every nation "

It is obvious that the spirit of this declaration is opposed to the urge of nationalism which is now the chief cause of conflicting policies Any nation which separates itself from the rest of the world in the name of race or religion and cultivates ideals of conquest by force in order to impose its beliefs upon others is not promoting social or ethical evolution but retarding it Science has made the world a single unit through the facilities of communication and transport now available and it recognizes no political or racial boundaries in its fields of knowledge To limit study or research in science to any national or racial group, and to disregard other contributions to the progress of natural knowledge, is to betray all that is best in scientific intention Among modern and social intellectual forces, science alone speaks in a tongue which meets with universal understanding if it should ever consent to be coerced into a purely nationalistic policy its suicide is inevitable

What is wanted to day is the international spirit of science in the consideration of problems in which the interests of several nations are involved This, as is suggested in a letter signed by the Archbishop of York, the Bishop of Bristol, Sir Gowland Hopkins, Sir Thomas Holland, Sir Frederic Kenyon, Sir Richard Gregory, Mr H G Wells, and others published in *The Times* of October 29, is the kind of moral rearmament to which attention should be given by all statesmen if rationalism instead of nationalism is to be an effective power in shaping the destiny of mankind The plea made in the letter is for a World Foundation such as has been initiated in the United States by Señor de Madariaga with a two fold purpose (1) to foster the idea of world unity among all peoples, and (2) to promote inquiries directed towards political and economic appeasement on all fronts These two purposes are essentially complementary Only through a new conception of world unity can we override the rock of national bias upon which so many admirable international schemes split

In the development of the social instinct, a sense of consideration for the needs of others has grown from the primitive stage in which it embraced members of the blood kin only, or those of the local group within which the members are more or less intimately acquainted to national groups, and to a commonwealth of nations. A World Foundation would embrace all to whom the dignity of man as an individual entity transcends racial and political boundaries. When such a world commonwealth extends to all men of good will it will be possible to estimate how far the human race has advanced along the road of spiritual as well as material progress. The urge of nationalism and its ideals has diverted the thoughts of peoples in totalitarian States away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization.

The efforts which scientific workers of any nationality may be expected to make in response to calls for unity and service should have for their ultimate aims a world federation and the preservation of intellectual freedom. Preparations for war, whether limited to the organization of national defence or not, cannot suffice in themselves to meet this present challenge of our day to all that is best in the heritage of mankind. The call which Dr E C Conklin addressed to the American Association for the Advancement of Science last December that those who inherit the tradition of liberty of thought, speech and Press and believe that it is essential to all progress should use their utmost influence to see that intellectual freedom shall not perish from the earth has but gained in cogency from events that have since taken place.

Such freedom is still essential for the advance of science and scientific workers to day may well feel even more than a year ago that the time has come when science should stand openly for freedom especially in countries where force war and civil disabilities leading to exile are used to compel acceptance of political or social creeds. The growing restriction of intellectual liberty is, indeed the most disturbing feature of the present international situation. From many sources before and as well as after the recent crisis have come appeals to rally in defence of liberty and scientific workers have more rather than less reason than the ordinary citizen to respond to that appeal. Science is everywhere the same in aims and methods. Its advance has depended on the contributions of individual inquirers without distinction of race, and anything that limits their contribution or hinders the exchange of views or the contact between different workers impedes that advance.

The greatest problems that confront mankind to day—the promotion of social co operation justice and brotherhood the upholding and development of loyalty to truth and the expansion of ethics until it embraces all mankind are problems which intimately concern science which indeed must bring its own contribution to their solution. There is, however, an even greater challenge. Such problems can only be solved if we zealously guard the freedom and integrity of our thought boldly facing new conditions and meeting every problem without shrinking from difficulties but faithful to the laws which govern our intellectual being.

It is precisely because when freedom of thought and work in scientific research and investigation are threatened their integrity is threatened also that the question is of such vital importance to science to day. Unless the present contraction of liberty is checked the threat to the advance of science and all that it implies for mankind will grow more serious. Already the free intercourse of men of science has been seriously checked both directly and indirectly through the doubts thrown on the integrity of what purports to be scientific work in certain totalitarian States. Even in the remaining democracies the orientation of scientific work is liable to be changed and restrictions imposed if more insidiously on the full freedom of scientific work, through the exigencies of national defence.

With this position no scientific worker who cares seriously for the integrity of his work or the advancement of his science can rest content. Alike in the prosecution of the research directly concerned with matters of national defence as for example in the distribution of population or building or in the objective study of social problems and international relations which are a fundamental part of any policy directed to prevent or eliminate war the principle of intellectual freedom is a vital condition. Violation of this principle injures the whole quality of the scientific contribution and may ultimately destroy it while at the same time it hinders the wholehearted co operation of all scientific workers which is so essential alike in the organization of national defence or a policy for peace.

The defence of intellectual freedom is thus a matter of immediate practical importance to the scientific worker, whether from the point of view of the integrity of his particular science or his response to the call for national service. He must neglect no opportunity either as a citizen or as a professional man of urging support for a policy which fully safeguards such freedom and be prepared to co operate with any national movement which aims at ensuring this essential principle of progress He should also be prepared to accept his share in the task of rehabilitating the many men of learning whose work has been interrupted by violation of this principle in other countries Equally he should be prepared to take his part in the clear thinking required to formulate sound principles of relations between the scientific profession and the State and to accept loyally the discipline or code of ethics thus evolved Nor must he fail to uphold the principle of supreme loyalty to truth essential no less in the smallest scientific investigation than in the broad programmes of objective research into social and international problems which must be pursued if we are to build a world order from which the fear of war and the wastage of armaments is ultimately banished

Seasonal Periodicity of Malaria

The Seasonal Periodicity of Malaria and the Mechanism of the Epidemic Wave
By Dr Clifford Allchin Gill Pp xi+136 (London J and A Churchill Ltd 1938) *10s 6d*

THE discovery by Ross of the mosquito cycle made it possible for the first time to explain a host of facts in the epidemiology of malaria which otherwise were entirely inexplicable It very soon became evident that malaria instead of being contracted from man s general surroundings in Nature as up to then had been supposed was merely a special case of a man to man infectious disease differing only from other infectious diseases in that an intermediate insect host was required for its transmission That the insect host was a necessary factor did not at first presuppose any very complicated relationship in this respect If there was no vector there would naturally be no malaria but other things being equal the amount of malaria might be expected to be in proportion to the numerical prevalence of the incriminated insect

This relatively simple outlook was soon found however to be far from an adequate one and the history of malaria investigation has more and more shown how complex are the factors which determine malaria prevalence Especially have recent researches shed unexpected new light in this field In the book under notice Colonel C A Gill gives a very clear and readable exposition of some of these new additions to knowledge Malaria does not merely show different degrees of prevalence in different regions of the earth it exhibits also peculiarities in the different terrestrial zones which can be described and defined

It is one of the merits of this small volume that it has for the first time clearly and interestingly given both the limits and the reasons for the existence of these zones The zones are essentially related to temperature and humidity the different combinations and permutations of which acting through the insect vector the human host and the parasite bring about special features which characterize each zone Thus below a certain critical summer temperature *Plasmodium falciparum* fails to make good and the field is occupied to the virtual exclusion of other forms of the parasite by *Plasmodium vivax* The long term relapse which is characteristic of this parasite not only appears to have enabled it to circumvent what would otherwise be very serious difficulties in maintaining transmission but it also gives to malaria in the temperate malaria zone quite peculiar seasonal and other epidemiological features

Subtropical zone malaria and tropical zone malaria differ from each other largely because in the latter long periods of extremely low humidity lead to decreased human immunity so that this zone is apt to be the site of those vast epidemics which hitherto in northern India have literally controlled the population These epidemics follow abnormally heavy rainfall and are terminated by the onset of a cold season Equatorial zone malaria has its own form of epidemic which as in the recent Ceylon epidemic follows upon drought and not upon heavy rainfall, and possesses features due to the fact that there is no cold season to cut short its course

All these interesting differences are very clearly set out by Colonel Gill who proceeding from the normal to the abnormal has been in the position to make a very valuable contribution to our knowledge of the causes and mechanism of epidemics of malaria The book is one which all malariologists should read S R C

Sponges

Die Rohstoffe des Tierreichs
Herausgegeben von Ferdinand Pax und Walther Arndt Lieferung 13 Kapitel 9 Schwamme Von W Arndt Pp 1577–2000 (Berlin Gebruder Borntraeger 1937) 45 gold marks

THIS is a new part of an encyclopædic work little known as yet in Great Britain which deals well and thoroughly with the commercial side of natural history There is much worth knowing about beast and bird beyond the ken of even the most learned zoologist The trapper, the fur trader and the plumassier the sponge merchant and the dealer in shells the pearl fisher and the ivory trader the druggist with his fats and waxes glues isinglass musk civet ambergris and galls all these not to speak of the men in Leadenhall Market or Billingsgate are highly skilled naturalists in their own peculiar way and have a fine field of learning and observation of their own

The volume before us consisting of more than four hundred pages is an extremely interesting account of the sponge fishery and the sponge market of the many sorts of sponges known to the trade, their use and value their place and mode of capture and all the trade statistics of this world wide industry

No man knows when sponges were first used They were a household word in Homer s time, and Ulysses called for water and a sponge to wash down the tables and chairs after a certain sad scene in the palace The very name is far older than Greek and harks back to that ancient *lingua franca* of the Levantine fishermen to which *tunny* and *pinna* and the *seine* net belong Oppian gives a picturesque account—it might be a modern one—of the sponge diver with a lump of lead in one hand and his crooked knife in the other and a mouthful of oil to smooth the sea and let the sunlight through From classical antiquity the book passes on to the trade routes of the Middle Ages and the old Italian apothecaries shops—and so at last to the sponge trade of the present day We are shown the fine Turkey cup or Levantine sponges the African Zimoccas the West Indian grass sponges and wire sponges the great elephants ears from the Philippines and many more and still we are only a little way from the beginning of this interesting and useful book

D W T

Complex Osmosis

Lectures on Osmosis
By Dr F A H Schreinemakers Pp xi + 266 (The Hague G Naeff, 1938) 8 50 gldrs

PROF SCHREINEMAKERS has been engaged since 1924 in studies in osmotic phenomena which have hitherto only been available in Leyden dissertations and the publications of the Amsterdam Academy of Science In this book he gives a collected account in English of his researches which will be of great interest to those who are concerned with the transport of material in animal and vegetable tissues

The fundamental equations of osmotic equilibrium were laid down by Gibbs, and provided at one time a valuable means of investigation of the properties of solutions, which has been superseded to a great extent by more convenient methods owing to the difficulty of preparing ideally semi-permeable membranes But ideal membranes rarely occur in Nature and, especially in complex solutions, a baffling variety of phenomena is encountered

This book is not concerned with the properties of solutions which determine the osmotic equilibrium but with the effect of the membrane on the *path* by which osmotic equilibrium is approached and the different types of behaviour which may be encountered in numerous different circumstances Thus although osmotic flow must always proceed on the whole towards thermodynamic equilibrium, when a membrane is permeable to two or more of the substances present it may happen that one substance is carried by another against its natural direction of osmotic flow, giving rise to apparent negative osmosis Again a membrane may be permeable to two substances in certain proportions , or only within a certain range of concentration In connexion with the latter, Prof Schreinemakers discusses some ingenious models of mechanisms by which this may be effected (checking membranes)

Although illustrative examples are given of many of the phenomena, with membranes of pig's bladder, 'Cellophane' and parchment, the book is not primarily concerned with phenomenological aspects of the behaviour of membranes It is to be regarded as the grammar of the subject, where all possible types of behaviour are tabulated and codified, thus providing a framework to which observed phenomena can be referred It is not easy to read, and the severe form of the presentation may repel some but its study by all students of membrane phenomena would be amply repaid

Finally we may note a point which is not generally known namely, that in the triangular representation of ternary systems the usual equilateral triangle may be replaced by a right angled triangle on ordinary graph paper which has similar properties J A V Butler

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Northeastern American Marine Algæ

Marine Algæ of the Northeastern Coast of North America
By W R Taylor (University of Michigan Studies Scientific Series, Vol 13) Pp ix + 427 + 60 plates (Ann Arbor University of Michigan Press, 1937) 5 dollars

RECENT handbooks dealing with the marine algæ of specific localities are few in number and no systematic account of these plants has come from North America since Farlow wrote his handbook of New England algæ more than fifty years ago Prof W R Taylor's volume describes the algæ from the Virginia capes to the arctic islands and Hudson Bay, and incorporates an incomplete manuscript left unpublished on the death of F S Collins in 1920 Collins's published works and especially his volume on the green algæ of North America have shown the breadth of his knowledge and experience and it will be therefore with especial satisfaction that algologists will learn of the incorporation of his unpublished work in the present volume Prof Taylor makes it clear, however, that the book must not be regarded merely as a revision of Collins's manuscript, and points out the wider geographical range with which it deals

Recent research on the marine algæ has been considerable and many new facts relative to their life-histories have been revealed, especially perhaps in the Phæophyceæ, where the mode of over wintering of the so called 'summer annuals' is gradually being discovered In the Rhodophyceæ, too, our knowledge of life histories has increased and new light has been shed on the life cycles of aberrant forms Such additions have their bearing on classification, and it is therefore obvious that Prof Taylor, though using the facts incorporated in the older manuscript, was forced, in the light of recent work, to make major changes in classification and in the description of some of the life histories

In the present volume, some 530 species and varieties are described and as many of them are also present in Britain, the book will be of value to algologists on this side of the Atlantic as well as to those who are working on the particular area with which the author deals Most of the common species have been redescribed from American material and data secured from the literature incorporated especially in regard to life cycles and the anatomy of reproductive organs In addition references are given to two exsiccatæ Algæ Exsiccatæ Americæ Borealis by Farlow Anderson and Eaton and Phycotheca Boreali Americana by Collins Holden and Setchell References are also made to relevant books and papers to synonomy and to illustrations It is of especial value to students of the subject to have references to morphological papers included in a systematic study of this kind and this greatly enhances the general value of the work

The author begins his volume with lists showing the geographical distribution of the commoner algæ and a brief account of algal habitats and floristic areas together with careful notes on the collection and preservation of specimens A brief historical survey follows in which the history of the study of American algæ is given This is followed by a classified list which will be of especial use as a check list to workers in other regions Keys for orders, families, genera and species are incorporated in the descriptive catalogue, and each species is described briefly the localities given and references cited

In the Phæophyceæ the classification adopted appears to be that suggested by Kylin in 1934 ("Zur Kenntnis der Entwicklungsgeschichte einiger Phæophyceen ' *Lunds Univ Arsskr* n f Avd , 2, 30 (9)) It is noteworthy that there is a complete absence of any members of the Cutleriales, Dictyotales and Sporochnales in the region described The classification puts *Acrothrix*, *Arthrocladia*, and *Desmarestia* into the Desmarestiales, thus removing *Desmarestia* from the

Laminariales where its brief sojourn on account of the possession of a microscopic gametophyte seemed peculiarly unsuitable on morphological grounds

In the red algæ recent work has been included and the so called parasites *Actinococcus subcutaneous* and *A agregatus* are included in the life histories of *Phyllophora Brodaei and Gymnogongrus Griffithsiæ* of which they are now known to form a part

With further reference to anomalous forms and in view of the work of Svedelius on the genus (The apomeiotic tetrad division in *Lomentaria rosea* in comparison with the normal development in *L clavellosa* *Sym Bot Upsal* II 2) it is interesting to note that *Lomentaria orcadensis* (Harvey) Collins is recorded only with tetraspores The investigation of the nuclear condition of this plant would be of especial interest

The book is illustrated by sixty plates drawn by Chin Chih Jao whose skill and algological knowledge have combined to produce illustrations of a very high order The drawings of external morphology are especially delightful and those drawn at high magnification combine accuracy of interpretation with beauty of line It is perhaps less convenient to have the illustrations at the end rather than inserted in the text but doubtless there were technical reasons for the decision For the benefit of those who are not very familiar with the region a map showing the general distribution of the algæ would have been helpful and could easily have been constructed from the data given

An extensive bibliography completes a volume that will be welcomed by algologists as a systematic handbook of a new and particularly pleasing kind L N

Statistical Theory

Simplified Statistics
By Leonard J Holman Pp xii + 142 (London Sir Isaac Pitman and Sons Ltd 1938) 3*s* 6*d* net

IN recent years it has been widely recognized that a knowledge of statistical theory is not only important in the sciences but is also of great usefulness in many fields of business and commerce Courses on statistics are now given in various commercial colleges and the subject is finding a recognized place in any well balanced commercial curriculum These developments have already called forth a number of suitable text books in which the subject is approached in a simpler and more practical way than in the earlier books where statistics was treated for the most part as a branch of mathematics

The regular student having been thus catered for the question arises whether it is possible to present statistical theory to the general public For this a still simpler and more attractive treatment is needed and it is such a presentation that the author has provided in this volume In his preface he enumerates the classes of readers for whom he has written Some people are in the habit of using statistical formulæ without having the least idea how the formulæ have been derived There are others who at one time made an effort to study statistical theory but coming up against a mass of algebraic formulæ abandoned the attempt But the general public is for the most part unaware that there is a theory of statistics and understands by the word statistics nothing but the lists of figures in official records such as census and trade returns Such readers if they have an aptitude for mathematics and are interested in the derivation of formulæ will in this book learn of the underlying laws and of the connexion of these with mathematical probability The examples are well chosen from everyday life the author not only considers the monthly fluctuation in the sales of a commodity but also discusses in detail how one would set about verifying such propositions as Smoking during youth inhibits growth and Brunettes are more excitable than blondes

In places the author has not succeeded in smoothing the reader s path At the very beginning of the book the reader is confronted with a diagram consisting of three large rectangles and a few smaller rectangles The diagram looks like the floor plan of a house and the beginner may be astonished to find that without warning the rectangles are referred to as a curve in fact a bell shaped curve The author has overlooked the fact that to the inexperienced eye rectangles do not look like a curve On the whole however the author has taken great trouble to make each step clear and sometimes to cheer the reader on his way with jocularity in the style of a news reel commentator The nature of statistical theory is such that the non mathematical reader can scarcely expect to follow the details of the argument without unusual perseverance but to any who wish to try their strength the book can be sincerely recommended R W G

Die Sedimente des äquatorialen Atlantischen Ozeans

Lief 2 C Zusammenstellung der Untersuchungsergebnisse nach Stationen geordnet, D Auswertung der Ergebnisse Von Prof Dr Carl W Correns, mit Beiträgen von V Leinz und O E Radczewski (Wissenschaftliche Ergebnisse der deutschen Atlantischen Expedition auf dem Forschungs und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der deutschen Wissenschaft von Prof Dr Albert Defant, Band 3, Teil 3) Pp xii+135–298 (Berlin Walter de Gruyter und Co 1937) 20 gold marks

IN this report, Dr Correns gives the result of the mechanical mineralogical chemical and microscopic examination of more than a hundred specimens of the bottom deposits from the equatorial parts of the Atlantic Ocean The larger number of these were cores obtained with a sampler of the Ekman type, and the longest measured 95 cm When the core consisted of more than one part each part was examined separately, and in nearly every case it was possible to assign it to its period, glacial, interglacial or post glacial An interesting result of this is that it is shown that in glacial times fine sand blew seawards from northern Africa as it does now from the Sahara

The mineral components of the various types of deposit are found to be much more uniform than was supposed previously, the minerals occurring in blue mud Globerigina ooze and red clay are strikingly similar Special attention was paid to the content of calcium carbonate, which is of great interest in view of Wattenberg's investigations into the conditions under which it is dissolved by the bottom water In the deep sea it is chiefly foraminiferous and W Schott has found that the sieve fraction No 2, with a particle radius of 1 0–0 1 mm consists almost entirely of foraminifera He uses this weight to calculate the foraminifera number of the deposit

Dr Correns sees in the deep sea deposits of the equatorial Atlantic Ocean a transition from blue mud with rapid sedimentation of the mineral components, by way of the calcareous clays and Globerigina ooze to the red clay, in which the finest minerals fall slowly to the bottom while the calcium carbonate is redissolved

Fortschritte der Paläontologie

Herausgegeben von O H Schwindewolf Band 1 Bericht uber die Jahre 1935 und 1936 Pp viii+374 (Berlin Gebrüder Borntraeger, 1937) 29 60 gold marks

THIS new periodical is intended to form a biennial review of the progress of palæontology It was planned with the idea that it should serve to keep up to date the "Handbuch der Paläozoologie", but the publication of that work was delayed and the first part has only recently appeared

The arrangement of the volume is similar to that of the *Palaeontologisches Zentralblatt* It begins with sections on text books, phylogeny, palæogeography, zoogeography and other general subjects, followed by sections on different groups of fossils, each written by someone with a special knowledge of the group and concluded with a select bibliography Each section aims at giving a summary of the more important work published in the years 1935 and 1936 With so many authors there must necessarily be some want of uniformity in both the character and the amount of information given, moreover, the quality and amount of research done must vary in different groups so that some sections of the volume lend themselves to more interesting treatment than others

The periodical should be of great value to advanced students and to specialists who wish to keep in touch with the work which is being done in other fields of palæontology

Heredity

By Prof A Franklin Shull (McGraw Hill Publications in the *Zoological Sciences*) Third edition Pp xvii+442+1 plate (New York and London McGraw Hill Book Co Inc 1938) 21*s*

THIS book has been largely rewritten in the present edition Its contents are still concerned mainly with the genetics of cultivated plants domesticated animals and man The human side has been considerably extended, and the order of the chapters rearranged Chapters are included on eugenics, population race problems and immigration

The book is intended as an introductory statement on genetics for first year students in American universities who have had no previous training in biology and are taking up the subject from the general cultural point of view It contains much that would be of interest to the general reader and should help the student to orientate himself regarding the bearing of genetics on human affairs The quantitative or biometric side of genetics is treated in an appendix of twelve pages This is followed by a series of 660 questions and problems based on the text, a list of literature and an index No typographical errors were noticed but Fig 34 A from another text book gives a misleading conception of the relative size of the parts in a flower bud

La Vie des mouches et des moustiques

Par E Séguy (Bibliothèque Juventa) Pp 254+12 plates (Paris Librairie Delegrave, 1938) 16 francs

M. SÉGUY the author of this manual, is a well known student and writer on the Diptera The book therefore is authoritative although essentially non technical Written in a clear style, it conveys to the general reader the latest essential information regarding flies and mosquitoes, their habits and more especially their relations with man The title of the book does not really convey the idea of its main purpose which is to disseminate knowledge of the great economic importance of this order of insects It deals in special with the relations of Diptera to human and animal disease, whether it be caused by the larvæ (myiasis) or brought about by the adult flies as vectors The book is illustrated by numerous figures combined into 12 plates which are drawn by the author It deserves a good reception, not only in France, but in other lands also

A D I.

Swedenborg's Treatise on Copper

THE circumstances in which a translation of Swedenborg s historic Treatise on Copper ' has become available to the public are indicated in a preface to the edition recently published* written by Mr Fullman editor and information officer of the British Non Ferrous Metals Research Association He writes

"In 1734 Emanuel Swedenborg, the Swedish Scientist, Philosopher and Mystic, published the three volumes of his Latin Treatise 'Opera Philosophica et Mineralia' The first volume contains a mechanical and geometrical theory of the origin of things a translation was published by the Rev Augustus Clissold under the title 'The Principia or the First Principles of Natural Things', (London 1846 2 volumes) The second volume deals with iron and steel and has been translated into French and Swedish a long review of the Swedish translation by Harald Carlborg appeared in The New Philosophy', April 1926, Vol 29, No 2, pp 33–59 The third volume is concerned with copper it is commonly known as The Treatise on Copper, or 'de Cupro', since the Latin title commences 'Regnum Subterraneum sive Minerale de Cupro et Orichalco' "

Some years ago Mr Fullman had occasion to check various references to the Treatise on Copper and not finding any version of the book other than the original Latin called on the Rev J R Presland librarian of the Swedenborg Society at Swedenborg House to see if he could assist him From him he learned that no translation of the "Treatise" had been published but that the Society had a manuscript translation in its strong room, and also that Mr L P Ford had approached Mr A H Searle with a view to the translation of the original Latin and that the work was done at Mr Ford s expense in 1901 He offered the translation to the Council (then Committee) of the Swedenborg Society "on the condition of its undertaking to publish the work" This offer the Committee found itself unable to accept At a meeting, held a year later a request was received from Mr Ford ' to preserve the English translation of Swedenborg's treatise on Copper by depositing it in their strong room" This request the Committee granted and the manuscript was shortly afterwards placed in the strong room at No 1 Bloomsbury Street, London from which it was transferred to Swedenborg House, Hart Street W C 1 when the Society moved there in 1925

The translator Authur Hodson Searle was born in 1839 and died in 1914 When he was about four years old, he suffered an illness which deprived him completely of his hearing and consequently, for a time, of speech He was taught the finger alphabet and lip reading and thus learned to converse, although in a somewhat muffled voice In spite of these physical disabilities he became an excellent Hebrew and Latin scholar He was not a metallurgist being in fact occupied as an artist in reproducing for the engraver plates of conchological specimens All in all as Mr Fullman writes, his preparation of this translation is a remarkable achievement and no reader of it can fail to be impressed by its quality '

The British Non Ferrous Metals Research Association has recently reproduced the translation in mimeograph form in three volumes and the present reproduction makes this work which is of great interest to metallurgists and others readily accessible at a reasonable figure

Swedenborg divided his ' Treatise" into three parts The first which constitutes the great bulk of the work and is the most important deals with the methods of smelting copper from its ores and the refining of copper as produced in Sweden Norway Russia, England, Spain, Hungary, Germany Austria and elsewhere with notes on the same subject from treatises by various authors The latter part of this volume contains an account of methods used for the separation of silver from copper and a discussion of brass and processes for its production The second part commences with an account of the nature of various copper ores and their occurrence throughout the world, and then deals with the assaying of copper ore, including assaying for silver The third and last part deals with miscellaneous matters including the production of various compounds of copper the specific gravity of the metal and its increase of weight on oxidation

Pride of place in the first part is given to an account of the method of roasting, smelting and refining of Fahlun ore This was one of the greatest copper mines in the world The author states that, at the time of publication of his book, the great mine was still unexhausted though having been continuously worked for a period of a thousand years At the height of its fame it yielded 60,000 cwt of copper yearly, so that, to use his words, "All its foundations, doors, grottoes, walls, porticoes, halls and columns were thrown open to their fullest extent, the ore glittering on all sides with a ruddy glow and almost blinding the eyes with rays of golden colour, so that the guests now coming from Fahlun seemed to be, as it were, introduced into the presence of Venus herself, sitting as a bride or newly wedded wife in her most splendid decorated bridal chamber, ready to receive and welcome them most joyfully"

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* British Non Ferrous Metals Research Association Miscellaneous Publication No 333 Swedenborg's Treatise on Copper (Opera Philosophica et Mineralia Vol 3) Translated into English by Arthur Hodson Searle Section 1 Being Chapters I–XIX of Part I of Original Pp xviii+180 Section 2 Being Chapters XX XLIX of Part I of Original Pp iii+181 348 Section 3 Being Chapters L–LIII of Part 1 Part 2 (Chapters I IV) and Part 3 (Chapters I–XII) of Original, with Index Pp iv+349–536 (London British Non Ferrous Metals Research Association 1938) 25s to Members 15s

The extraction of copper from its ores, mainly sulphide ores, containing iron, usually with some arsenic and antimony, was a long and laborious process Briefly, it was as follows First there was a calcination to drive off volatiles wood fuel being used This was followed by fusion and smelting, in which the fuel was crushed coal, the air being blown in from a blast pipe about three inches in diameter In this way a copper 'stone' was produced and collected in the fore hearth, which was tapped every two hours This stone was of an intense blood red colour and flowed very slowly Then followed a second calcination which consisted of six successive treatments in a 'burning fire' The gradual removal of the volatiles took place, with accordingly an enrichment of copper This calcination lasted about five weeks Then came a second smelting, which occupied a further week, in which further quantities of iron were slagged off, and the cupreous product was tapped from time to time This was known as coarse or black copper These furnaces were situated within a mile of the mine and there were about a hundred and thirty of them Next followed the refining of the coarse copper at Afwedstad in Sweden and the final stage consisted in the smelting of this so that it could be beaten out into laminæ or plates The total period required was between seven and eight weeks and the maximum annual production was about 2,000 tons, corresponding to a weekly output of not more than 40 tons When it is considered that the daily production of a modern copper works is of the order of 300 tons of refined metal, it will be realized that considerable advances have been made in the smelting and refining of copper in the last two hundred years

The British Non Ferrous Metals Research Association is to be commended for its public spirit in rendering available a treatise which gives so much information about the metallurgy of copper in the late seventeenth and early eighteenth centuries

H C H C

Oceanography and the Fluctuations in the Abundance of Marine Animals*

By Dr. Stanley Kemp, F.R.S.

It is interesting to note that the observations we have of salinity and temperature cannot be correlated with the biological data For many years past, Dr H W Harvey has followed the temperature and salinity changes at the western end of the Channel, and during the period since 1924 he has found that the most conspicuous movements were large incursions of low salinity water in May 1928 and in March and April 1936, while in 1932, 1933 and 1934 (especially in 1933) patches of water with unusually high salinity moved eastwards up the Channel So far as can be seen, these movements show no correspondence with the marked biological changes which have occurred it is in the phosphate data only that a correlation can be found

In the year 1921 there was an exceptional influx of Atlantic water, which filled the Channel and flooded into the North Sea Salinity and temperature were much above normal and numbers of unusual planktonic organisms of Atlantic origin were found in the North Sea. Recent experience at Plymouth might lead one to think that such an influx as this would bring benefit to the herring fisheries, but actually it was just the reverse, for at Plymouth and in the North Sea at Lowestoft Yarmouth, Grimsby and North Shields, the herring fishery was much below normal

It thus appears that incursions of Atlantic water into the Channel may bring advantage to the biology of the area or may be detrimental, that no obvious connexion between the biological data and temperature and salinity is noticeable, and that so far as we can at present see, the only correlation that can be established is with phosphate The explanation lies, I believe in our very considerable ignorance of the constitution and origin of the water masses which from time to time enter the Channel

There is evidently more than one way in which an influx of Atlantic water may be advantageous It may, in the first place, bring water with a high content of phosphate and other nutrient salts which will eventually yield an abundant plankton Or, secondly, though deficient in phosphate, it

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(Continued from p. 779)

may bring in large quantities of phytoplankton or zooplankton, the product of a former richness in phosphate This plankton will afford an immediate food supply for larval fish and other animals, and when it dies down the phosphate will be regenerated and will serve for further plankton production in the future

It is thus what we may call the biological condition of the water that is of importance and this no doubt is to some extent determined by the season of the year At times in summer the surface water may be largely devoid of both plankton and phosphate and an influx of such water, even though its high salinity may indicate an oceanic origin, will bring no improvement to biological conditions and may indeed be harmful In winter when the thermocline has broken down and surface phosphate has been renewed by convection and by stormy weather an influx may prove of advantage But it is perhaps more probable that upwelled water rich in the nutrient salts which are always to be found in the lower layers of the ocean is the potent source of surface enrichment, and of the conditions in which such upwelling occurs we are very largely ignorant We lack the necessary data and can merely speculate on what may be happening from analogy with what is known in other areas

I have dwelt at some length on these events in the Plymouth area because they afford a good example of a long period fluctuation and illustrate the way in which observations drawn from widely different lines of inquiry are linked together From other sources also there is good evidence of long period fluctuations in fisheries, and though the hydrographical changes to which they may ultimately be traced are not, as it appears, the same as in the Channel, they show that major alterations extending over a long term of years are by no means unusual

In 1925 the Norwegians discovered great numbers of cod on the banks surrounding Bear Island, and ever since that year, except in 1929 when ice interfered with the operations, the fishery has been maintained, many trawlers visiting the banks annually to take toll of their wealth Iverson, from whose paper my information on this fishery is derived, states that there was a former occasion when cod were plentiful in this area That was from 1873 until 1882 Between 1883 and the time when the present fishery began, the grounds were examined on a number of occasions, but very few cod were found and the results were unprofitable It was so in 1924, the year which preceded the present period of abundance

Another instance is afforded by the cod fishery in West Greenland At certain times large concentrations of cod appear on this coast and spread as far north as Disko Bay, affording a profitable fishery, but after a term of years their numbers suddenly decline and a protracted period of scarcity follows In 1917 cod were found in West Greenland in great abundance and the fishery on this coast has been maintained up to the present day Prior to that, as Jensen and Hansen have shown, the grounds were tested on a number of occasions without finding stocks of cod in marketable quantity, but early records indicate that there were at least two periods in 1820 and in 1845–49 when cod were present in great numbers

To these two instances of large scale changes in the fish population in northern waters many others could be added and all are apparently due to the same cause—to the fact that in recent years the entire area from Greenland to Bear Island has become appreciably warmer Berg has collected much information on the effects of this rise in temperature, Saemundsson has given an interesting account of the alterations which have occurred in the fauna of Iceland while Stephen has shown that marked changes have also taken place in the British marine fauna It is clear that an increased sea temperature, probably of the order of 1 0–2 0° C, has allowed various species of fish to extend beyond the normal limits of their distribution, with the result that it has been possible to establish productive fisheries in areas which formerly would not have yielded an adequate return It is evident, I believe, that at some future date conditions will revert to normal, and that a time will come when these lucrative fisheries will cease to exist

A distinction—which I believe to be a real one—can therefore be drawn between two kinds of fluctuations, both of which have a pronounced effect on the marine fauna Normal annual fluctuations are a constant feature They form the basis of fishery prediction, and our information, such as it is, is that their incidence is restricted a fishery for a certain species in a particular place will be affected, while other species in the same place, or the same species in another place will be unaffected It is to be assumed that the causes of such annual fluctuations, though of these we know but little, are also restricted both in space and in time

In contrast are what I have called long period fluctuations, which extend over a term of years and involve much larger areas Such fluctuations as these are due to a widespread change in one or more of the hydrographic factors in the environment, and large numbers of species, if not all, are affected simultaneously or within a short period. Long period fluctuations may mask the effects of the annual fluctuations and at times they will render fishery prediction unreliable.

Research in the Atlantic

Long period fluctuations may be brought about in entirely different ways In the Channel, as it appears, the change can be traced to a deficiency in phosphate, while in more northerly areas it is due to an increase in sea temperature But, though there is this wide difference the two sets of circumstances have this in common, that they originate in the open Atlantic, at the edge of the continental slope or farther to the west It is here in oceanic waters, that the causes of these large alterations in European fisheries must be sought

It might be thought that a full investigation of the Atlantic drift to which we owe so many advantages, would long since have been undertaken Yet, to the present day, there are many problems which remain unsolved and, as Dr Iselin has recently shown three mutually conflicting theories are extant regarding the circulation of water in the North Atlantic Fortunately there are signs that a period will be set to our ignorance On the American side of the Atlantic, the Woods Hole Oceanographic Institution and the Bermuda Biological Station are collaborating in a study of the Gulf Stream and of the effect of wind velocity and direction on the strength of a current Data recently obtained by the Woods Hole Institution show that the transport of water in the Gulf Stream has varied by as much as 20 per cent in fourteen months, and it may well be that this figure is below the normal range of variation When the observations over the five year period which is contemplated have been carried out, we may hope to know far more than we do at present of the Gulf Stream and its effects on circulation in the North Atlantic

During the present year, a German research ship is making a prolonged investigation of the hydrography of the North Atlantic, and only two months ago research ships from Denmark, Norway and Scotland were co operating with her in studying extensive areas from the Azores to Iceland

From such combined attack we shall learn much, and there is every reason to believe that the main features of the circulation in the North Atlantic will shortly be understood But the work in the eastern Atlantic is only an isolated set of observations, most valuable as a contribution to our knowledge of the general conditions, but affording little help in solving the problem of long period faunistic fluctuations of which I have spoken It is the deviations from the normal which are of paramount importance to the biologist and it is only by repeated observations made over a series of years that they can be detected I believe that the need for systematic oceanographic work in the eastern Atlantic will be more and more acutely felt as time goes on and I feel convinced that it is the only way in which we can ever reach an understanding of the reasons for the large fluctuations in our fisheries

Fisheries Research in the British Empire

There is an urgent need throughout a very large part of the British Empire for greater activity in the scientific administration of the fisheries, for to me at least it is apparent that the lessons which long years of experience have taught us in Great Britain are not generally understood elsewhere

The plain fact is that in the Empire as a whole we are deplorably deficient in fisheries administration To this broad statement there are of course some exceptions By reason of its situation in Europe, the Irish Free State is obviously one of them and it has taken its full share in the progress that has been made during the present century Another exception is Canada, where a vigorous fisheries service, with a competent scientific staff has been at work for many years Newfoundland a country to which fisheries are of predominant importance, not long since suffered a shattering blow in the loss of the whole of its laboratory buildings by fire, but it will recover from this disaster and we may hope that the work which had such a brilliantly successful beginning will shortly be resumed Australia has now made a fresh start after the tragic loss of the *Endeavour*, and has at last taken the wise step of founding a Commonwealth fishery department These are the high lights, and there are one or two colonies, such as the Straits Settlements and Ceylon, which give relief to what is otherwise a very sombre picture

In South Africa with its astonishingly rich fishing grounds and vast length of coast line, the fishery staff is utterly inadequate, and in India, where fisheries research has immense possibilities, there is apparently little hope that proper action will be taken In India fisheries are what is known as a transferred subject that is to say, they have been handed over by the central Government to the provincial administrations The result is that some provinces may have a scientific staff of one, others have none at all, while Madras, which is much the most enterprising and publishes a fisheries bulletin, has three In such conditions fishery work on any adequate scale is clearly out of the question and it is not possible even to begin the acquisition of the fundamental knowledge that is essential to future progress

In almost every problem which touches marine biology it is essential to possess a background of knowledge which can only be acquired by long years of patient study If there is one lesson to be learnt from the history of fisheries research—one that cannot be too heavily stressed—it is that the opportunity of dealing effectively with a fishery problem will generally be lost unless this basic knowledge has been obtained in advance and is ready for application Even in our home waters, which have been examined so long and so closely, our information is not within sight of being complete in almost every branch of fisheries work there are new fields to be explored new methods to be tried and many large gaps in the knowledge we possess But it may at least be said that we have made a beginning In many other parts of the world not even a beginning has yet been made, ignorance is profound and there is no background of knowledge which can be utilized

It is surely time that the importance of such knowledge was recognized and that early steps were taken to lay the foundations of fishery science throughout the Empire

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International Standard of Musical Pitch

By Dr. G. W. C. Kaye, O.B.E.

THE problem of the international standardization of musical pitch has recently assumed a new prominence in view of the increasing exchange of concert and similar programmes by the various broadcasting organizations in different countries The general question has come up from time to time in the past, though it cannot be said that any substantial measure of unification has ever resulted internationally

The history of musical pitch is one of many standards mainly evolved by some body of standing which at the time was able to impose its will to a greater or less extent on current practice In some countries, indeed, the choice of pitch was, and still is, enforced by legal decree It has long been customary to express musical pitch in terms of the frequency of the note A in the treble clef, and this convention will be observed in what follows

Ellis (*J Roy Soc Arts* 1880) gives us a good notion of the state of affairs which prevailed in the early history of musical pitch It appears that from the fourteenth to the seventeenth century the note A wandered haphazardly over a range of nearly 200 cycles per second (374 to 567) In the eighteenth century the upper limit came down by more than 100, the spread of pitch being from 377 to about 423 During the nineteenth century the range was from about 424 to 494, a progressive rise being evident up to about 1887 reflecting no doubt, as always a striving for increased brilliancy

In Great Britain the London Philharmonic Orchestra was the premier orchestra for many years, and the philharmonic pitch was followed by most other orchestras, being first based in 1826 on a value of 433 for A, and afterwards (nineteen years later) on 455 A conference of physicists at Stuttgart in 1834 adopted 440, while a similar conference of musicians and physicists appointed by the French Government in 1859 established the Diapason Normal which was based on a figure of 435 (largely through the influence of Koenig) the associated temperature of the instruments being taken as 15° C (59° F) This pitch, which was legalized in France and had a fairly wide vogue in Europe, was adopted by the Boston Symphony Orchestra at its foundation in 1883 and was endorsed in 1885 by an international congress at Vienna In 1896, the Philharmonic Society adopted 439 at 68° F (see Hipkins NATURE Aug 31, 1899), while in 1899 an international discussion by the pianoforte trade, which revealed values of A ranging from 435 to 442, also resulted in the adoption of 439 at 20° C (68° F) by the participating makers, a decision which materially assisted in checking the general tendency of pitch to rise Another significant step was the lowering in 1927 by the Army Council of the pitch of British Army bands from 455 to 439 at 68° F

In the United States, while musical pitch was the subject of many vagaries during the last century a figure of 440 is now universal, having been adopted by the American Federation of Musicians in 1918, the Music Industries Chamber of Commerce in 1925, and the American Standards Association in 1936 It may be added that this value is in good accord with the usual British figure, as the temperature in American concert halls is said to be customarily of the order of 70° F

To come to more recent events, a conference was recently held at Broadcasting House under the auspices of the British Standards Institution, with Dr G W C Kaye in the chair The conference was attended by representatives of some thirty musical and other organizations, including the Royal Academy of Music, the Royal College of Music, the Royal College of Organists, the Royal Military School of Music, the Musical Association, the British Broadcasting Corporation, the Old Vic and Sadler's Wells, the National Physical Laboratory and the federations and associations of manufacturers of wind and string instruments and organ and piano builders The meeting had also before it the views of eminent conductors and professors of music After a full discussion, the conference agreed unanimously that the British Standards Institution, as a member of the International Standards Association, should be asked to take action to try to secure an international standard of musical pitch A small committee, which was appointed to draw up definite proposals, has now commenced its labours

It emerged from the above meeting that, pending international agreement, the British Broadcasting Corporation has provisionally adopted a figure of 439 for the treble A It also appeared from radio observations made in Germany that many of the musical performances now broadcast from different countries in Europe are based on a pitch exceeding 435, being on the average about 443

The most recent information available appears to indicate that the accepted figures for A in most countries lie between 435 and 440 cycles per second, although this range is definitely broadened in actual practice On the whole, it would seem that if an international figure were to be adopted, it will probably be at or near 440 The choice of such a figure, which is of course absolute would be the primary duty of an International Conference

The next duty, though a secondary one, would be to deal specifically with the temperature question Many musical instruments, as at present constructed, exhibit appreciable temperature variation of pitch The majority of the stringed instruments present, of course, no difficulty in this respect, and, as regards the piano, its pitch is stated to fall by only about 1 part in 18,000 for 1° F rise in temperature actually, the effects of humidity changes are probably more significant In the case of the wind organ, which presents the major problem, the pitch of the flue-pipes rises about 1 part in 500 for 1° C rise (that is, about 1 in 1,000 per 1° F) for moderate temperature variations In other words, a pitch of 435 at 15° C becomes 439 at 20° C The orchestral wind and reed instruments (flute, oboe, clarinet, etc) are also influenced by the warmth of the breath, fingering, etc , they are said to have, on the average, about half the temperature coefficient of the wind organ

One of the great difficulties with most concert halls is the steady rise of temperature as a concert progresses, so that the pitch of an orchestra may rise by five or more cycles a second during the early stages of a concert It has been observed in Germany that, after the entry of wind instruments which had been kept cold, a sudden shifting of the pitch of an entire orchestra may often result Thus the concert pitch may be subjected to continual fluctuations during the playing Improvement may be effected by warming the instruments before a concert to bring them into a steady condition

The oboe which is often used as an orchestral standard of pitch is demonstrably unsatisfactory for the purpose The piano is clearly better, and a steel tuning fork better still, with a drop in pitch of only about 1 part in 16,000 for 1° F rise in temperature Elinvar forks are even better, with a positive or negative coefficient varying in different samples up to 40 parts in a million Valve oscillators with mica condensers can be readily constructed which have a temperature coefficient of pitch of less than 1 part in 1,000

There are two features which are likely to simplify the temperature question in the future One is the increasing vogue of air conditioning, which will make the temperature control of concert halls more feasible The other is the rapid development of electro acoustical instruments, such as the electric organ, which have no temperature coefficient, and would appear to present an important field of development Incidentally, the values adopted for the treble A in two well known makes of electric organ are 439 and 440 respectively

It is of course appreciated that temperature variation may be especially troublesome under outdoor conditions, which may be extreme in some countries, and it is probably impossible to legislate for such untoward circumstances Something can be done, it is stated, by pre tuning the different instruments, for example, in the case of military bands in tropical countries, by flat pitch tuning of the wind instruments and sharp pitch tuning of the percussion instruments

It is clear, however, that as things are at present, international agreement can only be secured for what may be termed reasonable concert hall conditions and until those conditions are such that the pitches of musical instruments are virtually free from temperature change, the working temperature will normally require to be specified It seems probable from the above that a figure at or near 20° C (68° F) is likely to be acceptable to the majority of nations

The indications are that an international conference on the question of musical pitch may be convened in 1939 It would accordingly be appreciated if those readers of Nature who are interested in the general situation would be good enough to communicate with the Director, British Standards Institution, 28 Victoria Street, London, S W 1.

Science and Engineering in Antiquity

GIBBON, in The Decline and Fall of the Roman Empire", when describing Rome in all its glory, said the city was "filled with amphitheatres, theatres temples porticoes triumphal arches, baths and aqueducts all variously conducive to the health, the devotion, and the pleasures of the meanest citizen ' The aqueducts appealed especially to him and of them he wrote The boldness of the enterprise, the solidity of the execution and the uses to which they were subservient rank the aqueducts among the noblest monuments of Roman genius and power " They evidently make the same appeal to Mr W J E Binnie, who, having taken as the theme for his presidential address to the Institution of Civil Engineers, delivered on November 1 "Science and Engineering in Ancient Times ' devoted many of his remarks to the work of Frontinus on the aqueducts This subject no doubt was also a congenial one, owing to Mr Binnie's own work as a hydraulic engineer

Sextus Julius Frontinus, who was born about A D 35 and died about 106, was a very able and conscientious government servant and for a time was governor of Great Britain When about sixty years of age he was appointed Curator Aquarum' or Commissioner to the Water Supply of Rome, and this led him to write his two books, ' De Aquis Urbis Romæ", an English translation of which was published in 1899, by the distinguished American hydraulic engineer, Clemens Herschel (1842–1930) himself the inventor of the Venturi meter When Frontinus took office there were nine aqueducts carrying water to Rome, and one of them had been in use nearly four hundred years, a longer period than Drake's leat has carried water to Plymouth The total length of the nine aqueducts was 263 miles, about 35½ miles being borne on arches The total capacity as estimated by Herschel was 84 million gallons a day, but the actual quantity supplied did not amount to more than 38 million gallons The Appian aqueduct (313 B C) was sixteen miles long and was almost entirely underground , the Anio Vetus (273 B C) was forty miles long The Marcia was fifty eight miles long, and was constructed about 145 B C The two older aqueducts followed the contour of the ground, but in the Marcia, arches with a total length of six and a half miles carried the aqueduct across the valleys The Claudia, the Julia, fourteen miles, the Virgo, thirteen and a half miles, the Alsietina, twenty nine miles, and the New Anio were erected nearer the age of Frontinus, some of them indeed in his lifetime One portion of the Claudia was a tunnel three miles long

The three earliest aqueducts were constructed of dressed stones about 18 in × 18 in × 42 in set in mortar, but most of the later aqueducts were of concrete and brickwork , the arches being divided into voussoirs by brick courses The waterways were rendered with *opus signinum* made of pottery ground into powder mixed with lime mortar The durability of this lining is shown by old underground tanks and conduits in Alexandria, where the surrounding limestone has been eroded away by water, leaving the lining intact Settling tanks were provided on each aqueduct and water was led into buildings by lead pipes Payment was made according to the diameter of the bronze nozzle or *calix* through which the water flowed

Frontinus was aware that the quantity of water varied with the head, and the length of pipe, but the laws governing the flow of water were unknown By laws existed regarding the water supply, and it fell to the lot of Frontinus to enforce them

In considering the construction of the roads, aqueducts, and tunnels of antiquity a question naturally arises as to what methods were employed in surveying and laying down the plans The answer to this question was given by Mr Binnie earlier in his address when dealing with the writings of Hero of Alexandria

To Hero are attributed a book on ' Pneumatics", three on ' Mechanics ', one on "Catoptrics", and another on the "Dioptra ' The ' Pneumatics" has been published in English, and the other five have been translated by Mr R C S Walters, a member of the Institution of Civil Engineers, and Mr Binnie had had the advantage of perusing his manuscripts In this connexion, it is perhaps worth recalling that in 1921 Mr Walters read a paper to the Newcomen Society entitled, "Greek and Roman Engineering Instruments", and that in 1928 the University of Washington, Seattle, U S A , published Mr E N Stone's pamphlet on "Roman Surveying Instruments" For lengths, the Romans used the *Pertica*, the *Decempeda*, and also the *Hodometer*, or road measurer , for horizontal angles they used the *Groma*, an example of which was unearthed at Pompeii in 1912, while by means of the *Dioptra* they could measure both horizontal and vertical angles The *Dioptra* was the forerunner of our theodolite, and with it, said

Mr Binnie, very accurate levelling could be carried out and it was possible to set out aqueducts with very flat gradients

Besides the writings of Hero and Frontinus, Mr Binnie touched upon the work of the Egyptians and their methods of drilling granite the views of Lucretius on matter, the universe and time, the career of Archimedes, and finally and briefly, the work of that versatile genius Leonardo da Vinci, a review of whose many activities was given by Mr E McCurdy to the Royal Institution on March 19 1920 a full report appearing in NATURE of May 6 and 13 and by Mr J W Lieb in a paper read to the Franklin Institute in 1921

Obituary Notice

Prof Karl Sudhoff

WE regret to announce the death of Karl Sudhoff, the Nestor and doyen of medical historians, which took place at Salzwedel in Saxony on October 8 at the ripe age of eighty four years

Sudhoff was born on November 26, 1853, the son of a theologian and philosopher, at Frankfort on Main, the birthplace of Goethe, who formed the subject of many of his non medical writings He qualified at Erlangen in 1875 with a thesis on a subject—primary multiple carcinoma of the osseous system—which gave no indication of his future activities, and for the next thirty years remained in general practice with a leaning towards gynæcology, first at Bergen near Frankfort and afterwards at Hochdahl near Düsseldorf He soon rose to eminence in his profession, and his financial success enabled him to accumulate a library rich in medico historical works

During this time, Sudhoff won a considerable reputation by his studies on Paracelsus, so that he was elected the first president of the German Society of the History of Medicine, founded in 1901 Four years later he was appointed as the first occupant of the chair of the history of medicine at Leipzig, where he founded an institute for this speciality, and held this post until 1924, being succeeded by his brilliant pupil, Dr Henry E Sigerist, now professor of the history of medicine at Johns Hopkins University

Sudhoff's activities may be considered under three headings (1) his successful career as a medical practitioner, in acknowledgment of which he was created a councillor in 1900, (2) his epoch-making work as a medical historian, (3) his ability as an organizer Sudhoff was an extraordinarily prolific writer, as is shown by the fact that a bibliography of his works and those of his pupils occupied nearly thirty pages of the *Festschrift* dedicated to him in 1924 on the occasion of his seventieth birthday, and more than fifty pages of his *Archiv* published ten years later His chief works, in chronological order, were his studies of Paracelsus, the iatro mathematicians of the fifteenth and sixteenth centuries, the anatomy of the Middle Ages, the history of hygiene, German medical incunabula, Alexandrian medicine, ancient balneology, manuscript plague tracts, the early history of syphilis, the school of Salerno, the surgery of the Middle Ages, the history of dentistry, a survey of the history of medicine, and early writers on paediatrics His minor works included obituaries of medical historians and others, an autobiographical sketch entitled 'Aus meiner Arbeit", and numerous reviews of current literature on the history of medicine In addition to purely medical subjects, he wrote on folk lore, magic, alchemy, astrology and Goethe in relation to the Rhineland

Mention should also be made of his editorial work In 1908 Sudhoff founded the *Archiv fur die Geschichte der Medizin und der Naturwissenschaften*, to which his name became attached in 1929, in 1909 he became editor of *Klassiker der Medizin*, and he was also joint editor of several other medico historical publications

The organizing ability of Sudhoff was shown by his establishment of the Institute for the History of Medicine at Leipzig, which he made a model of its kind, the organization of the Goethe exhibition in 1899 on the occasion of the hundred and fiftieth anniversary of the poet s birth, the active part which he took in the preparation of a historical section in the German exhibition of hygiene at Dresden in 1911, and his activity as dean of the medical faculty at Leipzig in 1922–23

Sudhoff had many friends in Great Britain, to which he paid several visits both before and after the Great War His *Festschrift* was dedicated to him by Sir Clifford Allbutt, and several other British writers contributed to the volume He was elected a corresponding member of the Section of the History of Medicine of the Royal Society of Medicine in 1913 the year of the International Congress of Medicine held in London, when he read a paper at the historical section of the Congress on the origin of syphilis, and thirteen years later he was elected an honorary fellow of the Royal Society of Medicine

J D R

WE regret to announce the following deaths

Sir John Griffith, president of the Institution of Civil Engineers in 1919, on October 21, aged ninety years

Mr George Jennison, formerly owner and principal curator of the Belle Vue Zoological Gardens, Manchester, on October 21, aged sixty six years

Colonel J Clibborn, C I E, formerly principal of the Thomason Engineering College, Rorkee, known for his work in connexion with irrigation in Northern India, on October 31, aged ninety years

News and Views

Geophysical Research at Johannesburg

On October 21, the Bernard Price Institute of Geophysical Research at Johannesburg was opened by General Smuts It is specially fitting that Johannesburg, perhaps the wealthiest and most industrialized city in Africa, the prosperity of which depends so largely on mining, should be the seat of this important new enterprise. The Institute is governed, in finance and administration, by a Board of Control directly responsible to the Council of the Witwatersrand University. The University has been enabled to establish and staff the Institute by gifts from the Carnegie Corporation of New York, and from Dr. Bernard Price, resident director of the Victoria Falls and Transvaal Power Company. Dr. Price's deep interest in the work and success of the Institute is shown also in his chairmanship of the Board of Control. The Institute is under the direction of Prof. B F. J Schonland, who as Carnegie-Price professor of geophysics gives post-graduate teaching in the University. At present, the Institute also has on its staff three scientific assistants

The Institute building, situated in the University grounds, has about 6,000 sq. ft enclosed floor space, on two floors; the first story extends only over about half the ground floor, so that there is a large roof terrace over which the first floor building can be extended later if necessary. In addition to the director's office, the library, workshop, store room, dark room and so on, the building contains a seismograph room, an oscillograph room, and five research rooms, in which are incorporated many special features appropriate to the needs of a geophysical research institute. There is also a guest room for the use of overseas visitors who may be co-operating in the Institute's research programme. The present programme of the Institute includes atmospheric electricity (a subject in which Prof. Schonland has already made outstanding contributions to knowledge, and which is of special local importance in view of the severity and prevalence of thunderstorms there), seismology, the study of the magnetic properties of the rocks of the Witwatersrand, and the behaviour of rocks under pressure. Radio studies are also being planned

Institute of Ornithology at Oxford

The statute relating to the proposed Edward Grey Institute of Field Ornithology was brought before Congregation at Oxford this week. Accommodation and funds for the Institute will be provided by the University. There will be a salaried director. The committee of management, although mainly of University members, will have representatives of the British Ornithologists' Union, the Oxford Ornithological Society and the British Trust for Ornithology. The business of the Institute will be to carry out research on problems of ornithology, especially on the numbers, distribution, movements, habits and economic status of British birds and to publish the results obtained It is evident that activity will be concentrated on field work and will begin by extending that done by the Oxford Ornithological Society. The Society has recently made a count of all species over small areas like Bagley Wood and of the waterfowl on the lake at Blenheim. It has also made surveys of a single species over a wider area as, for example, the count of all the rookeries in an area of more than nine hundred square miles around Oxford.

International Committee on Intellectual Co-operation

The report by Prof. G. de Reynold on the work of the twentieth plenary session of the International Committee on Intellectual Co-operation of the League of Nations (Geneva. League of Nations. London: George Allen and Unwin, Ltd C 253.M.150 1938.XII) indicates the services to intellectual life which this organization is rendering both directly and indirectly. Its influence on the teaching of the principles and facts of international co-operation, the revision of school text-books, the investigation of unemployment among university graduates, its studies on the rights of the scientific worker and the inventor and on the contract of publication, the International Studies Conference and the agreement with the International Council of Scientific Unions are briefly indicated by Prof. de Reynold, as well as its relations with the International Labour Office and the International Museums Office. Prof. de Reynold stresses the importance of the National Committees of Intellectual Co-operation and of the efforts of the organization to keep in touch with and respect al forms of culture, and of utilizing the most modern means of disseminating information. Resolutions adopted by the Committee at its meeting on July 16 are included, and among the appendixes are reports of the Advisory Committee on the teaching of the principles and facts of international co-operation, on the teaching of modern languages as a means of promoting mutual understanding between nations; of the Acting Secretary-General of the Rome International Institute for the Unification of Private Law on the work of the Institute in the field of intellectual rights and of the Advisory Committee on Professional Workers.

A further appendix gives extracts from the general report of the director of the International Institute of Intellectual Co-operation to the International Committee and to the Governing Body. In these extracts, reference is made to obstacles to intellectual life, including the questions of student exchange, libraries, archives, etc., the scientific study of international relations as developed by the International Studies Conference, including a note on the Prague Conference on the university teaching of international relations. Other matters dealt with relate to the use of broadcasting for disseminating information on international problems of the day, whether by documentary talks, round table broadcasts or international bibliographic information The use of the same means for disseminating information on the progress of the sciences and on developments in literature and the arts is also discussed, and for planning and sponsoring such programmes the collaboration of leading scientific institutions in different countries should be solicited The organization of a central international information office is also proposed, which with regard to scientific information would be in contact with scientific institutions and scientific workers in different countries, and at regular intervals would provide the programme committees with communiqués on recent discoveries and memoranda on new developments A resolution adopted by the Congress of the International Federation of Associations of Inventors and Industrial Artists recommends that the author of a scientific discovery or invention should not be deprived of his rights because he has himself divulged it in a scientific paper submitted to a learned society or published it in a scientific journal The resolution also urges an international agreement which in all countries would entitle the author of a scientific discovery or invention to claim a royalty from persons or enterprises utilizing the discovery or invention for industrial purposes

The School as a Cultural Centre

A RECENTLY issued bulletin of the United States Office of Education, The School Building Situation and Needs" by the official senior specialist in school building problems, emphasizes the view that the State schools, both primary and secondary, must provide, not only for the education of pupils enrolled in ordinary course as at present but also for cultural needs of other members of the community, notably adolescents who have left school but are not at work and adults needing re education in new lines of work made necessary by industrial changes and for recreation during leisure time It is clear, says the report, that technological advances and the resulting decrease in the number of workers required in industry are going to make it necessary for the public schools to provide either full time or part time education and recreational opportunities for a large proportion of boys and girls, between eighteen and twenty one years of age, who are neither in school nor at work School buildings must be equipped for this purpose A similar expansion of the purposes of school buildings was advocated in two addresses to Section L (Educational Sciences) of the British Association meeting in August at Cambridge by Mr W G Newton and Mr S E Unwin, county architect, Cambridge The former included in his summary of to-day's requirements to be interpreted in the school architect's building forms ' importance of the parent and the use of the school as a cultural centre", while the latter declared that "the school of the future will only be starting its work with child education, it will be a meeting place for people of all ages", " for adult activities, even if only for evening classes and adult lectures, a common room where the People can meet for discussion or friendly conversation, with facilities for light refreshment, will be necessary '

Industrial Arts and Education

THE report of a Committee appointed by the Commissioner of Education to consider the Interpretation of Industrial Arts in American Schools has been published as Bulletin No 34, 1937, by the United States Department of the Interior (Washington, D C Gov Printing Office, 15 cents) The report is primarily concerned with the way in which the study of industrial arts can contribute to a programme of education for a society which is fundamentally industrial, and the significance of such study in providing a background for education for citizenship, apart from its value in stimulating the development of creative and artistic abilities, is stressed The position of industrial arts in the elementary school, the junior high school, the senior high school, in adult education and in higher education is discussed in separate chapters of the report, and particularly in the senior high school, the contribution of industrial arts to vocational training is emphasized as well as its value in safety education In the broadest sense, safety education in the sense of providing every citizen with an adequate scientific or technical background for the life he or she is called upon to live in this present age is one of our greatest needs, and the report would be worth while if only for the terse but illuminating way in which it indicates opportunities which are at present often missed

Utilization of British Hardwoods

MR W A ROBERTSON, director of the Forest Products Laboratory at Princes Risborough, discussed the utilization of British hardwoods in a paper read before the Department of Forestry of Section K (Botany) at the recent meeting at Cambridge of the British Association. The author dealt with some of the more economic species such as oak, beech, ash, birch, sycamore, alder and poplar In discussing the more valuable hardwoods, oak, beech, ash, etc, Mr Robertson pointed to the fact well known to the scientific forester that the poorness of the British present-day timber is due to faulty sylviculture—a position which will not be rectified in Great Britain until recognition by owners of woods is given to the fact that they require just as careful and scientific attention throughout the life of the crop as agriculture Clean grown timber of any type can only be produced by good sylviculture, in which is included the essential item of correct thinning at specified periods The coming of plywood has opened new modes of utilization of large-sized hardwoods, since British timber of these species is every whit as good as the foreign Yet, as Mr Robertson says, the problem of the disposal of thinnings and cordwood still remains a difficulty

Long Ashton Research Station

RECENT developments in fruit products research are described in the Long Ashton Research Station report for 1937 Since 1932 a comprehensive study has been made of the possibilities of utilizing surplus and low grade fruits, both syrups and wines being investigated In 1934, fruit squashes were included in the programme, and with such success that in the following year production employing the Long Ashton methods was extended to the commercial scale Even greater success has attended the researches on fruit syrups The growing popularity of milk bars has resulted in a demand for various syrups as constituents of milk shakes For the last two years the Research Station has worked in close collaboration with a local firm producing these commodities and syrups are now being sold on the large scale under the National Mark Scheme A still more recent development has been the use of these syrups for aerated beverages, the high ascorbic acid content of the juices being an important feature in their favour Wines made from English fruits have attractive characters and are of full alcoholic strength, but they are relatively expensive, and development on the commercial scale is not expected to be so rapid as in the case of the syrups

Seismological Work at Stuttgart

A VERY valuable addition to seismological data and an interesting addition to earthquake literature appears in the report of the Stuttgart Seismological Station for 1936, edited by Dr W Hiller which has recently been received The station is equipped with three Galitzin Wilip seismographs orientated to record N S , E W and vertical movement, two Mainka seismographs of mass 450 kgm to read N S and E W vibrations two vertical Wiechert instruments of mass 80 kgm and 1,320 kgm respectively, and one trifilar gravimeter The report gives the readings of seismograms obtained with these instruments, including the phase, time of arrival amplitude in the three components and remarks chiefly concerning the position of the epicentre of the shock which caused the record At the end of the report are 15 pages of detailed study of earthquakes with epicentres in the neighbourhood of the station, including two sketch maps—one concerning the Bodensee earthquake of March 15 1936, and one of the earthquake of April 19 1936

Public Service Occupations

A BULLETIN entitled Training for the Public Service Occupations issued by the Office of Education, Department of the Interior, United States of America (Vocational Education Bulletin, No 192 20 cents) reviews the work already carried out in training for public service occupations below the university level The Bulletin is concerned with the manual aspects of the public services rather than with the administrative side, and it is intended to interpret the provisions of the George Deen Act as they relate to the promotion of vocational education for such occupations It also outlines methods which have been used with success in planning and developing training programmes, and indicates ways in which Federal, State and local trade and industrial educational agencies can assist in the organization of vocational training for such occupations Incidentally, the Bulletin should serve a useful purpose in educating the general public in the work and problems of the public services, as has been done very successfully in Great Britain in certain civic exhibitions

New Antarctic Land

IN a slender volume illustrated with photographs and maps ' My Last Expedition to the Antarctic, 1936–1937 (Oslo Johan Grundt Tanum 1938), Mr L Christensen has recounted all too briefly the voyage of the *Thorshavn* to the Wilkes Land and Enderby regions of the Antarctic A brief voyage resulted in important work largely through the help of flying In Lars Christensen and Ingrid Christensen Lands (Kemp and MacRobertson Lands) the mountain ranges were photographed and mapped The most important discovery, however was that of the missing land between Crown Prince Olav and Princess Ragnhild Land, where from 34° to 40° E Prince Harald Land was found from the air A long range of mountains was noted in the interior Thus practically the entire coast line of Antarctica from the Weddell Sea eastward to the Ross Sea is now known and it would appear that in many parts mountains arise through the ice sheet at greater or less distances from the coast In several parts, rocky coasts or outlying islands suggest landing places for ground work Mr Christensen brought back geological specimens from several of his landings, but he says nothing of their nature

Communication Equipment for Vehicles

To the *A W A Technical Review*, published by the Amalgamated Wireless (Australasia) Ltd , of July Dr G Builder and J D Gilchrist have contributed a paper on communication equipment for vehicles Since about 1924, specific instructions for one or more units has been effected extensively either by radio telegraphy or telephone broadcasting This only needed the fitting of receivers in the fleet units the reports back to the organization headquarters being made when necessary by the ordinary telephone service The advantages of two way transmission led very soon to the use of telegraphic transmission from the units to headquarters when it was necessary to acknowledge instructions and make reports This as a rule required trained radio operators both on the units and at headquarters As development progressed, the use of telephony rapidly became common and duplex working was adopted The improvement in the equipment has now made such services almost equivalent to the normal wire line telephone services In some cases it is possible to dial any one mobile unit from headquarters, causing a bell to ring in the mobile installation The personnel of the mobile units therefore, have not to keep continual watch and are not distracted by calls which do not concern them It is feasible to arrange a dialling number calling either all the units or a group of them simultaneously These highly developed systems are rare, but they indicate the inevitable trend of development in the near future The use of crystal control of transmitter and receiver frequencies has proved of the greatest value in this connexion. One of the earliest applications was to police work and this has proved of great value in preventing crime and arresting criminals.

Tuberculosis in Tunisia

In his inaugural thesis (*Thèse de Paris*, No 365, 1938), Dr M H Thamer states that in Tunisia, which is a country of 2,608,313 inhabitants with a mixed population consisting mainly of Tunisian Mussulmans (2,335,623) with Tunisian Jews (59,485) and Europeans (213,205) the mortality from tuberculosis is much higher among the Mussulmans than in the other two groups. In Tunis alone there are about 4,000 tuberculous Mussulmans, and tuberculosis alone is responsible for more than a third of all the deaths from epidemic diseases. Further proof of the high incidence of tuberculosis among Mussulmans is furnished by army statistics, according to which 0·59 per cent of the Mussulman soldiers are affected as compared with 0·25 per cent of the Europeans. Moreover all the Tunisian practitioners are agreed that the number of tuberculous subjects is increasing yearly in enormous proportions, and that the immense majority of the cases are highly infectious and run a rapidly fatal course. At the present time the means for combating tuberculosis in Tunisia are quite inadequate. The only institution for detecting cases is the Mussulman Dispensary at Tunis, while barely 84 beds are available for all the cases of pulmonary tuberculosis *in a population of more than two millions*, among whom there are more than 6,000 deaths from tuberculosis yearly. There are at present no institutions in Tunisia for the prevention of tuberculosis among Mussulman children. The following measures, according to Dr Thamer, are urgently required: (1) for children, the creation of open-air schools, holiday colonies and a preventorium; (2) for adults, the establishment of five sanitary districts for Tunis, Susa, Sfax, Ket and Bizerta respectively, in each of which there should be a tuberculosis dispensary and the provision of about fifty hospital beds; (3) there *should also be a sanatorium of about a hundred beds* in the suburbs of Tunis; (4) afterwards the antituberculosis campaign should be extended to the smaller towns and the rural districts which constitute about three quarters of the total population of the country.

Government Scientific Publications

Most scientific workers are aware that from time to time research papers of immediate interest to them in their own particular work appear among Government publications. Even to those who make the fullest and most regular use of such publications, the admirably written and printed "Brief Guide to Government Publications" which has recently been issued by H.M. Stationery Office will probably come as a revelation of the extent and importance of the contribution to scientific, industrial and agricultural research which comes from such sources. Whether in agriculture, economics or social questions, education, medicine and public health, transport and communications, science, industry and technology, H.M. Stationery Office not only supplies innumerable publications containing up-to-date information on specialized subjects, but is also to an increasing extent the channel through which the results of both pure and applied research are published. A very lucid but comprehensive description of the chief Government publications in all these fields as well as in others of less direct interest to scientific workers is contained in this useful guide, and not the least of its merits are the brief but clear accounts of how Government publications are sold and of the catalogues, lists and bibliographies of such publications which are available.

Research on Coal Utilization

The British Coal Utilisation Research Association has decided to establish an experimental station in London. Premises have been secured at West Brompton, and are now being equipped. Dr D H Bangham, lately professor of chemistry and dean of the Faculty of Science, Egyptian University, Cairo, who has made important contributions to the physical chemistry of charcoal, cellulose and other carbonaceous materials, has been appointed the senior member of the scientific staff, and will take charge of a group of programmes connected with the use of coal. Mr J S Hales, who will take charge of the Domestic Appliances Department, has worked at the Fuel Research Station on the measurement of smoke and the operation of coke fires, and has since served on the research staff of a manufacturer of domestic solid fuel burning appliances. Mr R T Hancock, formerly associate editor and contributor to "Kemp's Engineers Handbook", has been appointed head of the Intelligence Department and editor of the Association's monthly bulletin.

An Electrodeposition Exhibit

Many examples of the varied applications of electrodeposition were shown at a special exhibition held at the Science Museum, London, in 1935. The success of this exhibition prompted the arrangement of a smaller permanent exhibit, which has been generously presented by the Electrodepositors' Technical Society. The main features of the original exhibition have been incorporated in a single case, which is now on view in the Chemistry Collections of the Science Museum. One of the most interesting sections of the exhibit deals with research, and has been arranged by the Research Department, Woolwich. Here may be seen *the results of the systematic* studies of electrodeposition problems made at Woolwich and elsewhere during the past twenty years.

Crystals, Molecules and Atoms

In a review which appeared in Nature of September 10, p 455, of the second volume, entitled "The Fine Structure of Matter", of Dr C H Douglas Clark's treatise on atomic and molecular structure, reference was made to the omission of modern quantum theory from Part 3, entitled "The Quantum

Theory and Line Spectra' Dr Douglas Clark has written pointing out that his complete work has been subdivided for convenience in publication, and that an advertisement of the scheme printed as frontispiece shows that the concluding Part of Vol 3 will deal with modern quantum mechanics Papers relating thereto have been sorted for inclusion in Vol 3, and the Part recently published contains the classical treatment only Thus while in the opinion of the reviewer, modern quantum mechanics should have received attention already, Dr Douglas Clark believes that his plan, which follows the historical order of development as far as possible will prove satisfactory

Health Organisation of the League of Nations

THE April number (7, No 2) of the *Bulletin of the Health Organisation* is entirely devoted to the teaching of hygiene based on a report by Prof Jameson, Prof Pittaluga and Dr Stampar on certain European institutes and schools of hygiene The June number (7, No 3) contains papers on the assay of morphine and cocaine the sero diagnosis of syphilis, nutrition and nutritive requirements, and undulant fever in France The final article deals with the significance of codeine as a habit forming drug, this does not appear to occur and the medical use of codeine is therefore not a social danger

Guide to Official Statistics

THE annual volume entitled Guide to Current Official Statistics of the United Kingdom is now published for 1937 (London H.M Stationery Office 1*s* net) The greater part of the book is a subject index in which every entry is followed by a list of related publications each referred to by its official number This is followed by a numerical list of publications The arrangement makes reference easy, and the book shows the wide range of valuable statistical and other matter that is available

Announcements

THE Lord President of the Council has appointed Dr G Stafford Whitby, at present director of the Division of Chemistry, National Research Council, Canada, and formerly professor of chemistry at McGill University, Montreal, to be director of the Chemical Research Laboratory, Teddington, in succession to Sir Gilbert Morgan, who retired on September 30 Dr Whitby is expected to take up his duties early in 1939

THE Council of the Royal Society of Edinburgh, with permission of the Hon Lord Robertson, have caused to be incised on the house at 14 India Street, Edinburgh, the following inscription

JAMES CLERK MAXWELL
NATURAL PHILOSOPHER
BORN HERE 13 JUNE 1831

THE Hermann Göring foundation ' Reichsjägerhof has sent an expedition to Greenland for six or seven months investigation of animal and plant life as well as to make geographical and meteorological observations

AT a recent session of the Health Section of the League of Nations, an international commission was appointed to promote uniformity of standards for patent medicines Dr Charles H Hampshire, of London, was appointed chairman, and the other members are Profs H Baggesgaard of Copenhagen, E Zunz of Brussels M Tiffeneau of Paris R Eden of Zurich, L van Italie of Leyden and Mr Ernest Fullerton Cook of Philadelphia

ONE of the Hunterian professorships of the Royal College of Surgeons of England has been awarded to Dr Donald W G Murray of Toronto, who will deliver his lecture in London next year This is the second time that this award has been made to a Canadian, the other occasion being in 1924, when Dr William E Gallie, of Toronto was so honoured Dr Murray has been appointed for his work on heparin, which has been done in conjunction with Prof C H Best, professor of physiology in the University of Toronto

DR WU LIEN TEH, for thirty years in the Health and Medical Service of the Chinese Government, including the directorship of the Manchurian Plague Prevention Service and of the National Quarantine Service, recently retired to his home in Penang He was editor of the *National Medical Journal* now known as the *Chinese Medical Journal* for fifteen years, and was founder and later president of the Chinese Medical Association

THE Central Association for Mental Welfare has decided, with the approval of the Board of Control to hold courses and establish a diploma for workers engaged in the teaching and training of low grade mental defectives The course will be held from January until December 1939, and the first two terms will be spent in approved occupation centres The third term will be spent in London and will consist of theoretical and specialized practical work Further information can be had from the honorary secretary of the Association, 24 Buckingham Palace Road S W 1

ACCORDING to official statistics, more sugar and margarine are consumed in Denmark than in any other country in the world During the period 1930–34, the annual consumption of sugar in Denmark was 54 kgm per inhabitant as compared with 49 5 kgm in England, 46 3 kgm in the United States, 25 6 kgm in France and 10 3 kgm in Poland

THE *Internationale Zeitschrift für Psychoanalyse* and the journal *Imago*, the official organs of the International Psychoanalytic Society, which are both edited by Prof Freud, have ceased publication The *International Journal of Individual Psychology* is also suspending publication

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 838.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

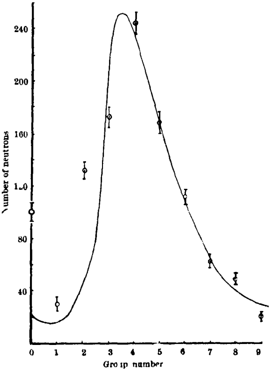
Velocity Distribution of Thermal Neutrons

WE have been developing during the past year an apparatus to make possible the study of neutrons of known energies within the thermal region. In principle, the apparatus consists of a device for producing a burst of neutrons lasting about 0·5 millisecond at intervals of 5 milliseconds. The source is surrounded by paraffin to slow the neutrons down to thermal energies, and these neutrons are then detected by a boron tri-fluoride chamber 5·4 metres away. The electrical pulses from the chamber are amplified and fed to a cathode ray oscillograph. Time signals are also received by the same amplifier and oscillograph whenever the bursts of neutrons occur. Since the neutrons take an appreciable time to cross the 5·4 metres between source and detector, a pulse from the chamber will be recorded later than the time signal corresponding to the burst which produced the neutron, and the distance between the two is inversely proportional to the velocity of the neutron. The traces on the oscillograph screen are photographed on a rapidly moving film, and the distances between the time marks and the pulses measured after development. From an analysis of these measured distances the velocity distribution of the neutrons can be inferred.

The source is a tube of the Oliphant type yielding deuterons, which strike a target of heavy ice. The discharge producing the ions has a voltage of about 20 kv. and is made intermittent by means of a beam of light interrupted by a tuning fork. This light falls on a photo-electric cell the current from which is amplified until it can control the 20 kv. discharge. To accelerate the ions we use a field of between 200 and 250 kv.

The accompanying graph shows the distribution between ten sub-divisions of the period of 1,556 neutrons, the faster neutrons appearing to the left. We have calculated the distribution to be expected if Maxwell's distribution law held for the neutrons, taking a temperature of 15° C., and assuming that the efficiency of the boron counter is inversely proportional to the velocity of the neutrons; it is shown on the figure by the curve. A correction, of the order of 20 per cent, has been made to the observed counts to allow for neutrons which did not follow the direct path between source and detector. This was done by making an experiment with a thick boron absorber in the direct path of the beam, and subtracting the result after correcting for the relative strengths of the neutron source under the two conditions.

The curve is adjusted to fit the experimental count for the middle division, and shows reasonably good agreement for the slower neutrons. At the zero of the time scale appears a group of fast neutrons which have not been slowed down by the paraffin to thermal energies. The discrepancy at divisions 2 and 3 may be due either to a peculiarity in the absorption of boron affecting the efficiency of the chamber at these velocities or to the hydrogen in the paraffin not being free. This may delay the achievement of equipartition of energy and affect some velocities more than others. We hope to examine the first suggestion by measuring the absorption of the neutrons of different energies by a boron screen.



○ EXPERIMENTAL OBSERVATIONS; VERTICAL LINES INDICATE STANDARD DEVIATIONS.

It will be seen that our apparatus constitutes a 'velocity spectrometer' for slow neutrons. A suggestion for constructing such an apparatus has been put forward recently by Milatz and Horst[1] and Alvarez[2] has described an apparatus which bears the same relation to ours that a monochromator does to a spectrometer, but we believe that the results reported here are the first to be recorded by the method.

G. E. F. FERTEL.
P. B. MOON.
G. P. THOMSON.
C. E. WYNN WILLIAMS.

Imperial College,
London, S.W.7.
Oct. 10.

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[1] Milatz and Horst, *Physica*, 5, 796 (Aug. 1938).

[2] Alvarez, *Bull. Amer. Phys. Soc.*, 13, 6 (1938).

Decomposition of Organic Peroxides

CONTINUING the investigation on the alkyl peroxides[1] and their relation to combustion phenomena, we have now obtained data on ethyl hydrogen peroxide, and propyl hydrogen peroxide

Ethyl hydrogen peroxide decomposes heterogeneously in the temperature range 140–200°, the rate of reaction being in accord with the expression for adsorption derived from the Langmuir isotherm, due allowance being made for the buffering effect of unchanged peroxide and decomposition products In agreement with this result, packing the vessel greatly increases reaction rate It was also found that coating the surface with salt increases the reaction rate, which may be connected with the suppressing effect of salted walls on the reactions of hydrocarbon and oxygen The products of the peroxide are mostly liquid at room temperature and include acetaldehyde and formaldehyde

At higher pressures the decomposition is homogeneous, explosive, and is attended with light emission The products of the decomposition are chiefly gaseous, and resemble those obtained from explosion of the mixture $C_2H_6 + O_2$

Propyl hydrogen peroxide was not obtained pure but the preparation used (60 per cent by iodometric method) formed propionaldehyde on heating at 200°, together with a gas containing propylene, ethylene, methane, hydrogen and carbon monoxide No explosive decomposition has yet been observed

Both the above compounds initiate markedly the slow reaction $C_3H_8 + O_2$, although they were found to reduce the induction period, they did not, however, affect the subsequent reaction rate, that is, in the expression $\omega = A(e^{\varphi t} - 1)$ only A, and not φ is changed

Their initiating effect can be nullified by poisoning (for example, with salt) the surface of the reaction vessel, which leads to the conclusion that the initiation takes place *after* a collision of the peroxide with the wall, which can direct the decomposition in two senses

$$\text{(i) peroxide} \xrightarrow[\text{clean wall}]{} \text{initiators}$$

$$\text{or (ii) peroxide} \xrightarrow[\text{poisoned wall}]{} \text{inert products}$$

This conclusion is in agreement with deductions from the observed accelerating effect of inert gases on the reaction $C_3H_8 + O_2$, for if the first reaction product is a peroxide, the reaction

$$\text{(iii) peroxide + fuel} \xrightarrow[\text{(in gas)}]{} \text{chain carrier,}$$

will be favoured at the expense of reaction (ii) A possible alternative explanation of the effect of the inert gas would be that it is more adsorbed on the poisoned surface than on the clean surface

To settle this point, further experiments on the effect of inert gases on the decomposition of these peroxides are in hand

It is noteworthy that hydrogen does not accelerate the slow oxidation of propane

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A C EGERTON

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Sept 29

[1] NATURE 141 472 (1938)

Mechanism of the Rearrangement of Phenyl Ethers

WHEN certain phenyl ethers are heated at their boiling points, the non aromatic group migrates from the oxygen to the nucleus The more important groups which so migrate are allyl, benzyl and *tert*-alkyl If the rearrangement of some of these ethers is effected in a suitable solvent, the migrating group is transferred in part, to the solvent Thus by heating a quinoline solution of benzylphenyl ether, benzyl quinoline is formed together with the normal products of the rearrangement Toluene is also formed

These observations find a satisfactory explanation if the assumption be made that the preliminary phase of the rearrangement is the elimination of the migrating group as a free radical Thus toluene results from the disproportionation of the benzyl radical—a reaction known to occur with free radicals[1] The transference of the migrating group to the solvent arises out of its reaction with the free radical The assumption that free radicals take part in the reaction makes clear the observation, hitherto inexplicable, that the rearrangement of benzylphenyl ether is very materially assisted by the presence of metals such as zinc or copper[2]

W J HICKINBOTTOM

Department of Chemistry,
University of Birmingham

[1] Hey and Waters *Chem Rev* **21** 169 (1937)

[2] Behagel and Freiensehner *Ber* **67** 1368 (1934)

Splitting of the Hæmocyanin Molecule by Ultra-violet Light

INVESTIGATIONS along different lines (ultracentrifugal sedimentation[1], X ray analysis[2]) have shown that the proteins contain particles possessing the hall mark of individuality and therefore are, in reality, giant molecules We have good reason to believe that the particles in protein solutions and protein crystals are built up according to a plan which makes every atom in it indispensable for the completion of the structure Primary protein reactions are therefore elementary acts which must, of necessity, obey the laws of quantum mechanics[3]

From this point of view, it would seem of interest to test the action of various energy quanta on proteins under such conditions that complications by secondary reactions are reduced to a minimum The experience with protein dissociation reactions accumulated in this laboratory[1] indicates that the forces holding the large blocks of very big molecules together are less strong than the forces acting between the dissociable parts of smaller protein molecules The chance of observing the primary process caused by the absorption of an energy quantum, therefore, appears to be most favourable in the case of proteins of very high molecular weight

We accordingly chose the hæmocyanin of *Helix pomatia* (molecular weight 6,740,000) as protein material for our first experiments Splitting of this molecule by ultra sonic waves has recently been observed in this laboratory[4] As energy quanta, we used ultra violet light Hæmocyanin solutions of various pH were exposed to the radiation of a quartz mercury lamp By means of ultracentrifugal sedimentation determinations, it was found that at a pH of 6 2 a splitting into half molecules occurs Prolonged irradiation causes denaturation, finally resulting in complete precipitation It is of interest to note that at *p*H 6 2 a further splitting of the half molecules does not take place At *p*H 7 4, however, both halves and molecules of smaller size are formed By means of suitable filters, it was found that the photochemical action is confined to the region of wave length in which the 'protein part of the molecule absorbs (2 800 A and shorter wave lengths) The band corresponding to the absorption of the prosthetic group (3 700–3 200 A) is inactive

From these observations we conclude that the weakest bond in the molecule of *Helix* hæmocyanin is that holding the two halves together To split up further by ultra violet light the half molecules, an increase in the number of ionized groups is necessary

We hope to gain further information by extending these experiments to other high molecular proteins and by using other kinds of energy quanta

THE SVEDBERG
SVEN BROHULT

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University, Uppsala
Sept 30

[1] Svedberg T NATURE 139 1051 (1937)

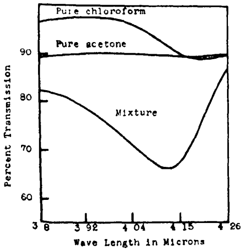
[2] Bernal J D and co workers NATURE, 141 521 (1938) Astbury W T *Trans Faraday Soc* 34 378 (1938)

[3] Cf Jordan P *Phys Z* 39 345 (1938)

[4] Brohult S NATURE 140 805 (1937)

Association of Unlike Molecules through Hydrogen Bonds

IN donor solvents such as acetone and dioxan the position of the OH fundamental of water alcohols or phenol depends upon the solvent so as to indicate hydrogen bond formation between the solute and the solvent[1] Using CH_3OD I have extended the work on alcohol mixtures to include new solvents many of which absorb in the 3 μ region and hence cannot be studied with ordinary alcohol Most of the amines apparently form very strong hydrogen bonds with an OH or an OD group—that is in general they produce longer shifts in the OD band than do oxygenated solvents like ethers and esters



ASSOCIATION BAND IN CHLOROFORM ACETONE MIXTURE (MOLE FRACTION 0 5, CELL THICKNESS 0 015 CM)

An interesting case of association between unlike molecules is that of chloroform with other liquids[2] I have observed an associational band in the region of 4 μ for mixtures of chloroform with donor solvents such as pyridine, ether and acetone Considering with other factors, the position of the band and the manner of its variation in position and intensity for the different mixtures, I believe it to be an NH or an OH vibrational band resulting from a hydrogen bond formed by the sharing of the proton of the CH chloroform group with the N or O of the solvent One of the bands is shown in the accompanying diagram A similar, but weaker associational band was found for some bromoform solutions In all previous infra red studies of hydrogen bonding, only shifts in the bands of either the solute or solvent were observed—no new bands were found This seems to be the first direct observation of the new band which would be found in any case of hydrogen bonding, and hence I consider it the most definite evidence yet given for the existence of hydrogen bonds

A more complete report of these results will appear elsewhere

WALTER GORDY

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Ohio State University
Columbus Ohio
Sept 14

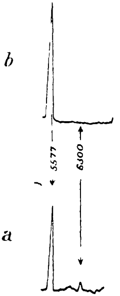
[1] Gordy W *J Chem Phys*, 4 749 (1936) *J Amer Chem Soc* 60 605 (1938) Gordy W and Nielsen A H *J Chem Phys* 6 12 (1938)

[2] Macleod and Wilson *Trans Faraday Soc*, 31 596 (1935), Glasstone S, *Trans Faraday Soc* 33 200 (1936) Gordy W, *J Amer Chem Soc* 60 605 (1938), Zellhoefer, G F, Copley M T and Marvel C S *J Amer Chem Soc* 60 1337 (1938)

Very Small Intensity of the Red OI Triplet during the Auroral Displays of September 14 16

IT has been shown in previous papers[1, 2] that the red aurora of type *A* owes its redness to the enhancement of the red OI triplet $({}^1D_2 - {}^3P_{0,1,2})$ and that the relative intensity of this triplet and the frequency of the red auroras of type *A* seem to follow the sunspot frequency[3, 4] This rule was found to hold for spectrograms obtained since 1923 and up to the winter season 1937–38

As we approached the present sunspot maximum the red auroras of this *A* type and the intensity of the red triplet became very pronounced indeed On spectrograms obtained during the winters 1936–37 and 1937–38, the red line 6300 was usually about equally as strong as, and sometimes much stronger than the green line[3, 4, 5]



a Sept. 14–15 1938
exp 2320–0025
b Sept. 15–16, 1938
exp. 2045–2400

Very brilliant auroral displays appeared at Oslo during the two nights September 14–15 and 15–16 this autumn On both nights we took several auroral spectrograms on panchromatic plates (Agfa Isopan) *Although the green line 5577 appeared with great density on the plates the red line 6300 was only just visible on one of the spectrograms* The result is illustrated in the accompanying figure, which gives photometer curves for two of the spectrograms Only one of these curves shows the red line

Thus the average intensity of the red line 6300 relative to that of the green one was very small indeed throughout these auroral displays Not only the red OI triplet, but also the red bands of the first positive group of nitrogen were relatively very weak

As a result of the weakness of the red part of the spectrum, the auroras appeared green or bluish The small intensity of the red triplet is very interesting when seen in connexion with the fact that we are just at a sunspot maximum and it will be of great interest to see whether this small intensity of the red triplet is maintained throughout this winter and during the next few years If that is the case, it would mean that the intensity of the red triplet suddenly drops when the sunspot frequency has reached its maximum and that consequently the agency which is effective in producing the enhancement of the red OI triplet is not directly connected with the sun spots, but with some other solar phenomenon such as flocculæ or prominences or with some kind of active matter carried to high solar levels as the result of solar activity

I **Vegard**

Physical Institute
Oslo
Sept 23

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[1] Vegard I Nature **117** 356 (1926)

[2] Vegard L *Geofys Publ* **9** No 11 (1932)

[3] Vegard I *Z Phys* **106** 108 (1937)

[4] Vegard L Nature **141** 200 (1938)

[5] Vegard I *Geofys Publ* **12** No 5 (1938)

Scattered Reflections of Radio Waves from a Height of more than 1 000 km

Besides the two main divisions of the ionosphere the *E* and *F* layers at heights of 120 km and 250 km , more or less irregularly occurring reflecting layers have been observed Magnetic storms and auroras are usually accompanied by an increase of the height of the *F* layer *F* layers with an equivalent height of 400–500 km are often observed during and after magnetic storms

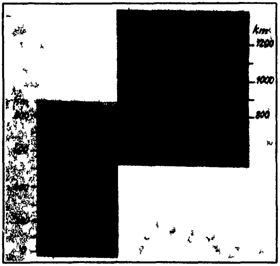

Fig 1

Scattered reflections 850 1200 km. equivalent height Recorded July 7, 1938, 18h 0m –18h 5m M E T on 7 65 Mc /sec

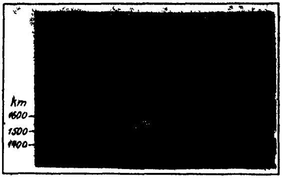

Fig 2

Scattered reflections 1300–1600 km equivalent height Recorded July 9 1938 16h 45m 16h 50m M E T on 9 0 Mc /sec

During recent months, experiments with a pulse transmitter with considerable output have been made using frequencies which were higher than the critical penetrating frequencies of the *F* layer the latter being controlled and recorded by a second set consisting of a receiver and a transmitter of moderate output The output of the larger transmitter was more than 50 kw in the pulse the aerial used was a horizontal half wave dipole the distance between the transmitter and the receiver was 150 m

On a number of afternoons and evenings, scattered reflections from a region lying between 850 km and 1,600 km equivalent height were recorded Fig 1 is a record showing scattered reflections between 850 km and 1,200 km equivalent height, and Fig 2 shows scattered reflections with 1,300 km to 1,600 km equivalent heights On the latter figure the white line indicates a ground wave 180° out of phase with the pulse emitted Since a 50 cycle circuit was used for the oscillograph this indicates a time difference of 1/100 sec which corresponds to an equivalent height of 1 500 km The echoes observed on the oscillograph screen are faint and the amplitudes rapidly varying They seem to be similar to the scattered reflections from the 100 km level recently described by Eckersley[1] and Appleton[2], and an explanation of these high echoes as due to ionospheric clouds seems to be probable

A detailed study of the appearance of these high echoes will be published elsewhere

Leiv Harang
Willi Stoffregen

Auroral Observatory,
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Sept 12

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[1] Nature **140** 846 (1937)

[2] *Proc Roy Soc* **164**, 467–476 (1938)

The Electron Neutron Interaction

Recently, we described the results of experiments which led us to the conclusion that electrons are emitted from atoms when they interact with fast neutrons by some hitherto unknown process[1] On the other hand, Kallmann and Kuhn[2] have shown that gamma rays are emitted in the D–D reaction and that the neutron electron interaction postulated by us is not necessary to account for their results

Recently, we repeated our experiments using the coincidence method of two counters instead of a single counter method We constructed a pair of thin walled, semi cylindrical counters placed close side by side, and only simultaneous discharges taking place in both counters were recorded In this way we could get rid of many ambiguities with which one inevitably meets in experiments with a single counter For example the effect of recoil atoms is completely avoided, and the complete protection of the counters from the X rays excited in the discharge tubes becomes unnecessary, because the double counter system is insensitive to low energy electrons The latter circumstance was a decisive advantage in that it reduced the effect of the secondary gamma rays excited in matter in the direct neighbourhood of the counter

With this arrangement we confirmed in the first place that, when carbon was used as the secondary electron emitter the radiations coming from the target and sensitive to the double counter system consisted chiefly of gamma rays in agreement with the result of Kallmann and Kuhn But in the second place, when lead was used as the electron emitter a definite indication was observed that the electrons are emitted by the direct action of fast neutrons As we have already stated the postulation of the new effect is only necessary when the effect is observed in the case of light elements (see also Seaborg and Grahame[3]) Our present results can be accounted for by the existence of gamma rays from the target together with the internal conversion of the lead nucleus excited by the neutrons The disagreement with our former result seems to have come from the error involved in the estimation of the effect of the secondary gamma rays excited in the walls of the counter and that of the recoil atoms in the counter We should like to express our regret for this error

As to the origin of the gamma rays coming from the target, their intensity is of the same order of magnitude as would be expected from gamma rays excited in the substance constituting the target (glass) and the Dewar vessel for liquid air cooling the target It is, however, probable that they are inherent in the D–D reaction But their intensity is too low to relate them directly with the low-energy neutron group found by Bonner[4] The quantum energy of the gamma rays was estimated by the method of Bothe and Becker and it was found to be about 2 Mev The value is that to be expected from Bonner s result, but it is indistinguishable from the quantum energy of the gamma rays excited in most of the substance by the D–D neutrons

Details of this work will be published shortly in the *Proc Phys Math Soc Japan*

SEISHI KIKUCHI
HIROO AOKI

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Osaka
Sept 15.

See for example NATURE 141 328 645 (1938)

[2] *Naturwiss* 26 106 (1938)

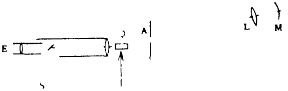
[3] NATURE 141 1053 (1938)

[4] *Phys Rev* 53 711 (1938)

A New Method of Measuring the Velocity of Light

IN determining the velocity of light by Fizeau s toothed wheel the number of eclipses per second cannot be made more than about half a megacycle Thus the method requires great distances In two modern determinations, that of Karolus and Mittelstaedt at Leipzig in 1926, and that of Wilmer C Anderson at Harvard in 1937, the toothed wheel was replaced by a modulated Kerr cell and the frequency varied in the one case from 3 to 7 megacycles per second, and in the other case from 7 to 56 megacycles per second I have recently replaced the Kerr cell by a piezo electric quartz oscillator working at 115 mega cycles per second, and have thus been able to use Fizeau s method with a very short base line

The accompanying diagram represents the arrangement *Q* is the quartz The periodic electric field is applied in the direction of the arrow, and under its influence stationary ultrasonic waves are formed At the rarefactions and condensations the density of the quartz is altered thus its refractive index varies periodically and if parallel light is incident in the direction of the axis of the telescope the quartz acts on it like an intermittent diffraction grating This intermittent grating takes the place of Fizeau s toothed wheel The first order spectrum is as bright as the direct image



Monochromatic light from the source *S* is reflected down the telescope by a Gauss eyepiece The aperture *A* is placed in such a position that only a first order spectrum gets through The light then travels along an optical bench *AL* and is reflected back on its path by the lens mirror combination *LM* If when it returns to *Q* the grating is in action the first order spectrum is diffracted along the telescope to the eye of the observer at *E* if on the contrary, the quartz atoms are momentarily in their mean positions there is no diffraction Thus when the lens mirror combination is drawn back along the bench the image undergoes a periodic change in intensity As the grating forms twice in each period of the oscillator and the light has to traverse the path both going and returning, the positions of the mirror which give minima are only about 65 cm apart The first position at 32 cm from the quartz cannot be obtained owing to the aperture *A* getting in the way but the others which lie within the range of the bench, at 97 cm 162 cm 227 cm 292 cm and 357 cm , are all easily visible

The method is still in process of development, and will later be described in full It is too soon to estimate its possibilities, but at present it seems better than the other methods for measuring the velocity of light in liquids

The method was discovered during the course of an investigation supported by the Carnegie Trust for the Universities of Scotland, and I have been indebted to my colleague Dr John Thomson for freely placing his knowledge of short wave wireless at my disposal

R A HOUSTOUN

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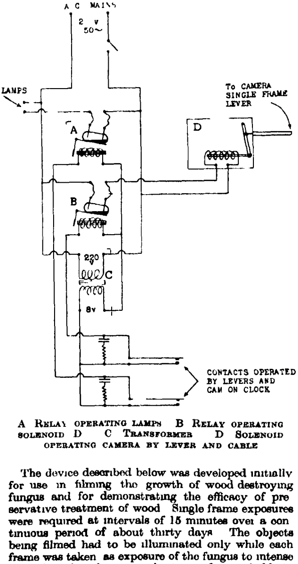
Sept 22

Automatic Operation of Ciné-camera and Lighting Arrangements for Time Lapse Studies

The ciné camera provides a convenient means of recording the growth of plants and fungi, or other very slow movements. The method employed is to expose one or more frames of a film at regular intervals over the period of study. The camera is operated through the single frame crank or release either by hand or automatically. Where artificial lighting is necessary, lamps are also switched on at the appropriate moment. The apparatus required for automatic operation is generally elaborate and expensive. The design of a relatively simple and cheap form may therefore be of interest to investigators and others.


A C MAINS
2 V
50~
LAMPS
TO CAMERA SINGLE FRAME LEVER
D
A
B
220 V
C
8V
CONTACTS OPERATED BY LEVERS AND CAM ON CLOCK

A Relay operating lamps. B Relay operating solenoid D. C Transformer. D Solenoid operating camera by lever and cable.

The device described below was developed initially for use in filming the growth of wood destroying fungus and for demonstrating the efficacy of preservative treatment of wood. Single frame exposures were required at intervals of 15 minutes over a continuous period of about thirty days. The objects being filmed had to be illuminated only while each frame was taken, as exposure of the fungus to intense light, for other than very short periods, was liable to affect its growth.

Apparatus. The ciné camera is operated by means of a solenoid (see accompanying diagram), the single frame release being connected by Bowden cable to a lever, the free end of which is pivoted to the armature. The solenoid and the lamps for illuminating the objects are connected to the mains and controlled by mercury tube relays. A small transformer supplies 8 v. current to the latter. The circuits containing the relays are opened and closed by reed contacts operated by levers and a cam on the minute hand shaft of an eight day clock.

The method of operating the contacts is a modified form of that sometimes used in electrical master clocks. The cam is four sided, so that the contacts are closed every fifteen minutes. Each contact is moved by a pair of followers, the inner ones being pivoted to the clock frame and the outer followers being pivoted to the inner at their mid points. The differences in length of the four cam followers govern the sequence and duration of closing and opening the contacts. The inner followers are in each case shorter than the outer and when they are dropped by the cam the pivots of the outer followers are lowered giving angular motion to the latter and so closing the contacts. When the outer followers are dropped in their turn by the cam they resume their original position relative to the inner followers and open the contacts. The sequence is as follows. The inner follower for the lamp relay contact falls first; a second or so later the inner follower for the solenoid relay contact falls. The outer follower for the latter then falls after a suitable period has elapsed and the solenoid circuit is opened. Soon after, the outer follower for the lamp circuit falls. During the next fifteen minutes the followers are gradually raised by the cam until the operation is repeated.

This arrangement has the advantage that the loading on the clock movement is small and uniform, without tendency to retard or stop the clock when the contacts are operated. The timing is accurate and readily adjustable by slight alteration in the lengths of the followers. Any number of operations from one to thirty or more per hour can be obtained by using suitable cams, larger diameters being required, of course, for the greater frequencies.

When films prepared in this manner are projected at normal rates, the otherwise imperceptible growth or displacement of the object is shown and rhythmic movements may become visible.

P. Harris.

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Sept. 22.

Sampling Lake Deposits

Work by the Freshwater Biological Association during the past year has directed attention to the importance of the deposits at the bottom of lakes as a means of interpreting their history since the Ice Age[1] and similar work on both freshwater and marine deposits has been progressing in other parts of the world[2]. Cores from the floor of lakes or the sea have usually been taken with a sampler consisting of an open ended pipe driven vertically into the deposit by its own weight (for example, Bigelow tube), by a hammering device, by exploding a charge at its upper end[3], or by screwing it into the deposits by means of connecting rods operated from a pontoon[4]. Such methods have the disadvantage that the deposits tend to be compressed and distorted by the pipe, so that the resulting core fails to give an accurate picture of the original stratification. The apparatus described in this communication was designed by one of us (B. M. J.) to avoid these difficulties, it has been tested successfully on Windermere, and should have application to similar problems elsewhere

Fig 1 shows the whole apparatus with the sampler proper (*F*) at the bottom, extension tubes (*E*) above it, of sufficient length to penetrate the deepest deposit to be sampled, and above these a length of guide tube on which slides a driving weight (*D*) The gear (*C*) for closing the sampler is carried on a flange at the upper end of the guide tube A bridle of cable supports the whole apparatus and works the driving weight The top of the bridle is hooked to a trip release (*B*) on the end of the main cable (*A*)

The sampler proper is shown in cross section in Fig 2 in the open position (*A*) and closed position (*B*) It consists of an outer tube, of 2½ inch bore, of which one third of the circumference is cut away, and an inner half tube The cut side of the outer tube is closed, except for a small longitudinal opening, by a face plate The inner half tube is carried by radial arms on a shaft, which passes upwards to the closing gear, so that when the shaft is rotated the inner half tube projects through the longitudinal opening, passes through an arc of a circle, and closes against the face plate The top and bottom ends of the inner half tube are closed by thin diaphragms, for the passage of which cross slots are left in the face plate The bottom end of the outer tube is closed by a solid steel point which slides on its attachment to act as a valve

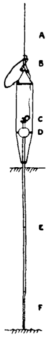

Fig 1.

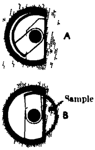

Fig 2

A, Sampler open, B Sampler closed

In use, the whole apparatus is lowered by a single cable from a pontoon, with the sampler in the open position Its own weight is sufficient to penetrate the upper soft layers of the deposit, and it can be driven down to the required level by raising and dropping the sliding weight A messenger weight sent down the cable then releases the trip, which disconnects the main cable from the driving weight and allows a fine by pass cable to be tightened by hauling up the main cable Tension on this fine by pass cable, transmitted through a pulley and skew gears (*C*), revolves the central shaft, and with it the inner half tube, thereby enclosing a core of the bottom deposit in the sampler (Fig 2, *B*) Loss of any part of the sample is prevented by the diaphragms mentioned above As the fine by pass cable completes the closure, a second strong by pass cable (to the left of *B*, Fig 1) becomes tight and takes the weight of the whole apparatus as it is hauled out of the deposit The latter process is made easy by the valve at the bottom of the sampler allowing water to pass down the tube to fill the hole left in the deposit On reaching the surface, the apparatus is laid horizontally and the closing gear is turned backwards to expose the core which is then transferred to a trough in which it is stored for examination

The experimental sampler was made to collect cores only 4 feet long but deeper deposits were explored by using extension tubes (*E* Fig 1) to take successive but overlapping cores at increasing depths In this way cores of 9 feet in length were obtained in Windermere There seems however, no reason why a longer and better constructed apparatus on the same plan should not be capable of extracting undisturbed cores from considerably greater depths of deposit and under many fathoms of water

The advantages of this apparatus over others previously used for similar purposes are that (1) it is worked from a pontoon with only a single cable and is therefore applicable to almost any depth of water, (2) there is no need for connecting rods to the surface, (3) for obtaining cores at successive depths in the deposit there is no need for devices to ensure that the sampler enters the same hole again, (4) there is no compression or appreciable distortion of the core, at any depth, because the inner half tube cuts laterally along the arc of a circle into undisturbed deposit

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[1] Nature **142** 238 (Aug 6 1938)

[2] Wasmund E Handt d Biol Arbeitsmethoden Abt **9** 1899 (1936)

[3] Piggot C S *Smithsonian Report for* 1936 207

[4] Reissinger A *Int rnat Rev d Hydrobiol* **33** 1 (1936)

Nature of the Gonadotropic Hormone from Pregnant Mare Serum

In a recent communication, Hartman and Benz[1] reported on the carbohydrate content of gonadotropic hormone preparations from pregnancy urine and pituitary gland A similar result was previously reported by Karl Meyer[2] who investigated a product obtained from Prolan by reaction with iodine The product obtained contained 11 07 per cent total nitrogen 16 4 per cent total reducing sugar of which 7 72 per cent was hexosamine The acetyl value was 3 16 per cent If these figures are recalculated on the iodine free substances, the figures are 11 9, 17 7, 8 3 3 4 per cent respectively

We have been occupied lately with the purification of products obtained from pregnant mare serum, and we found that they contain considerable amounts of reducing sugar, hexosamine and acetyl groups They give strongly positive Molisch and Elson Morgan reactions for hexosamine The most interesting fact we derived from our investigations is that apparently the relation of total nitrogen and hexosamine nitrogen is in some way characteristic for the purity of the products

In analysing different products prepared from mare serum which are in the market as well as our own products, we have found that in the average product this quotient, N_{hex}/N_{total} is between 1/34 and 1/48 The purest product gave 1/14, whereas the above cited preparation from human pregnancy urine[2] showed a relation of 1/18 4 On the other hand, using the analytical data of Meyer[3], on the glycoprotein, ovomucoid *a*, a quotient of nearly 1/9 is obtained

Our findings would confirm the assumption of Karl Meyer and John W Palmer as to the mucoid nature of gonadotropic fractions

It may be of interest that the gonadotropic hormones apparently do not contain cystine

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E Schwenk
K Meyer

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[1] Nature 142 115 (1938)

[2] Kurzrok Endocrines in Obstetrics and Gynecology p 115 (Williams and Wilkins Baltimore 1937)

[3] Meyer Karl, *et al* Cold Spring Harbor Symposia on Quantitative Biology 6 (in the Press)

Production of Mammary Carcinomas in Mice of a Susceptible Strain by the Synthetic Œstrogen, Triphenyl Ethylene

It is well known that in certain inbred strains of mice, many of the females develop spontaneous mammary tumours Few or no tumours occur in the males of these strains or in the females spayed before puberty When, however, these males are injected with œstrone over prolonged periods, a number develop mammary tumours

We have produced mammary carcinomas in the males of such a strain by the injection of a synthetic œstrogen Fifty three males of the *R* III strain (Dobrovolskaia Zavadskaia) received weekly a sub cutaneous injection of 5 mgm of triphenyl ethylene in oil, the dose being later reduced to 3 mgm The injections were started before the age of sexual maturity and have been continued up to the present time Twenty six mice are still alive after 28 or more weeks of treatment

So far, ten mammary carcinomas have developed in nine male mice (one mouse developed two tumours) They are of the same histological type as those which occur spontaneously or which are produced by the injection of a natural œstrogen in this strain, that is, they are papillary adenocarcinomas with cystic and degenerative areas The tumours appeared at 18, 19½, 21 (two mice), 23, 24 (two mice), 26 and 29 weeks of treatment

Several tumours have also developed in females of the same strain ovariectomized before puberty and afterwards injected with triphenyl ethylene Their histological examination is at present in progress

Twenty nine males and twenty one females (non spayed) of a strain which does not spontaneously develop mammary carcinoma (black agouti) have also been injected with triphenyl ethylene for a similar period, and no tumours have so far developed

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G M Bonser

Dept of Experimental Pathology,
University of Leeds.

Oct 3

A Hæmoglobin from Bile Pigment

Under this title, Lemberg, Legge and Lockwood have described in Nature of July 23, p 148, "a new hybrid hæmoglobin" formed by special treatment of hæmoglobin – ascorbic acid solutions In the summary given, p 166, one finds the following "The new compound, like hæmoglobin, combines reversibly with oxygen and carbon monoxide but the non protein part of its molecule is a bile pigment closely related to verdohæmatin This might give the impression that the existence of bile pigment globin compounds was not known before

In 1932, Barkan[1] suggested that the easily split off blood iron (leicht abspaltbares" Bluteisen), discovered in 1925 by him[2], may be a step in the formation of bilirubin Later Barkan and Schales[3] pointed out that the two fractions E and E' of the 'easily split off' blood iron accompany the hæmoglobin in the circulating blood as intermediate products of bilirubin formation E and E' are hæmoglobin like compounds in which the bearer is an undenaturated globin, whilst the prosthetic group is a hæmin or hæm derivative with an opened porphyrin ring similar to that in Lemberg s 'verdohæmochromogen' We called these compounds pseudohæmoglobins, and the prosthetic groups pseudohæmin and 'pseudo hæm' We suggested the use of the prefix 'pseudo for such products which resemble in many points the 'true' ones and differ from them only by the opening of the porphyrin ring, indicating by the letter α, β, etc, at which methene group the opening took place (in our case α pseudohæmoglobin, α pseudo hæm, etc) We were able to show[3] that the two native fractions E and E differ by the valence of the iron It is in the divalent form in E (E is a pseudo hæmoglobin *in sensu strictiori*) but trivalent in E (E' is a pseudomethæmoglobin) We were able to transform E into E and vice versa[3] Barkan and co workers described many properties of the pseudo hæmoglobins E and E The most important fact is that the bile pigment – globin compound E combines reversibly with oxygen and carbon monoxide according to the 'distribution equation, and that the relative carbon monoxide affinity (by which is meant the ratio of the affinity for carbon monoxide to that for oxygen) is rather greater in the case of E compared with hæmoglobin (Barkan and Berger[4]) The pseudo methæmoglobin E' (like the methæmoglobin) does not react in this way with oxygen and carbon monoxide

Recently Lemberg observed that verdohæm (pseudo hæm after our definition) unites with native globin to give a hæmochromogen and not a hæmoglobin Therefore he assumed as a working hypothesis that in the disintegration of hæmoglobin the alteration of the globin part precedes the oxidation of the prosthetic group[5] Barkan and Schales[6], on the other hand, have emphasized that the existence of E and E' (that is, of *iron containing bile pigment – globin compounds*) in the normal red blood cells gives evidence that an oxidation of the prosthetic group must be the first step in the breakdown of hæmoglobin The new statement by Lemberg and his co workers that an iron containing bile pigment – globin compound is readily formed from hæmoglobin seems, when considered in connexion with our previous work, to support our opinion mentioned above

There is no evidence, however, indicating whether or not the new hæmoglobin product of Lemberg and co-workers is identical with our pseudohæmoglobin found in erythrocytes. Thus it is doubtful whether the new name 'choleglobin' is necessary and suitable. The choice of rather unsystematic names in bile pigment nomenclature is, we find, a hindrance rather than a help to discussion.

Some other details in the letter of Lemberg and co-workers may be discussed elsewhere.

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OTTO SCHALES.

Universitetets Biokemiske Institut,
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Sept. 20.

Barkan, G., *Klin. Wschr.*, 1050 (1932).
Barkan, G., *Hoppe Seylers Z. physiol. Chem.*, **148**, 124 (1925).
Barkan, G., and Schales, O., *Hoppe Seylers Z. physiol. Chem.*, **248**, 96 (1937).
Barkan, G., and Berger, E., *Klin. Wschr.*, 1868 (1928) and *Arch. exp. Path. u. Pharmakol.*, **136**, 278 (1928).
Lemberg, R., "Perspectives in Biochemistry", 137 (Cambridge University Press, 1937).
Barkan, G., and Schales, O., *Hoppe Seylers Z. physiol. Chem.*, **253**, 83 (1938).

A Viable Homozygous Deficiency in *Drosophila melanogaster*

THROUGH combination of fragments of chromosomes from two complicated rearrangements (obtained in my work dealing with the w^{mt} position effect, 1938, in the press), one of which causes a light w^{mt} and the other a very dark w^{mt} eye colour, the first having the break to the left and the other to the right of the *w* gene, a stock was obtained which had no *w* gene in its genotype. Since the cytological observations show that the breaks occur near each other, or even at the same point in both the original aberrations, it was concluded that only one gene, namely, the gene white, was deficient. The cytological data agree well with the phenotypical actions of the *w* deficiency which does not differ from a simple *w* mutation causing the white eye colour. The cytological observations agree also with the data obtained by numerous authors showing the position of the *w* gene in the $3C_2$ region of Bridges' salivary chromosome map. But in the *w* deficiency combinations the $3C_2$ band is not thinner than in the normal chromosome.

This may serve as evidence for the conception that the genes are really localized in the intrabandular areas. In this case the *w* gene must be included between the disks $3C_2$ and $3C_3$ in the X chromosome map. It may be also that this finding, which does not agree with the data of Shultz (1938), who has shown that in the *w* mutations the $3C_2$ disk is thinner than in the normal chromosome, is caused by the fact that in both of the original aberrations and in their compound, the $3C_1$ and $3C_2$ disks, which are translocated from chromosome IV to chromosome II L, stain more deeply by aceto-carmine, that is, more nucleic acid is present.

The *w* deficiency males and females (the latter have been obtained by crossing *w* deficient males to notch^8 females) do not differ from the typical w^w mutations, and have no other pleiotropic effects. The increased sterility of the *w* deficient males is due probably to the original sterility effect present in one of the aberrations involved.

It is the second undoubted case of viable homozygous deficiency; the first was obtained by H. J. Muller (1935, the *y, ac* deficiency). The phenotypical effect which is caused by the *w* deficiency corresponds well with Muller's theory (1932) of the action of hypomorphic and amorphic mutations. Thus, the *w* mutations are typical amorphic mutations and probably some of them are caused by real deficiencies. The viability of the deficiencies and the absence of pleiotropic effects in these flies shows a high degree of discontinuity of the hereditary substance in the sense that the role taken by some genes is very low and that they affect few physiological functions of the whole organism. This may be caused by a high degree of duplication of genes, partially not homologous with each other.

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Thermal Conductivity of Mud Brick

INVESTIGATIONS of the thermal conductivity of mud brick, of which the methods of manufacture with mud and straw seem to have remained practically unchanged through thousands of years, have been made with small- and large-scale apparatus.

Results with small samples 10 cm. in diameter and from 1 cm. to 2 cm. thick have given results ranging from 3·8 × 10^{-4} calories per sq. cm. per 1° C. temperature gradient per sec. with much straw to 8·0 × 10^{-4} c.g.s. units with minimum straw.

The results with mud brick walls built vertically in 150 cm. × 140 cm. × 28 cm. frames vary from 3·9 × 10^{-4} to 6·0 × 10^{-4} c.g.s. units. The weight of water in the bricks was found to vary by some 15 per cent according to the humidity of the air. Such bricks appear considerably better heat insulators than ordinary burnt bricks now used in constructional work, but are less heat insulating than the best cellular concrete.

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Bluffing by Eclipse Prediction

LIVY'S description of the Roman general, C. Sulpitius Gallus, warning his men before the battle of Pydna (168 B.C.), that an eclipse of the moon would take place on the following night is well known. He gave a scientific explanation of the phenomenon so that they should not take it as an adverse omen. The Macedonians, on the other hand, were, according to the historian, unprepared and thoroughly alarmed.

Less familiar is the very effective use of a solar eclipse by the Byzantine Emperor, Alexius I Comnenus, who figures so prominently in the history of the First Crusade. To quote the words of his biographer, his daughter Anna Comnena:

In the course of the discussion a certain Nicolas, one of the Emperor's secretaries, came up to him and whispered in his ear, 'You may expect an eclipse of the sun to take place to-day', and on the Emperor's expressing a doubt, he swore with an oath that he was not lying. Then the Emperor, with his habitual quick wittedness, turned to the Scythians and said, 'I appoint God as Judge; and if a sign appears in the heavens this day, you will know for a surety that I have good reason for suspecting, and therefore not receiving, your embassy because your leaders are not sincere in their overtures for peace. If, however, no sign appears I shall stand convicted of having been wrong in my surmise Before two hours had passed the light of the sun failed and the whole disk was darkened by the moon s passing over it At that sight the Scythians were terrified (The Alexiad translated by Elizabeth A S Dawes London Kegan Paul 1928)

In fiction, we have Mark Twain and Rider Haggard making use of this device, Rider Haggard s description of the duration of an eclipse being a stock example of a scientific howler in literature It would be interesting to find who first thought of this form of bluff in imaginative writing The earliest reference I can discover is in the romance The Prairie Bird , by the Honourable (Sir) Charles Augustus Murray My copy is dated 1854, but, according to the Dictionary of Natural Biography, this book was published in 1844

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Sept 26

Points from Foregoing Letters

EXPERIMENTS have been made by G E F Fertel Dr P B Moon, Prof G P Thomson and Dr C E Wynne Williams on the distribution of velocities among the neutrons emitted from a source surrounded by paraffin By using as the source an intermittent discharge they find that with one apparent exception, the distribution follows the Maxwell law

Ethyl hydrogen peroxide decomposes heterogeneously in the temperature range 140–200° according to E J Harris and Prof A C Egerton Coating the surface of the vessel with salt increases the reaction rate and at higher pressure the decomposition is explosive The authors discuss the action of this and other organic peroxides upon propane oxygen mixtures

From a study of the rearrangement of benzylphenyl ether and similar ethers in suitable solvents Dr W J Hickinbottom suggests that the observed facts are best explained by assuming that the rearrangement is dependent on the intermediate formation of free radicals

Irradiation of hæmocyanin (mol weight 6 740 000) with ultra violet light of wave length corresponding to the absorption band due to the protein part of the molecule (around 2800 A), leads to the splitting of the molecule, according to ultracentrifuge experiments by Prof The Svedberg and S Brohult The authors consider that primary protein reactions are elementary acts which obey quantum mechanics

A graph showing a new absorption band in the region 4μ in mixtures of chloroform with acetone, due to association between the molecules of these solvents is submitted by Prof W Gordy, who states that this is the most definite evidence yet published for the existence of hydrogen bonds between associated molecules

A very small intensity of the OI triplet in the auroral spectrum during the displays of September 14–16, which resulted in the auroras having a greenish or bluish tinge, is reported by Prof L Vegard, who suggests that the enhancement of that radiation in the auroral spectrum prior to the sunspot maximum may be due to some kind of active matter carried to high solar levels as the result of solar activity

Dr Leiv Harang and Willi Stoffregen have obtained scattered reflections of radio waves from heights between 850 km and 1,600 km equivalent height, using a pulse transmitter with considerable output The frequencies used were higher than the critical penetrating frequencies of the F_2 layer The scattered reflections are explained as due to ionospheric clouds

Dr R A Houstoun describes a variation of Fizeau's method of determining the velocity of light, in which the toothed wheel is replaced by an intermittent diffraction grating This enables the range to be diminished to a four hundredth of its value

An arrangement for recording the growth of plants and other very slow movements by photographing at fixed intervals with a ciné camera is described by P Harris Advantages claimed for the new arrangement are that the clock movement is small and uniform and the timing accurate and easily adjustable, so that from one to thirty or more operations per hour can be readily obtained

A device for sampling lake deposits in which the inner half tube cuts laterally along the arc of a circle so as not to disturb the deposits, is described by B M Jenkin and C H Mortimer The apparatus is worked from a pontoon with only one cable without connecting rods to the surface and samples at successive depths can be taken without the sampler having to enter the same hole again

G Fleischer Dr E Schwenk and K Meyer find that the proportion of hexosamine in relation to the total nitrogen in the gonadotropic hormone present in pregnancy urine is of the same order as that in the glycoprotein ovomucoid α The authors consider that this supports the view concerning the mucoid nature of gonadotropic extracts

Dr J M Robson and G M Bonser report that injections of triphenyl ethylene (a synthetic œstrogen) lead to the production of tumours in male mice of a strain in which females alone develop spontaneous tumours

Prof G Barkan and O Schales have pointed out that in the red blood cells there are present iron containing bile pigment – globin compounds These pseudohæmoglobins accompany the hæmoglobin in the circulating blood as intermediate products on the way to bilirubin formation The recent work of Lemberg and his co workers described in NATURE is believed to support the opinion of Barkan and Schales that an oxidation of the prosthetic group and not an alteration of the protein part may be the first step in the breakdown of hæmoglobin to bilirubin

Through combination of fragments of chromosomes from two complicated rearrangements found in two varieties of the fruit fly (*Drosophila*), one of which causes a light and the other a dark eye colour, I B Panshin has obtained a stock in which the gene white is absent in the genotype Cytological observations support the view that the genes are localized between the dark staining bands of the chromosomes

Research Items

Indians of the Copper River Delta, Alaska

A DETAILED record and analysis of the culture of the Eyak Indians by Dr Kaj Birket Smith and Dr Frederica de Laguna ('The Eyak Indians of the Copper River Delta, Alaska', *Kgl Danske Videnskabernes Selskab* København Levin and Munksgaard, 1938 Pp 592+18 pl) is based mainly on observations made during an expedition to Prince William Sound in the summer of 1933 The Eyak it had been estimated in 1930, were distinct from Eskimo, Tlingit and the Atna, or Athapascan speaking tribes of the Copper River Valley The hypothesis then suggested that they were a group of the Athapascans who had come from the interior down the river is here tested and discussed in the light of intensive ethnographic study Eyak culture is an extremely complicated thing, as might be expected from their geographical situation on the borders of three or four of the principal culture areas of North America, and close to the main cultural gate between the two hemispheres The basic structure seems fairly clear More than eighty Eyak elements, namely, 45 per cent of the 183 traits studied, are classed with the ice hunting culture They belong to all phases of human life, comprising dwellings, dress, conveyance, house utensils and tools, hunting methods and weapons, magic and religion, etc The elements of the snow shoe culture, on the other hand, are exceedingly few in number and of a casual character This culture can never have been adopted as a whole The analysis of Eyak culture adds strength to the evidence of a circum Pacific culture stream, as 27 of its elements seem to belong here Further, the greater part of the 22 Tlingit elements must be included among circum Pacific traits, as in most instances they are elaborations of Old World forms, which have drifted back to the north The origins of the remaining elements can be classified roughly as follows Asiatic without belonging to any well-defined complexes previously mentioned (9 elements), Eskimo Thule culture and north west coast, chiefly from the southern area of the latter (7 elements), Eskimo Thule traits (10 elements), North East Coast and Plateau, or in a few cases only, the latter (17 elements)

Blood-groups in India

IN a paper on the blood group distribution in India (*J Genetics*, 36, No 2) Dr Eileen Erlanson Macfarlane discusses previous results and adds new ones from different parts of India Different castes as well as races have been compared, and, as might be expected, the castes differ in their blood groups The rather small samples indicate that, in Bengal *A* is similar in different castes, as would be expected if it is of ancient origin, but the percentage of *B* increases and that of *O* decreases in the lower castes On the Malabar coast these conditions are reversed, the higher castes being highest in *B* It is evident that *B* has spread both socially, in different castes, and geographically, and it is suggested that *B* may have spread from a single source in north central India during recent millenniums In Bengal, the Mohammedan blood groups are similar to those of low caste Hindus in the same region, which accords with the tradition that they were low caste converts from Hinduism in Moghul times The relatively low *B* in Cochin is accounted for by the fact that migratory movements from farther north missed the Malabar coast, the lower castes and pre Dravidians being high in *A*

Frequency of Multiple Births

MR ALBERT V T DAY of 180 Kings Highway Westport Connecticut, writes to direct attention to the empirical rule connecting the observed frequencies of twin, triplet and quadruplicate births namely that approximately one birth in 80 is of twins, one in 80^2 of triplets, and one in 80^3 of quadruplets He suggests that the discovery of such a consistent rule in inorganic physics would not be treated as a mere mathematical coincidence If the said rule is a functional expression of some real biological mechanism its true basic ratio may be 81, derived as 9^2 or 3^4

Food Pellets of Owls

BY studying the activities of a captive short eared owl (*Asio flammeus*) Dennis Chitty has added to knowledge of its food habits (*Proc Zool Soc*, Ser A, 108 267, 1938) The formation of pellets it is said, is not due to any special diet or structure of the alimentary canal and Guérin regards their ejection as a deliberate act the time of which is determined at will by the bird In the short eared owl the time of ejection of pellets was found to be related to the weight of the meal previously taken, although as a rule pellets were retained longer at night than during the day At each ejection the owl completely emptied its stomach, the pellet representing the residue of one or two meals of which the combined weight seldom exceeded 40 gm Biochemical analysis of the food taken by the owl shows that pellet ejection involves a low percentage of ash, and particularly of calcium in the retained food matter The data gathered in these experiments have been used to estimate the food requirements of an owl in natural conditions (though the results may be considerably off the mark) It is concluded that in a year a short eared owl would eat more than 47 lb of voles and mice, and probably more than 95 lb but less than 142 lb Where some relationship is known between the size of owl and vole populations in the same area, this represents a consumption of the vole population by owls at a rate of 0 02–0 05 per cent of the population per day—not enough to make any serious impression upon a vole plague

Moulds of Blue Cheese

MOULD fungi which can grow under the conditions of low oxygen tension provided by the cracks of certain cheeses are somewhat variable, and many species have been described It was suggested by Thom in 1930 that all these species were really cultural variants of one, namely, *Penicillium roqueforti* S Dattilo Rubbo has re examined the question in great detail (*Trans Brit Mycol Soc*, 22, Pts 1 and 2, 174–180, Aug 1938), and his results substantially confirm those of Thom A new variety, *viride*, of *P roqueforti* has been obtained from Blue Cheshire cheese, but this is the only variant of significant permanence isolated from Roquefort Gorgonzola, Stilton, Blue Vinney, Wensleydale and Blue Cheshire products Dolce Verde cheese, however, provides an isolated exception, for its organism is related to *P expansum*, a blue mould associated with the rotting of fruit

The Pitch-Crust Fungus

A DETAILED paper by W H Wilkins (*Trans Brit Mycol Soc*, 22, Pts 1 and 2, 47–93, Aug 1938) gives an account of the spore germination and methods of infection of the common pitch crust fungus, *Ustulina vulgaris* This fungus can attack standing timber, and causes subsequent decay The investigation shows that while spores can germinate upon living trees, penetration is very slow Dead wood, on the other hand, allows germination and ready penetration and it is suggested that in Nature the organism is somewhat saprophytic and grows first upon non living timber Saturated wood and a temperature above 10° C for not less than 24 hours are the necessary conditions for spore germination and the age of the spores is also a potent factor The optimum temperature for germination is 25–30° C and the optimum pH is 6 Spores germinate upon, and penetrate, ash, beech, elm, horse chestnut, lime and poplar, but not oak The collected result of these experiments is, however, considered to suggest the improbability of spore transmission in temperate climates, and other methods must be considered

New Zealand Forest Fungi

NUMEROUS references to published work upon fungi which attack New Zealand forest trees have been collected by Mr T T C Birch (*N Z J Forestry*, 4, 2, 1937, or *N Z State Forest Service Bull* 9, 1938) For each fungus species, the New Zealand hosts are given, distribution of the parasite is indicated, a description of the type of damage caused is given, and then the references to published work It is thus possible to obtain with ease a conspectus of New Zealand forest pathology Many of the sixty two species listed are common in Europe, though not always as parasites *Schizophyllum commune*, for example, is a parasite in New Zealand, but is usually considered a saprophyte in Great Britain Seven species, the hyphæ of which are probably mycorrhizal, are also mentioned, and beneficial symbiosis of *Boletus luteus* with *Pinus radiata* has been proved by Mr Birch

The Earth's Crust

A RECENT paper by Neil R Sparks (The Eureka Earthquake of June 6, 1932 , *Bull Seism Soc Amer* , 26, 13–27 , 1936) has aroused considerable interest in that the thicknesses of the crustal layers and the velocities of waves in them turn out to be rather different from those determined for Europe In consideration of this, Stoneley (*Bull Seism Soc Amer* , 28, 191–195 ; 1938) has reviewed the observations, determining the standard deviations He finds the thicknesses of the granitic and second layers to be 12 6 ± 2 5 km and 12 2 ± 1 9 km , compared with the 16 and 14 km given in Sparks's paper The velocities of the P waves in these turn out to be 7 15 ± 0 065 and 7 53 ± 0 073 km /sec respectively, using Sparks's assumptions The most recent determination by Jeffreys (*Mon Not Roy Astro Soc* , Geoph Supp , 4, 210 , 1937) for European earthquakes is 17 ± 2 km and 9 ± 3 km for the thicknesses of the granitic and intermediate layers respectively, and P^* is 6 498 ± 0 026 km /sec

Absorption of the CH_2 Group near 3μ

IN a previous communication (*Proc Roy Soc* , A, 162, 419 , 1937), Drs J J Fox and A E Martin recorded observations made on the CH vibrations of some organic compounds in the 3μ region They indicated that, whilst a CH_2 group in general gave rise to two C–H vibration bands, in some molecules, especially those containing a benzene ring, the C–H units interacted to give several bands Continuing this work, the same authors have examined a large number of compounds containing CH, CH_2, and CH_3 groups arranged in different ways, and a recent paper (*ibid* , 167, 257–281 , 1938) contains details of the absorption in the 3μ region, of seven compounds in which CH_2 groups are attached to the rest of the molecule by single bonds By reviewing the data available for ethylene, the authors have been able to explain the CH_2 bands observed in more complicated molecules When only one CH_2 group is contained in the molecule, the two bands observed correspond to the CH valency vibrations in and out of phase , but as the number of CH_2 groups in the molecule is increased, coupling between them causes an increase in the number of bands Thus dioxan has four strong bands Using a model of the form aldehyde type which approximates to the molecules studied, the observed frequencies can be explained assuming that the CH force constant is 4 52 × 10^5 dynes/cm It is found that the mass to which the CH_2 group is attached, and the various other force constants involved, have only slight effects on the position of the CH_2 absorption bands in the 3μ region, except in rare instances where the bonds connecting the CH_2 groups to the rest of the molecule are strained Compounds containing CH_3 and aliphatic CH groups will be dealt with in a forthcoming communication

Ultra-Rapid Processing of Radiographs

BY ordinary methods of processing, the minimum time between the taking of a radiograph and the viewing of the finished film is about ten minutes Development takes five minutes and the remaining time is needed for a quick rinse and sufficient fixing to render the film legible In certain surgical operations—the Smith Petersen nail operation is a case in point—frequent radiographs are required for inspection during their progress, and the surgeon is held up while these are being prepared It is now possible by mean of a process devised by Messrs Kodak, Ltd , to view the films within one minute after exposure By the use of the new ultra rapid developer which this investigation has produced, the development of normally exposed films takes only fifteen seconds A quick rinse of ten seconds in clean water and fixation for thirty seconds in a special bath complete this stage of the process, so that the surgeon's loss of time is greatly reduced It is stated that films prepared by this special process can be made available for future reference by giving them a final fix in a normal hardening bath and then thoroughly washing them The radiographic quality of the films produced by this new method compares well with that obtained under the more familiar processing conditions

Aggregation of Purified Tobacco Mosaic Virus

DR HUBERT S LORING, DR MAX A LAUFFER, AND DR W. M STANLEY, Rockefeller Institute for Medical Research, Princeton, New Jersey

THE point of view has been advanced by Bawden and Pirie[1] that purified tobacco mosaic virus consists of stable aggregates of many smaller units present in the infectious tissue extracts. Such aggregation has been stated to take place after purification by chemical means or after high speed centrifugation, and to result in a decrease in specific activity, in an increase in stream double refraction, and in an inability of the purified virus to pass ultrafilters which readily permit of the passage of crude virus. Similar conclusions have been drawn for purified latent mosaic virus[1]. It was early recognized that prolonged chemical treatment of tobacco mosaic virus with salts at room temperature resulted in a decrease in specific activity[2]. Later, other evidence was secured indicating that aggregation of virus occurred as a result of such treatment; hence there is complete agreement that the rather drastic chemical procedures used by Stanley[3] and by Bawden and Pirie[1] and others for the purification of tobacco and latent mosaic viruses and their strains resulted in aggregation.

TABLE 1

ACTIVITY AND STREAM DOUBLE REFRACTION OF TOBACCO MOSAIC VIRUS AFTER ONE TWO THREE AND FOUR SEDIMENTATIONS

Experiment	Activity*			Stream double refraction†			
	1	2	3	1	2	3	4
Original juice	466	2068	799	14.4	21.0	21.2	18.5
Sedimented and redissolved in supernatant juice	486	2243	798	17.7	19.9	19.5	19.8
Original juice	1152	970	609				
Sedimented and redissolved in water or buffer	1267	988	561	16.7	8.7	13.8	15.8
Twice sedimented virus	1777	2359	1221		18.0		11.0
Three times sedimented virus	2025	2052	1276			25.3	
Once sedimented virus	605	1413					
Four times sedimented virus	533	1163			36.0		27.0

* Activities are expressed as numbers of lesions obtained on 30–40 half leaves of *Phaseolus vulgaris* plants by a 1–2000 dilution in 0.1 *M* phosphate buffer at *p*H 7 for samples of juice and 10^{-4} gm per c.c. for samples of purified protein.

† Stream double refraction is expressed as the galvanometer deflections in mm. caused by undiluted samples of juice and re-suspended virus or by concentrations of purified virus equal to those of the once sedimented virus redissolved in water.

For this reason, other means for purification were sought by us. Highly active preparations were obtained from the infectious juice of young plants after three or four precipitations of the virus with ammonium sulphate, provided long exposure to the salt was avoided[3]. In more recent work, however, it was found that preparations obtained by means of high-speed centrifugation in the absence of salt possessed a high and uniform specific activity, and this method has been used almost exclusively[4]. It has seemed desirable to examine the nature of such preparations of purified virus in view of Bawden and Pirie's finding that all their purified preparations consisted of aggregated virus and their contention that centrifugation causes such aggregation.

The question of aggregation of tobacco mosaic virus has been studied by comparing the activity, the stream double refraction, and the filterability of virus before and after purification by ultracentrifugation. The virus was sedimented from clarified infectious juice by centrifugation at about 5° for $1\frac{1}{2}$ hours in a field of about 50,000 *g*. To determine the effect of one sedimentation the virus was redissolved in the supernatant juice from which it had separated, or in the same volume of water or 0.1 *M* phosphate buffer at *p*H 7. The solutions were then centrifuged at low speed to remove a small amount of insoluble material. To obtain more highly purified samples, the once sedimented virus dissolved in water was subjected to one or more additional sedimentations. The activity tests were made on leaves of *Phaseolus vulgaris* L. plants by the half leaf method[5], and the stream double refraction measurements in the apparatus previously described[6].

The results of the activity and stream double refraction measurements are shown in Table 1. When the sedimented virus was redissolved in the supernatant juice and the activity of the resulting solution was compared with that of the original juice at the same dilution, both sedimented and unsedimented virus produced about the same number of lesions. When the sedimented virus was redissolved in water and compared at the same dilution with the original juice again comparable numbers of lesions were obtained with both solutions, although the protein concentration of the former was only about 80 per cent that of the juice. As shown in Table 1, the stream double refraction of the once sedimented virus, whether redissolved in the supernatant juice in water, or in dilute buffer was about the same as that of the original juice. The combined activity and stream double refraction measurements demonstrate quite conclusively that one sedimentation under the conditions described failed to cause either an appreciable decrease in specific virus activity or an increase in stream double refraction, as would be expected if irreversible aggregation of the original virus had taken place. They also showed that such centrifugation resulted in practically complete sedimentation of the virus. In agreement with this the supernatant juice which had been poured off contained less than 1 per cent of the original virus activity and showed a negligible amount of stream double refraction.

The results of the activity comparisons and stream double refraction measurements of virus purified by two, three, or four sedimentations are also shown in Table 1. These samples were compared on a protein basis. The activity results are comparable to those found after one sedimentation in that no great change in activity took place after several sedimentations. A comparison of once and four times sedimented virus, however, showed a slight decrease in specific virus activity after four sedimentations. In agreement with this, four times sedimented virus showed a significant increase in stream double refraction If this is due to aggregation, then, in view of the activity measurements, the amount must either be relatively small or must be largely reversed at the dilution used for the activity measurements

The ultrafiltration experiments were carried out in the presence of 0 1 M phosphate and nutrient broth at a 1–5 dilution at about pH 8 under the conditions used by Thornberry[7] Ultrafilters of about 190 mμ and 330 mμ average pore diameter, kindly supplied by Dr J H Bauer, were used In each case the filterability of the virus was determined by comparing the activity of the solution on half leaves before and after filtration The results are summarized in Table 2 They show that once sedimented virus, redissolved in the supernatant juice, or virus purified by four ultracentrifugations, possessed about the same ability to pass ultrafilters of 190 mμ average pore diameter as the virus in the original juice Once sedimented virus, as well as clarified infectious juice, could be filtered through filters of 330 mμ average pore diameter without significantly affecting the virus concentrations The ultrafiltration results are, therefore, entirely comparable with the activity and stream double refraction measurements, except that the small amount of aggregation indicated by the two latter measurements in the case of the four times sedimented virus appears to be insufficient to affect its filterability through membranes of 190 mμ average pore diameter

TABLE 2

EFFECT OF SEDIMENTATION ON ULTRAFILTRATION OF TOBACCO MOSAIC VIRUS

Virus solution	Dilution*	Average pore diameter (mμ)	Activity†		Per cent virus in filtrate
			Before filtration	After filtration	
Infectious juice	1 100	190	483	203	42
Sedimented virus in supernatant juice			292	307	105
Four times sedimented virus			1038	382	37
Infectious juice	1 100	330	846	66	9
Sedimented virus in water			1782	1700	96
Twice sedimented virus			268	121	45

* Dilutions are in terms of the original juice The solvent in each case consisted of nutrient broth at a 1 5 dilution in 0 1 M phosphate at pH 8

† Number of lesions produced on 24 30 half leaves of *Phaseolus vulgaris* plants

The results of the three types of experiments described above fail to show an appreciable irreversible aggregation as a result of centrifugation They are in agreement with the finding of Loring[4] that latent mosaic virus purified by ultracentrifugation readily passed filters of 450 mμ average pore diameter, and the observation[5] that the tobacco mosaic virus nucleoprotein in clarified juice and that purified by ultracentrifugation have the same sedimentation constant. The latter observation, as has been shown by Lauffer[9] from theoretical considerations, indicates that the size and shape of the particles of purified virus are the same as those of the virus particles in the juice It is improbable that virus in untreated juice is in the form of prismatic plates as suggested by Bernal[10], for it has already been demonstrated that such virus consists of rod-like particles[4,11] Recent work indicates that tobacco mosaic virus has a molecular weight of at least 43×10^6, a length of at least 430 mμ, and an effective diameter[9] of about 12 mμ

The results obtained in the present work fail to confirm Bawden and Pirie's[1] report that one sedimentation causes great increase in stream double refraction, and indicate that tobacco mosaic virus purified by a few careful centrifugations is comparable in specific activity, in stream double refraction, and in filterability to the virus in untreated juice In view of unpublished observations that isoelectric precipitation or precipitation by means of ammonium sulphate at room temperature causes a loss of specific activity and an increase in stream double refraction of ultracentrifugally isolated virus, it is evident that the virus first isolated by chemical means, as well as preparations obtained later by us and by others by means of prolonged chemical treatment at room temperature, consisted largely of aggregated virus Preparations obtained by rapid chemical treatment in the cold or preferably by means of ultracentrifugation in the cold appear to be the only ones yet obtained that are comparable to the virus in untreated juice with respect to specific activity, filterability and stream double refraction

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Takahashi W N and Rawlins T E *Science* **77** 26 284 (1933) **85** 103 (1937)

F C BAWDEN, Rothamsted Experimental Station, Harpenden, AND N W PIRIE, Biochemical Laboratory, Cambridge

WHEN we found that the infectivity and filterability of preparations of tobacco mosaic virus were reduced and the anisotropy of flow was increased by chemical methods of isolation, we suggested that linear aggregation had taken place[1,2] This is now confirmed by Loring, Lauffer and Stanley, but they claim that unaggregated preparations can be made by the use of a high speed centrifuge We found that sedimenting the virus increased anisotropy of flow, but we made no measurements of the effect on infectivity or filterability It was suggested by analogy with the chemically prepared virus that this effect was also a result of aggregation There is no necessary contradiction between our observations and those of the American workers We centrifuged for 3 hours at 25–30° C, whereas they used a more efficient centrifuge running at 5° C, furthermore, their measurements of anisotropy of flow were made at very much higher rates of shear[3] than were ours A lengthening of the virus rod would be expected to increase the readiness with which anisotropy of flow would be demonstrated rather than the total amount shown, and the changes which we have claimed might well be undetectable by their method.

Even if centrifugation does not cause aggregation, completely unaggregated preparations could be expected only from plants that have been recently infected, for aggregation occurs naturally in the sap of plants that have been long infected[4]

We have emphasized the need for caution in interpreting centrifugal data on systems which can, in some circumstances, aggregate It may be possible to isolate unaggregated tobacco mosaic virus by short periods of centrifuging in strong gravitational fields at a low temperature. But it is significant that four sedimentations cause an increase in anisotropy of flow detectable by the method of Loring, Lauffer and Stanley. It therefore seems improbable that one sedimentation should have no effect Also, until more adequate data on the activity, chemical composition and physical properties of virus preparations made solely by high-speed centrifugation have been published, it will not be possible to assess their purity

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[1] Bawden F C, and Pirie, N W, *Proc Roy Soc*, B **123**, 309 (1937)

[2] Bawden F C, and Pirie, N W, Reunion Inter de Physique Chimie et Biologie (Paris, 1937), *p* 382

[3] Lauffer, M A, and Stanley, W M, *J Biol Chem*, **123**, 507 (1938)

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Dr. Kenneth M. Smith, F.R.S., Potato Virus Research Station, Cambridge, and **W. D. MacClement**, Molteno Institute, Cambridge.

Dr. Stanley and his colleagues draw the conclusion that tobacco mosaic virus is not aggregating after centrifugation since it passes a membrane of 190 mμ average pore diameter In our ultrafiltration experiments, we have found that this virus, after precipitation at *p*H 3 4, will pass through a membrane of smaller pore size than the foregoing and has an end-point under optimum conditions of 150–175 mμ This indicates an aggregation of some kind, since the accepted ultrafiltration end-point of tobacco mosaic virus in crude clarified sap is about 50 mμ In our opinion, therefore, it is not justifiable to draw the conclusion that the virus is not aggregated merely because it passes a membrane of 190 mμ average pore diameter Tobacco mosaic virus, however, which has been subjected to the full process of purification and will therefore take up the liquid crystalline state, has a filtration end-point greater than 450 mμ, it is clear, therefore, that intermediate stages of aggregation are possible

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Origin of the Solar System

THE presidential address to the British Astronomical Association was delivered by Rev Dr M Davidson, on October 26, at Zion College, and dealt with the theories advanced to explain the system of planets and satellites of the solar system

After brief reference to certain electric theories, in particular to that of H P Berlage, which appeared in *Prof Roy Acad Amsterdam* in 1930–34, other theories which have held the field for a time were discussed The main objection to the old and rather attractive Laplacian hypothesis is the enormous discrepancy between the angular momentum that the rotating nebula must have possessed and that which the solar system possesses to-day. Further, the theory suggested that the planets were thrown off from the original sun by internal forces and were not removed by some outside agency, but, as the major planets have about 98 per cent of the angular momentum of the solar system and only about 1/700 of the total mass, this suggests the action of an internal body

The planetismal hypothesis of Chamberlin and Moulton did not receive so much attention in Great Britain as might have been expected The manner in which the planets were formed, according to this hypothesis, differs essentially from that which the more recent tidal theory assumes In the former case, they are assumed to have been built up slowly by accretions drawn into the original nuclei, in the latter case the once liquid planets received very little later accretions. The difference may not be of much interest to an astronomer but to the geologist it is of the utmost importance

The planetismal hypothesis is the parent of the more recent tidal theories, and naturally many of the objections to the latter will also apply to the former. Dealing with Sir James Jeans's theory, which first assumed a very extensive sun but later adopted the 'Roche model'—a body with a strong central condensation—Dr Davidson referred to a number of objections to the theory The greatest of these, he believes, is that which arises from a consideration of the distribution of angular momentum in the planets, per unit mass, as pointed out by Prof H N Russell The visiting star which was supposed to have produced the eruption from our sun must have made a very close approach, and, even under the most favourable conditions, it could not have produced ten per cent of the angular momentum per unit mass that the planets possess at present This seems to be sufficient, without any other objections, to condemn the theory

The recent theory of Dr R A Lyttleton was then dealt with This starts with the assumption that the sun was once a binary and that its companion was ejected by a visiting star, the filament formed by the usual disruption, which is supposed to occur in these cases, finally producing the planets and satellites, the latter by close approaches of planets However, as Dr H Jeffreys has shown, the satellites could not have been formed in the manner assumed, and Dr Lyttleton was forced to abandon his original explanation of these bodies, and to assume rotational instability of enormous primitive planets Jupiter and Saturn, according to this theory, were once a single extensive planet, and from the filament resulting from the disruption their satellites were formed, and even other independent planets His explanation of the origin of the primitive planets was severely criticized by Dr W J. Luyten and Dr E L. Hill In particular, they had shown that the visiting star, which must have removed the filament from the companion at least 20 astronomical units from the sun (half the distance of Pluto), required a velocity of about 100 km a second, and at such a distance from the sun the matter would escape. There are other objections, and Dr. Lyttleton, recognizing the validity of these, has modified the theory in one respect especially If the visiting star is greater than the companion of the sun, the conditions would obviously be more favourable, but, on the whole, it seems extremely doubtful if an explanation will be found along these lines Dr Davidson is of opinion that some much simpler explanation, not demanding so many *ad hoc* assumptions would be forthcoming, but this might be a long way off yet

In conclusion, Dr Davidson referred to the new satellites of Jupiter and to the fact that Mr J Miller had predicted a missing satellite (NATURE, Feb 5 p 245) Unfortunately, satellite x, for which an orbit had been computed, did not fit into the place predicted for it, as it was 7 million miles from Jupiter He felt, however, that there was a space about 2½ million miles from Jupiter in which a satellite would some day be discovered The fact that satellites vi, vii, and x are moving in similar orbits at nearly the same mean distances from their primary provides another problem for the cosmogonist Perhaps a shoal of minute bodies occupies this region, but naturally one can only conjecture on such matters

At the close of the address, Dr Davidson vacated the presidential chair, which was then taken by Mr B M Peek the newly elected president

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Removal of Sulphur Acids from Flue Gases

In Great Britain there is manufactured annually about one million tons of sulphuric acid but a quantity of sulphur oxides much greater than this is discharged into the atmosphere by the combustion of coal In the last ten years it has become possible to reduce atmospheric pollution from this source The concentration of sulphur oxides in chimney gases is very low and so long as fuel consuming units were small and scattered the resulting damage was relatively inconspicuous Moreover any effective process for desulphurizing the gas would have been prohibitive in cost Engineers limited their efforts to reducing the visible pollution by smoke and grit

Technical developments in the generation of electricity compelled attention to the problem of cleaning flue gas Mechanical stoking made it possible to burn fine coal at high rates of combustion and caused the discharge of much grit and dust into the atmosphere The introduction of pulverized fuel accentuated the grit nuisance Economy of steam production and power generation was secured by working in ever larger units and the need for reducing the high cost of distributing electricity required that these units should be installed near the load The result has been the erection of huge coal burning units using inferior coal in large centres of population With the project to erect the generating station at Battersea, the danger of discharging large quantities of sulphur acids into the heart of London was recognized and the London Power Company was compelled to render its chimney gases innocuous before passing into the air Now the concentration of coal burning into large units while increasing the local intensity of atmospheric pollution, eased the technical problem of designing and operating economic processes of sulphur removal In a relatively short time the Battersea station was discharging into the air, flue gases almost free from sulphur The gases, before entering the chimney, were washed with large volumes of Thames water to which lime was added and the clarified effluent returned to the river

When the Fulham Power Station came to be enlarged, the authorities were able to insist that a similar standard of purity should be maintained, but in addition, that no effluent should be returned to the Thames, lest the alkalinity of the river water, already diminished by the Battersea plant, should be destroyed The very existence of the Fulham plant was thus dependent on devising a process which made no liquid effluent The wash liquor would inevitably become saturated with salts which must be removed as fast as made The salt in this case was calcium sulphate, which is prone to form a troublesome scale on surfaces and in a continuous process liable to block the plant

In an address delivered at a recent meeting of the London Section of the Society of Chemical Industry Dr R Lessing described the course of experiments which showed how the salt could be removed without scale formation Calcium sulphate solutions can persist in a supersaturated state, but this condition can be prevented if the wash liquor contains sufficient $CaSO_4, 2H_2O$ in suspension It was found possible to define conditions under which the flue gases could be washed continuously with a liquor containing in suspension about 10 per cent of $CaSO_4$ and working in a closed cycle Water removed by evaporation up the chimney was replaced and fresh lime was added to replace that removed by precipitation of lime salts An essential feature in the cycle was a delay tank where the desupersaturation of the liquor could proceed to a point where deposition of scale in the plant would not occur

This process has now been in operation at Fulham and elsewhere long enough to leave no doubt that gases can be discharged from chimneys practically free from sulphur acids without the production of a liquid effluent An important advantage of a washing process is the simultaneous removal of grit Mechanical methods of removing grit are only partially successful The electrostatic precipitator can retain grit almost completely but allows acid gases to pass into the air Moreover, the electrostatic precipitator is not certain under overload conditions such as arise when 'soot blowing is in progress

The cost of sulphur extraction during the first year's working at Fulham was 0 0144*d* per unit and will doubtless be reduced with further experience This may be a price well worth paying to reduce the damage due to sulphur in urban atmosphere Dr Lessing said that the washing of the chimney gases at Battersea and Fulham would eventually mean a reduction of sulphur pollution in the London area amounting to ten per cent This shows the importance of this striking success of chemical engineering

H J HODSMAN

American Association for the Advancement of Science

Virginia Meeting

THE American Association for the Advancement of Science meets in Richmond for its first Virginia convention on December 26–31

On Monday evening, December 26, at the John Marshall Hotel, editors of all Virginia newspapers, members of the National Association of Science Writers, prominent officials of the State and of the American Association and others will be entertained at dinner by members of the local Virginia Section of the American Chemical Society planning committee, headed by Lloyd C Bird Sir Richard Gregory, editor of NATURE, is to be the principal speaker Austin H Clark, curator of the Division of Echinoderms at the Smithsonian Institution and formerly director of the press service for the Association, will be honoured at this meeting for his long service and untiring co operation with the Press of the world in helping to make available scientific news for the public

Dr George D Birkhoff, professor of mathematics at Harvard University and retiring president of the Association, will be the principal speaker at a general session on Tuesday night at the Mosque His subject will be "Intuition, Reason and Faith in Science Dr Wesley C Mitchell, professor of economics at Columbia University and president of the Association, will preside The address will be followed by a reception by the local committee to the Association and guests at the Thomas Jefferson Hotel

The joint session of the Society of the Sigma Xi and the Association will be held on Wednesday night at the Mosque with Dr W F Durand, emeritus professor of engineering at Stanford University, as the principal speaker Dr Durand is a past president of Sigma Xi, the leading honorary scientific fraternity of the United States and a member of the National Committee for Aeronautics His subject for the seventeenth annual Sigma Xi lecture will be 'Modern Trends in Air Transport"

On Thursday evening there will be a joint general session of the United Chapters of Phi Beta Kappa and the American Association at the Mosque The lecturer will be Dr Frank Pierrepont Graves, New York State Commissioner of Education, and his subject will be Is Education a Science ? '

The mental health symposium, one of the features of the meeting, will end on Friday night with a general session at the Mosque Dr C Macfie Campbell, professor of psychiatry at Harvard Medical School, will be the principal speaker

As a contribution to the general public, members of the local planning committee are arranging a public meeting at the Mosque for either Saturday afternoon or evening with Dr William M Mann director of the National Zoological Park, Washington, D C, as the speaker Dr Mann has kindly consented to show and explain his motion pictures taken in Sumatra during an expedition for specimens for the National Zoo This motion picture and Dr Mann's address will be one of the principal features for the public during the meeting

In order to commemorate the outstanding work of Virginia s first State geologist W B Rogers, after whom Mount Rogers in Southwest Virginia is named on the occasion of the Virginia meeting of the American Association, the Virginia Section of the American Chemical Society has organized a tour to include a visit to White Top and Mount Rogers in picturesque southwest Virginia The erection of a tower of native rock on top of Mount Rogers, which would give visitors and pilgrims to this beauty spot a view of five States, is one of the proposals for the memorial Prof Rogers, a graduate of the College of William and Mary, where his father was a professor, was appointed professor of natural philosophy at the University of Virginia, and first State geologist in charge of the Virginia Geological Survey in 1835 His work brought him national recognition as a leading Virginia man of science, and created a general appreciation of that day of the scientific possibilities in Virginia Dr Rogers helped in the formation of the Association of American Geologists and Naturalists He was elected president of the Association in 1848, when it was transformed into the American Association for the Advancement of Science, and in 1876 became president of the latter body

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Laboratory of Saharan Biology

THE extent of investigations carried out by the French in the Sahara is well known to the British scientific world, and not a few British biologists have made that desert a field of their researches In the past, such explorations have had to take the form of more or less arduous expeditions, which prevented more lasting observations requiring a convenient and suitably equipped base The need of establishing such a base was recognized by French authorities some years ago, and all biologists interested in desert life will be glad to know of the existence of a Laboratory of Saharan Biology (Laboratoire de Biologie Saharienne) at Beni Ounif, in the south of the Oran province of Algeria and on the border of French Morocco.

The Laboratory occupies an old fort, which was abandoned as it had lost its military importance, and comprises several rooms with the necessary furniture and scientific equipment In a village which has grown around the fort one can obtain all the necessities of life, while its relatively small size enables one to reach unspoilt desert by a short walk The environs of Beni Ounif are exceptionally interesting for a biologist, since most of the types of desert environment can be found within easy distance *reg* (hard, pebbly desert), *hammada* (stony desert), *erg* (sand-hills), *oueds* (dry water courses) and a large oasis with date cultivation The Laboratory presents unique facilities, by its situation and equipment, for investigations on various problems of the ecology of desert plants and animals, which can be attacked by direct observation in the field combined with experiments on fresh material in the Laboratory

Owing to insufficient publicity, the Laboratory has remained hitherto practically unknown to biologists outside France, and it is to be hoped that this note will attract the attention of biologists who may wish to work on desert biology but believe that this must necessarily involve the discomforts of travelling and camping Beni Ounif is reached by train from Oran or Algiers in seventeen hours, and inexpensive accommodation can be found in one of the several local hotels Foreign research students are very welcome, and no charge is made for the use of the Laboratory Detailed information can be obtained from the director of the Laboratory, Prof Ch Killian Faculté des Sciences Algiers, Algeria

B P Uvarov

University Events

Cambridge —In accordance with its usual practice Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph D The value of the studentship may be as much as £300 a year Candidates must not have reached the age of twenty six years before May 1 1939 In certain circumstances, an election may be made to an additional studentship The same College offers as usual Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B A M Litt M Sc or Ph D These exhibitions are of the titular value of £40, but their actual value varies Further particulars may be obtained from the Senior Tutor Trinity College Cambridge

I Rothbarth has been appointed assistant in statistical research

The degree of master of arts has been conferred upon Dr J E Driver (London) University demonstrator in chemistry

At Emmanuel College Dr G R Owst, professor of education has been elected into a professorial fellowship

Prof R G W Norrish has been elected a member of the Council of the Senate

London —Dr H S W Massey, who has been since 1933 independent lecturer in mathematical physics in the Queen's University, Belfast, has been appointed as from January 1 to the Goldsmid chair of mathematics tenable at University College

The Chester Beatty scholarship in radiology of the value of £400 for one year has been awarded to Mr E P Allen This scholarship was established through the generosity of Mr A Chester Beatty for two years to enable students to study radiology in the United States

The John Marshall fellowship of the value of £500 a year for two years has been awarded to Mr K C Eden This fellowship was established under the will of the late Miss A B Marshall in memory of her father, Prof John Marshall

The following doctorates have been conferred D Sc in biochemistry on J F Danielli, D Sc in botany on Miss Ann C Halket, D Sc (engineering) on Prof J T MacGregor Morris

Science News a Century Ago

Royal Astronomical Society

On November 5, 1838, at a meeting of the Royal Astronomical Society a letter written on October 23 from Konigsberg by Bessel to Sir John Herschel was read, describing his efforts to determine the parallax of a fixed star Bessel began his letter Esteemed Sir,—Having succeeded in obtaining a long looked for result, and presuming that it will interest so great and zealous an explorer of the heavens as yourself, I take the liberty of making a communication to you thereupon Should you consider the communication of sufficient importance to lay before the other friends of astronomy I not only have no objection, but request you to do so With this view, I might have sent to you through Mr Baily, and I should have preferred this course as it would have interfered less with the important affairs claiming your immediate attention on your return to England But, to you I can write in my own language and thus secure my meaning from indistinctness

Bessel then went on to describe how to attempt the determination of the parallax of a star he thought of using Fraunhofer's heliometer, why he chose 61 *Cygni*, and the course of his observations which were begun in September 1824 After having his heliometer repaired, he resumed the inquiry and in March 1840 terminated a series of 402 measures

Botanical Society of Edinburgh

At a meeting of the Botanical Society of Edinburgh on November 8, 1838 Prof Graham read an account of a visit which he along with some friends, had paid to the west of Ireland in August, to examine its botanical productions It was stated that the mountains of Cunna mara (*sic*) present very little of the alpine vegetation with which the mountains of Scotland are clothed a difference probably arising from their structure the summits, or nearly two thirds of their height being composed of the most unproductive quartz Near the base of the mountains some micaceous soil exists, and there a little alpine vegetation was found The only peculiarity which the quartz presented was abundance of *Saxifraga umbrosa* (*athenæum*)

Prof Robert Graham was born at Stirling on December 7 1786 and died at Coldoch in Perthshire on August 7 1845 After practising medicine in Glasgow, he was appointed professor of botany in the University of Glasgow in 1818, being the first occupant of the chair Two years later he was transferred to the chair of botany at Edinburgh which he held until his death

The Australian Museum

It would not be easy to imagine, said the *Mechanics Magazine* of November 10, 1838, 'a more gratifying evidence of a young colony's progress in civilization than that which is given by a handsome volume, a few copies of which have lately reached this country The book is A Catalogue of the Specimens of Natural History and Miscellaneous Curiosities deposited in the Australian Museum' It is very handsomely printed 'by James Tegg and Co, at the Atlas Office, George street Sydney, an offshoot from the well-known 'Thomas Tegg, at the Old Mansion House, Cheapside, London''

Societies and Academies

Paris

Academy of Sciences (*C R*, 207, 549–603, Oct 3 1938)

M MOLLIARD The complete cycle of development of certain phanerogams in aseptic cultures Radish stitchwort and ivy leaved toad flax among others can be grown from the seed, produce flowers and set good seeds, inside sterile tubes closed by plugs permitting exchange of gases only It is proposed to study the inheritance of acquired characters shown by such plants

H LAGATU and L MAUME Does the NPK [nitrogen phosphorus potassium] content of leaves of a branch of an Aramon vine differ according as the branch bears more or less fruit ?

J SHOHAT (CHOKHATE) Generalized orthogonal polynomials

H CARTAN Cousin s first problem

A EDREI Recurring determinants and the singularities of a function given by its development by Taylor's method

C JACOB Formation of the complex potential of plane flow in a liquid in a multiply connex domain

D AVSEC Thermo convectional turbulence and the condensation of water vapour

T V IONESCU Coupling an oscillating circuit with a Geissler tube

P DUQUÉNOIS Complex structure of tartar emetic

M CHÊNE Preparation of iron phosphides by fusion electrolysis [of iron oxides and sodium phosphates]

P EHRENFEST, JUN Loss of energy of cosmic radiation penetrating a screen of 9 cm of gold

M PRETTRE Mechanism of the abnormal influence of temperature on the oxidation of mixtures of oxygen or air and hydrocarbons

E CORNEC and H MULLER Cryoscopy of salt solutions While the use of a salt solution in place of water facilitates the determination of molecular lowering of freezing point, the lowering of eutectic points is necessary to find readily the number of ions in the electrolyte studied

MME Z SOUBAREW CHATELAIN Absorption spectra by reflection in the ultra violet of some molybdenum compounds in the solid state

Y TA Influence of non polar solvents on the infra red absorption bands (CH) application to the molecules $CH_2X—CH_2X$

C DUFRAISSE and P COMPAGNON Dienic syntheses starting from diphenylisobenzofuran new synthesis of tetraphenylnaphthacene (rubrene)

E LEGÉ Transformation of oily substances [from plants] into mixtures of hydrocarbons

G DEFLANDRE Dinoflagellate microplankton preserved in the bituminous Kimmeridgian schists of Orbagnoux (Jura)

A BRUNEL and R ECHEVIN The glycolic ureides in the development of the flower and fruit of *Acer pseudoplatanus* L

M M JANOT and P GONNARD Methoxyl index of some gums and in particular of gum arabic and gum tragacanth

P CHOUARD Nature of the excitation by hetero auxins in provoking the formation of roots or of buds at any point on leaf cuttings The first effect is an unorganized tumour, due to the hetero auxins, serving as a depot of metabolic products Differentiation follows and is due to other factors

TCHOU SU Germinal localization in the unfertilized egg of anurans

G SANDOR and J TABONE Existence of unstable acetyl functions in the proteins of horse serum

Moscow

Academy of Sciences (*C R* 19 No 9 1938)

I CHIODOVSKY The problem of moments and the polynomes of S Bornstein

I PRIVALOV Limited values of an analytical function

B SEGAL New type of diophantic approximations

M A SABIROFF Remarks on the article by B D Kaminsky

I MAGNARADZE Solution of the fundamental problems of plane theory of elasticity in the case of contours with corners

B G FESSENKOFF Origin of the zodiacal light

D IWANENKO and A SOKOLOW Some remarks on the equations of the theory of showers

A SEIDEL and J LARIONOV Nature of the narrow absorption bands in solutions of praseodymium salts

M VEINGEROV A method of gas analysis based on the optico acoustic phenomenon of Tyndall Roentgen

N MIHAI Determination of differences between equatorial and meridional gravity moments of the earth by observations of gravitation

J B ZELDOVICH and D A FRANK KAMENECKIJ Theory of uniform flame propagation

J B ZELDOVICH and B I JACOVLEV Thermal explosion of nitrous oxide

L H FREIDLIN and A I LEBEDEVA Interaction of sodium amide with salts of formic acid

V A PLOTNIKOV Non aqueous solutions

I I KITAIGORODSKY Self hardening as a method of increasing the strength of glass

V PORFIRYEV Deep seated tectonics of the Caspian lowland

V A VAKHRAMEEV and D M RAUZER CHERNOUSSOVA The Middle Carboniferous in the north eastern part of the region adjoining Lake Balkhash

I D SEDLETZKIJ Soil colloidal minerals of the aluminium hydroxide group

G M LITVER Observations on specific sensitivity to radiant energy in oocysts of Coccidia of rabbits

V I PATRUSHEV Differences in blood composition in cattle, yaks and their hybrids

S I ALIKHANIAN (1) Bristle mutation (hairy wing) in *Drosophila melanogaster* as a possible duplication (2) Influence of the *Y* chromosome upon variability in *Drosophila melanogaster*

E I JAKIMOVA Dihaploid hybrids *Triticum durum* Desf *T vulgare* Host

H F KUSHNER The connexion between heterosis in mules and their blood composition

B S MOSHKOV Photoperiodism and immunity

V G ALEXANDROV and O G ALEXANDROVA Structure of couch grass grain

I V KOZHANCHIKOV Peculiarities of gaseous metabolism in insect tissues

A I IRIKHIMOVICH Age unconformable transplantations of extremities in tadpoles and axolotls

A BORISSIAK Contribution to the phylogeny of Dicerorhinæ

J A EFREMOV Some new Permian reptiles from the U S S R

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, November 7

University College London at 5 —Dr J F Danielli The Permeability of Membranes (succeeding lectures on November 14 and 17) *

University of Leeds at 5 15 —Dr H Spencer Jones, F R S Solar and Terrestrial Relationships *

Royal Geographical Society at 8 30 —Miss G Caton Thompson Climate Irrigation and Early Man in the Hadhramaut

Tuesday, November 8

Royal College of Physicians at 5 —Dr Harold Scott Conquest of Disease in the Tropics (Fitzpatrick Lectures Succeeding lecture on November 10)

Chadwick Public Lecture (at the Royal Society of Tropical Medicine and Hygiene) at 5 30 —Sir Stanley Woodwark The Rise and Fall of certain Diseases concurrent with the Progress of Sanitation and Hygiene *

University College London at 30 —Prof P Pruvost Some Problems of Sub Surface Geology in Northern France (succeeding lecture on November 10) *

King's College London at 8 30 —Prof A Dalcq The Formation of the Pronephros and its Causes *

North East Coast Institution of Shipbuilders and Engineers Newcastle on Tyne —Sir William Bragg Pres R S The Molecular Basis of the Strength of Materials (Andrew Laing Lecture)

Thursday November 10

Royal Society at 4 30 —Prof E D Adrian F R S Some Problems of Localisation in the Central Nervous System (Ferrier Lecture)

London School of Economics at 5 —W G Eady The Care of the Unemployed (succeeding lecture on November 11) *

Friday, November 11

Physical Society (at the Imperial College of Science) at 5 15 —Prof A V Hill F R S The Transformations of Energy and the Mechanical Work of Muscles' (Guthrie Lecture)

Royal Institution at 9 —Sir William Bragg, Pres R S Combination Tones in Sound and Light"

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Lecturer (woman) **in Mathematics** in the Froebel Educational Institute Training College for Teachers Grove House Roehampton Lane S W 15—The Principal (November 8)

Director of the Imperial Bureau of Forestry—The Secretary Executive Council of the Imperial Agricultural Bureaux 2 Queen Anne's Gate Buildings London S W 1 (November 15)

Four Assistants (grade III) for work on aeronautical electrical equipment at the Royal Aircraft Establishment South Farnborough—The Chief Superintendent (November 18)

Assistant Lecturer and Demonstrator in Zoology and Comparative Anatomy in University College Cardiff—The Registrar (November 19)

Lecturer (Chemistry) in the Department of Pure and Applied Science in Loughborough College Leicestershire—The Registrar

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Report of the Council of the Natural History Society of Northumberland Durham and Newcastle upon Tyne for the Year 1937 38 Intended to be presented at the Annual Meeting of the Society 31st October 1938 Pp 48 (Newcastle upon Tyne Natural History Society) [1710

Colonial Office Pitcairn Island General Administrative Report by J S Neill Medical Report by Dr Duncan Cook Based on Enquiries made during thirty nine days residence on the Island between the 15th May and the 23rd June 1937 (Colonial No 155) Pp 79 (London H M Stationery Office) 1s 3d net [1810

Other Countries

Canada Department of Mines Bureau of Economic Geology Geological Survey Memoir 199 Lake Etchemin Map Area Quebec By Carl Tolman (No 2424) Pp ii+20 (Ottawa King's Printer) 10 cents [1710

Fiskeridirektoratets Skrifter Serie Havundersøkelser, Vol 5 No 6 The North Atlantic Halibut and Net Fishing By Finn Devold Pp 68 Serie Teknologiske Undersøkelser Vol 1 No 2 Virkningen av frysehastighet lagringstemperatur og råstoffets friskhet på kvaliteten av frossen fisk Av Olav Notevarp og Erik Heen Pp 30 (Bergen A/s John Griegs Boktrykkeri) [1710

Department of Agriculture New South Wales Veterinary Research Report No 7 1937 By Wm L Hindmarsh Pp 125+3 plates (Sydney Government Printer) [1710

Catalogue of Foreign Scientific Serial Publications in the various Institutions in Japan Third edition Pp viii+25+825 (Tokyo National Research Council) [1710

U S Department of the Interior Office of Education Bulletin 1938 Misc No 2 To Promote the Cause of Education Pp 80 20 cents Bulletin 1938 No 3 Nature and Use of the Cumulative Record By David Segel Pp v+48 10 cents (Washington D C Government Printing Office) [1810

Bulletin of the American Museum of Natural History Vol 74, Art 6 Fossil Mammals from Burma in the American Museum of Natural History By Edwin H Colbert Pp 255-436 (New York American Museum of Natural History) [1810

Department of Agriculture Straits Settlements and Federated Malay States General Series No 30 Reports of the Field Branch for the Year 1937 Pp iii+171 50 cents Annual Report on the Departments of Agriculture Malaya for the Year 1937 By O T Faulkner Pp ii+81 1 dollar *2s 4d* (Kuala Lumpur Department of Agriculture) [1810

Union of South Africa Department of Mines Geological Series *Bulletin No 11 Vermiculite Deposits in the Palaboroa Area* N E Transvaal By C M Schwellnus Pp 27 (Pretoria Government Printer) *6d* [1810

Indian Central Cotton Committee Annual Report of the Director Technological Laboratory for the Year ending 31st May 1938 Pp 42 (Bombay Indian Central Cotton Committee) 6 annas [1810

Advisory Committee on Education Staff Study No 11 Library Service By Carleton B Joeckel Pp viii+107 15 cents Staff Study No 13 The National Youth Administration By Palmer O Johnson and Oswald I Harvey Pp x+121 15 cents (Washington D C Government Printing Office) [1810

Journal of the Indian Institute of Science Vol 21A Part 8 Contributions to the Study of Spike Disease in Sandal (*Santalum album* Linn) Part 19 Physiological and Physical Methods of Characterising the Disease By A V Varadaraja Iyengar Pp 89 102 1 2 rupees Vol 21A Part 9 Studies on the Chemical Composition and Physical Properties of Plant Tissue Fluids Part 2 Effect of Mineral Fertilisers on the Tissue Fluids of Ragi (*Eleucine coracana* Linn) By S Rajagopal and A V Varadaraja Iyengar Pp 103 114 1 rupee Vol 21A Part 10 Attempts towards the Synthesis of Cantharidin, Part 2 By P C Guha and B H Iyer Pp 115 118 8 annas Vol 21A Part 11 Reactions of Chromates at High Temperatures Part 4 Decomposition of Mixtures of Calcium Chromate with Calcium Carbonate By V T Athavale and S K K Jatkar Pp 119 130 1 rupee Vol 21A, Part 12 Utilisation of Myrobalans Part 1 Preparation and Purification of Myrobalan Extract By S R Sunthankar and S K K Jatkar Pp 131 148 1 4 rupees Vol 21A Part 13 Utilisation of Myrobalans Part 2 Myrobalan Oil By S R Sunthankar and S K K Jatkar Pp 149 152 8 annas Vol 21A, Part 14 Utilisation of Myrobalans Part 3 Utilisation of Myrobalan Extract for the Preparation of Ink and for Cotton Dyeing By S R Sunthankar and S K K Jatkar Pp 153 158 10 annas Vol 21A, Part 15 Reactions of Chromates at High Temperatures Part 5 Decomposition of Strontium Chromate By V T Athavale and S K K Jatkar Pp 159-168 14 annas Vol 21A Part 16 Rotary Drilling Mud Part 1 The Effect of Tannin on the Viscosity By P Y Narayana Pp 169-178 14 annas Vol 21A Part 17 Reactions of Chromates at High Temperatures Part 6 Decomposition of Mixtures of Strontium Chromate and Strontium Carbonate By V T Athavale and S K K Jatkar Pp 179-188 14 annas Vol 21A Part 18 Electrometric Titration of Tannic Acids Part 1 Electrometric Titration of Ellagic, Ellagitannic and Chebulinic Acids By S R Sunthankar and S K K Jatkar Pp 189 208 1 8 rupees Vol 21A Part 19 Electrometric Titration of Tannic Acids Part 2 Electrometric Titration of Gallic and Gallotannic Acids By S R Sunthankar and S K K Jatkar Pp 209-222 1 2 rupees Vol 21A, Part 20 Equilibrium in Electrodeless Discharge Part 5 Equilibrium in the Dissociation of Oxygen and in the Formation of Ozone in Silent Electric Discharge By R Krishnan and S K K Jatkar Pp 223-236 1 2 rupees Vol 21A, Part 21 Adsorption of Gelatin by Precipitated Hydroxides By J G Kane Pp 237-244 12 annas. (Bangalore Indian Institute of Science) [1810

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Human Evolution and Mechanization

IN an address* at the end of last year before the American Society of Mechanical Engineers Prof Earnest A Hooton of the Peabody Museum Harvard University surveyed the course of evolution in the primate stem regarding it as a series of adaptations in a progression towards the specifically human attributes of tool making and tool using He showed how each of the modifications in structure such as the development of the hand with its opposable thumb and sensitive finger tips of the foot as a movable point of balance of upright stature with the consequent visceral readjustments of stereoscopic vision and of the central nervous system and the changes in form size and complexity of the brain were all antecedent conditions in the attainment and elaboration of a material culture The results of recent observation and experiment with monkeys and apes have also shown how structure and mentality in each branch of the pithecoids has militated against the attainment of anything more than some rudimentary form of mechanical achievement while the failure to develop an articulate language has precluded the passing on of experience and acquired knowledge which is an essential element in human cultural progress

We will not attempt to follow Prof Hooton in detail as he traced the influence of the invention of tools from the time when it relieved man of the necessity of further structural adaptation in the struggle for survival—tools as he says made organic adaptation obsolete—to the dominance of the machine in modern civilization There are however two points which call for special consideration Of these the first is a development of the familiar principle that disuse of an organ leads to its atrophy Prof Hooton suggests that when human evolution emphasized cerebral development it diverted nutriment from other parts of the body and the less active organs diminished in size While however he goes on no man has need of the strength of the ape he ought to need the brains of a man he should not be able to survive with the brains of a moron The machine and mass production of modern civilization favour the survival of the physically unsound and the mentally impotent by relieving mankind of the opportunity or indeed the necessity for physical and mental exercise The second point maintained by Prof Hooton is that invention is the product of the individual and is accepted with reluctance by the many if indeed it be not actually suppressed though the conservatism of the masses is responsible for the preservation and stability of the culture already achieved

Prof Hooton intentionally paints in darkest colours the picture of present day trends in mechanized society which he regards as rushing headlong along the downward path on a well engineered road Man's mechanized science he says has so far outstripped his biological status and social ideals and behaviour that it has become a menace What we must do he concludes is to direct a modicum of that high intelligence and creative ability which is too much monopolized by mechanical science to the study of ways and means of repairing and improving the human machine

With this conclusion all will be in hearty sympathy especially in so far as it implies the building of a better race and the study of the capabilities stored up in our species through the millions of years of primate evolution which have culminated in man At the same time certain comments present themselves for consideration It is possible to exaggerate the deadening effect of mechanization on the human mind Much depends upon the individual and his character qualities and interests In the days before mechanization it was the deadening effect of manual labour of any kind now contrasted with mechanization which was blamed and often not unjustly for the inertia and the baseness of the masses in our population They always have been and always will be coarse in some degree while they are unleavened by the desire and the opportunity for self development Such an opportunity must now come in our modern civilization through the development of a regulated mechanization which will give labour the necessary leisure

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* The Simian Basis of Human Mechanics or Ape to Engineer The Tenth Henry Robinson Towne Lecture delivered at the Annual Meeting New York N Y Dec 6–10, 1937, of the American Society of Mechanical Engineers Reprinted from *Mechanical Engineering* of January 1938 *Antiquity* of June 1938

But again surely the moron like character of the base mechanic is much exaggerated The mental and social effects of mechanization through atrophy of the powers of the mind and the dangers of passive receptivity induced by gramophone wireless and the cinema are patent indeed but are they really so serious as they are said to be ? The introduction of the talking film has placed the cinema more nearly on the level of the theatre as an educative and cultural influence Its failure is now in its material rather than in its method of presentation—this does not refer to natural history and other instructional films—and the shortcomings of the film as drama are being remedied rapidly Both cinema and wireless now reach thousands where formerly the theatre music and literature influenced hundreds or it may be only tens The effect is to be seen around us everywhere in daily life in a raising of the general cultural level Nor is individual performance likely to be seriously affected Photography and the gramophone were it was feared to put an end in turn to painting and music Both have helped the development of these arts and the understanding of their principles while as regards the individual executant they may possibly have eliminated a few who never would have attained perhaps even a mediocre competence

In a sense new inventions are the work of an individual yet in all but backward cultures the individual unless in exceptional instances is the spear head, while the general cultural level of society is the shaft of the spear The individual gathers up the threads of a general cultural trend This applies even in highly specialized branches of thought as for example when a whole body of scientific workers is proceeding along certain general but related lines of development Darwin was indebted to a general drift of philosophic and scientific thought and speculation which had been incubating for a generation or more before his time Only in the more primitive type of society existing in complete isolation could such conditions as Prof Hooton pictures prevail—a society in which innovation by an individual would be suppressed or adopted only with extreme reluctance by the conservative masses Cultural advance is usually a process of cross fertilization that overcomes by one means or another the natural conservatism which is undoubtedly a prominent feature in the make up of a primitive group The effects of such cross fertilization of cultures can be seen in the processes of growth of all the great civilizations of the Old World Of its advantages and disadvantages we are ourselves perhaps the most conspicuous example

What may be termed the humanization of future progress in a mechanistic world—a world in which as Western civilization spreads more and more widely to the peoples of less advanced culture mechanization will increase rather than diminish—is more likely to be brought about by a cross fertilization of the existing cultures of the different peoples of the world than by internal development of a nationalized ideal For while the nationalized ideal *ex hypothesi* is separatist in tendency it is only by a general pooling of ideals and ideas such as for example in the biological study of man which Prof Hooton rightly desiderates that we can hope to solve the problems threatening world civilization problems ranging from those of currency and the distribution of a food supply now running to waste to that which must be the pre occupation of us all the preservation of peace

Finally a word as to the biological study of man to which Prof Hooton would direct some of the creative energy now devoted to the interests of mechanization It is difficult to avoid the conclusion that in the application of scientific investigation to the problems of man s future and the planning of human relations—which must come if the world is not to drift into a worse chaos than that of the present time—the study of human heredity in all its aspects will play an important part How far the study of eugenics as at present pursued will enter into the attack on this problem is an open question Who is to decide what is the type to which to breed ? Further the prolifera tion of the alleged inferior classes of the population is after all only in accordance with Nature s method of ensuring in any species that out of an innumerable progeny the fit shall survive This is not an argument in favour of the physically and mentally degenerate but the history of English society is the last which should be called on to testify that the product of any one grade is inferior If however it is maintained that such an excess in numbers of offspring constitutes a social burden the argument is removed from the biological to a sociological plane and constitutes a problem of a different character

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Dialectical Materialism in Biology

Biology and Marxism
By Prof Marcel Prenant Translated by C Desmond Greaves Pp xxiii + 223 (London Lawrence and Wishart Ltd 1938) 10*s* 6*d* net

MANY readers of NATURE will ask what Marxism has to do with biology It would be possible to write a volume on the economic influences which have done much to determine the course of biological research For example botany was at one time largely concerned with medicinal herbs The greatest age of systematic botany was that of the crude exploitation of Colonial floras and interest in plant genetics arose with the need for improvement in Colonial plants such as Canadian wheat and Javan sugar beet

But Prof Prenant s book is an attempt to apply to biology the principles of dialectical materialism the philosophy of Marx Engels and Lenin It was written for working class students to whom Marxism is already familiar and not primarily for biologists Nevertheless, every biologist who recognizes that Marxism whether true or false is an important philosophical movement will find the book extremely interesting

The author points out that Marxist ideas are peculiarly applicable in biology because both biology and Marxism are concerned with change and he is primarily concerned with evolution both individual and social Here Marx s and Engels criticism of Darwin whose results as a whole they accepted is of great interest In 1878 Engels wrote Darwin when considering natural selection leaves out of account the causes which have produced the variations in separate individuals and deals primarily with the way in which such individual variations gradually become the characteristics of a race variety or species On the other hand many biologists will consider the criticism of Darwinism quoted on p 194 less valid

It is particularly interesting to see how a modern Marxist tackles some of the outstanding problems of biology A Marxist must be *materialistic* without falling into mechanism and Prof Prenant certainly does his best to steer a course between the Scylla of epigenesis and the Charybdis of preformationism when discussing theories of embryonic development In his account of heredity while admitting the main results of the Morgan school he stresses the importance of the cytoplasm and above all the fact that at no time can the chromosomes be regarded as independent of their surroundings

In my opinion Prof Prenant under estimates the importance of selection for man It is true that natural selection in the strictly Darwinian sense of selective killing has been largely replaced by what Karl Pearson called reproductive selection based on differential fertility However under this new form selection is perhaps as important as ever and Dr Needham s critical notes show that there is plenty of room for divergence between Marxist biologists on quite fundamental questions

Indeed should interest in Marxism spread as appears to be probable there is no doubt that biological and other scientific problems will be more and more discussed from a Marxist angle That this need not involve any slavish acceptance of Marxist writings as gospel will be clear to any reader of Prof Prenant s statement (p 198) that in explaining life as an innate property of protein Engels was straying from the dialectical path Provided Marxists are willing to follow this example I do not think that non Marxist biologists need fear an attempt to impose Marxist dogmas on science such as probably occurred in some quarters in the Soviet Union between 1922 and 1932 and they may even admit that Marxism makes for a novel approach to certain problems which is bound to stimulate thought and experiment

The translation is almost uniformly excellent and the publishers may be congratulated on a book which will certainly interest Marxists in biology and should also interest many biologists in Marxism J B S HALDANE

Challenge to Ten

Duodecimal Arithmetic
By George S Terry Pp viii+407 (London New York, and Toronto, Longmans, Green and Co Ltd, 1938) 30s net

THIS handsome volume of tables is one of the most astonishing books ever composed by an enthusiast The practical advantages of twelve over ten as the base for everyday reckoning in any community which has progressed beyond counting on the fingers are obvious, and almost every language has a word for a dozen So far as the change from one base to another depends on the schooling of a single generation, it could be effected by a stroke of a governmental pen Unfortunately, ten dominates not only our habits but also our records, not only our present means of computation but also our inheritance of tables Converted to a belief in duodecimals by Emerson Andrews's 'New Numbers", and perceiving more clearly than many advocates that the issue is not theoretical, Mr Terry applied himself forthwith to the task of reducing the handicap by which any rival of the decimal system is delayed at the start, by providing a comprehensive collection of tables in the scale of twelve

As a practical man, Mr Terry begins with adequate tables for conversion between the scales of ten and twelve, but except in these tables the work is duodecimal throughout The tables include square roots of n and $12n$ and cube roots of n, $12n$ and 12^2n to 6 places from 12^2 to 12^3, reciprocals to 16 places as far as 12^3 9 place logarithms to base 12 at interval of $1/12^3$, natural logarithms, circular functions and their logarithms, exponential and hyperbolic functions, the exponential integral and the sine and cosine integrals the factorial function and its logarithmic derivative, and Bessel functions of orders 0, ½, and 1 Attention is paid everywhere to interpolability and the volume ends with a number of tables of interpolation coefficients

Some of the tables were calculated directly in the scale required, and some were obtained by the conversion of standard decimal tables In all cases, the ample margin of three places beyond those published was reserved, and the tables were differenced before being cut down The volume has been produced by reproduction of typescript this method eliminates many sources of accidental error, and is seen here at its best, the typist having evidently been aware of responsibility for the appearance as well as for the accuracy of the pages

Mr Terry's task could not have been performed more modestly, more efficiently, or with better judgment Nevertheless, such is the obstinacy of humanity that it is only too likely that when the millennium has come at last, five gross and eight more years must elapse before the universal adoption of duodecimal arithmetic E H N

Analysis of Explosives and Matches

Explosives, Matches and Fireworks
By Prof Joseph Reilly (Section of Lunge and Keane's "Technical Methods of Chemical Analysis", Second Edition Vol 4) Pp xi+172 (London and Edinburgh Gurney and Jackson, 1938) 7s 6d net

THE general arrangement of this work is the same as in the first edition of Lunge and Keane's treatise which was published in 1911, but the section on explosives, which previously was by the late Oscar Gutmann, has been rewritten entirely by Prof Reilly The directions in this section are clear and practical, and numerous references are given, so that the reader can obtain more detailed information Stability tests occupy twenty-four pages, and of these the Abel heat test takes seven, whereas the other forty-three methods dealt with have only seventeen pages between them In many cases only the general character of the test has been given, but as the chemical practitioner will seldom be called upon to carry them out, this is no doubt sufficient

The sections on matches and fireworks in the first edition were written by Dr A Bujard, of Stuttgart, and the English translation was revised by E G Clayton Prof Reilly has rewritten most of the earlier parts, dealing with woods and waxes for matches, phosphorus and the composition and manufacture of glue, but the rest of the matter is almost unchanged since 1911 Of the fifty-one and a half pages devoted to matches twenty-five deal with glue and other binding substances

Nearly all technical works dealing with fireworks are unsatisfactory, and that of Bujard and Clayton was no exception It is therefore to be regretted that the section has not been rewritten On p 149 are given some coloured fire mixtures containing potassium chlorate and sulphur, and there is a green star mixture specially recommended by Clayton containing realgar as well On p 151 Prof Reilly has added the words "The use of chlorates is restricted in mixtures on account of their sensitiveness and has been made illegal in some countries " This is too mild as mixtures containing chlorate together with sulphur or a sulphide have been forbidden definitely for fireworks since 1894 in Great Britain and are classified as fulminates" If one of the ingredients be sulphide of arsenic (realgar) the composition is specially dangerous Many fatal accidents have been caused by such fireworks

Mercury fulminate and detonators are dealt with twice—in the explosives section and again in that dealing with ' Primings and Fireworks"—but the word fulminate" does not occur in the index, and against mercury fulminate ' there is only reference to the fireworks section The latter contains a description of the Esop test for detonators which is inaccurate and confused

The first two thirds of this book are very satisfactory but unfortunately this cannot be said of the remainder A M

General Scientific Knowledge

Van Nostrand's Scientific Encyclopedia
Pp v + 234 (London Chapman and Hall, Ltd, 1938) 50s net

THIS encyclopædia is stated to cover the basic sciences of chemistry physics mineralogy, geology botany, astronomy, and mathematics and the applied sciences of navigation aeronautics and medicine and the three branches of engineering, civil, mechanical and electrical To do this even when as many as 10,000 separate articles each of between 100 and 1,000 words are allowed, necessitates a good deal of selection, abbreviation and omission The authors and publishers plead, in the preface, for indulgence for such omissions, they write "The exercise of judgement in the selection of material was unavoidable and it was necessary to maintain a limit of difficulty beyond which it was impracticable to go in attempting to cover so broad a field within the physical confines of one useful volume " To grant this indulgence seems but just

The information given is, on the whole accurate and trustworthy, but in some instances the obligatory brevity may give the reader a wrong impression, and occasional statements are, to say the least, controversial Each little article is logically written, beginning with a simple definition which is afterwards developed, and the more complex concepts are then discussed Every term explained in the volume is printed in bold type wherever it is used significantly in the course of articles on other terms This system of cross reference is a useful and helpful feature of the book No provision, however, is made for those who wish to pursue a subject further, a few references to standard works might have been included at the end of the more complex articles True, there would be difficulty in selecting suitable references but the authors have had to exercise their powers in this direction throughout the preparation of the whole work

The authors are all associated with American academic institutions, and naturally American practice and views are reflected in many of the articles The responsibility for each science has been left largely in the hands of a single author for the sake of unity, but in each instance a number of others has worked with the author and a group has acted in an advisory capacity

In a work of this nature, some inconsistencies are bound to occur for example some three pages are devoted to an article on chemistry, but no entries at all are to be found under such headings as physics" biology ' or medicine ' some indication of the scope of these subjects might have been given with suitable cross references Despite all that is often said about the absurdities of placing the different branches of science in water tight compartments it is still necessary to define their scope both for academic and for economic reasons Each university authority appears to have clear notions as to the dividing line between various branches of science, although they are not always in common agreement Again, admission to membership of the various professional scientific and engineering bodies normally involves the decision of some committee as to whether a man is a chemist, physicist, electrical engineer and so forth, and cases are frequent when a man is elected to several such bodies, demonstrating his versatility or may be the difficulties of dividing science into professional groups Whilst for many purposes several such individual organizations are advantageous, one representative and respected body able *and willing* to speak for science as a whole, and perhaps also engineering, is likely to achieve more There appears to be a growing desire to have such a body, as the recent activities of the British Association for the Advancement of Science has proved But this is digressing—the point to be stressed is that the boundaries of the various branches of science have been defined and some indication of these definitions artificial and changeable as they may be should in the reviewer s opinion have been included in such an encyclopædia It is interesting to find NATURE and the *Philosophical Magazine* are classified on p 249 under *chemical* journals while the Royal Society heads the list of chemical societies !

The printing is excellent and is in double column with clear headings The illustrations are clear and helpful and some pleasing coloured plates are included The book is well produced and considering its 1 200 pages is not too bulky for convenient handling It will form a valuable addition to the libraries of teaching institutions and be of considerable help to those private individuals who can afford it requiring a reference book of science H R L

Gulf Coast Oilfields

Gulf Coast Oil Fields
a Symposium on the Gulf Coast Cenozoic Edited by Donald C Barton and George Sawtelle Pp xxii+1070 (Tulsa Okla American Association of Petroleum Geologists London Thomas Murby and Co 1936) 4 dollars 18*s* 6*d*

AT the Houston convention of the American Association of Petroleum Geologists held in March 1924 an attempt was made to give a comprehensive picture of American salt domes Papers included descriptions of oilfields theories as to their origin and a general summary of research carried out to that date In 1926 these papers were published by the American Association of Petroleum Geologists in the form of a symposium entitled Geology of Salt Dome Oil Fields

Since that time a wealth of new information and discoveries concerning Gulf Coast geology has come to light In fact developments during the intervening decade have been far more rapid than during the quarter century which preceded publication of the original volume At the 1933 convention of the Association at Houston a series of papers was presented which reflected the trend of progress at that time and these have formed the nucleus of a further volume under the above title recently published Other important papers have been added to make the whole symposium representative of what is in reality a new era of Gulf Coast geology

The work comprises in all forty four papers grouped under three headings general and theoretical papers stratigraphy descriptions of oilfields and salt domes The last group is subdivided into four regions South Texas South east Texas Southern Louisiana and East Texas An unusual frontispiece to this book is a mosaic of parts of forty aero photographs taken at heights of approximately 12 000 ft of Barbers Hill Salt Dome Chambers County Texas to facilitate accurate reading of this frontispiece the significance of various elements of the picture are indicated and instruction given in the correct interpretation of this and similar aerial photographs

D C Barton points out in a foreword to the volume that application of geophysical methods of prospecting was largely responsible for the incidence of the new era of Gulf Coast history Half way through the period under review the number of known domes had been doubled by torsion balance and seismograph discoveries and an intensive refraction campaign was being conducted Then after a short lull due to economic depression to the flood of oil from East Texas and decline in geophysical successes three important discoveries in Texas and Louisiana confirmed the theory that deep dome structures are more prolific than shallow ones and easier to prospect The rate of exploration afterwards became the fastest in the history of the Gulf Coast The area of potentially good production was vastly increased production zones were deeper and the depth of drilling almost doubled In 1924 production of crude oil was 30 million barrels In 1934 it was 94 million barrels and in the first half of 1936 25½ million barrels were produced from southern Louisiana alone

It seems almost impossible that this rate of progress should be maintained but D C Barton predicts some interesting developments in the coming decade Of these perhaps the most spectacular is that wells to a depth of 20 000 ft or more may be mechanically feasible and not commercially impracticable Moreover in his view there will be progressive improvement in geophysical technique with the possibility of detecting commercial accumulations of oil and gas by direct method and prior to drilling though probably not at great depth Increased efficiency in recovery of crude oil from sands increased production of gasolene kerosene and diesel oil from a given quantity of crude oil conversion of natural gas into gasolene by polymerization and increased efficiency in the consumption of petroleum products as motor fuels will all combine to make the next decade as prosperous as the one that is just past

An Introduction to the Scientific Study of the Soil

By Prof Norman M Comber Third edition Pp vii + 206 (London Edward Arnold and Co, 1936) 7*s* 6*d* net

WHILST no outstanding changes have been made in the third edition of Prof Comber s deservedly well known book its subject matter has been brought fully up to date without sacrifice to the conciseness and clarity of the original text The book is intended for agricultural and horticultural students, that is, those whose interest in the soil has a strong practical bias, nevertheless, the scientific point of view is maintained so consistently in each chapter that the student is led to think of the soil as much from the pedological as from the purely practical point of view Indeed, the greater part of the book is concerned with the study of soil as a natural entity quite apart from the problem of its agricultural utilization It is perhaps the chapters dealing with the main facts of soil physics and soil chemistry that help the reader most to bridge the apparent gap between the scientific and the practical approach to the study of soil

The scientific point of view from which the book is written is typified in the title of the penultimate chapter on The Artificial Treatment of the Soil", in which the effects of common cultivation practices on soil fertility are briefly reviewed In this section a useful account of the replicated plot system used in modern field experiments is also given The chapter on soil water is a good example of the author s facility in stating main facts and definitions, which are apt to be lost sight of in the more advanced literature of soil science Useful advice on how to use the latter is given at the end of the book, but in the text itself there are practically no references to the sources of the works which are quoted The inclusion of such references would be surely welcomed by what Prof Comber describes in his preface as botanists, ecologists and others besides agricultural students , who are partly responsible for the demand for a third edition of this extremely useful book

A J L L

The Organisation of Agriculture

with Applications to South Africa By Prof Hubert D Leppan Pp v + 83 (Johannesburg Central News Agency, 1936) 4*s*

ONE of the most urgent of many tasks confronting South Africa is to save the soil The causative evils most frequently cited are faulty pasture management, particularly overstocking, and cultivation of unsuitable land Behind these lie racial, social and political causes that have influenced the development of South African agriculture A complete re organization of agriculture is now imperative

Prof Leppan considers that in a policy of land utilization concentrating almost entirely on properly organized animal husbandry lies South Africa's chief hope of salvation He traces the past policy of encouraging cereal production, assisted by export subsidies, tariffs and a magnificent elevator system, to the economic consequences of the South African War, and points out that the reverse policy of encouraging cheap grain imports would have the effect of increasing soil fertility, thereby helping to save the veld from erosion The imported feeds would be used to relieve pressure on the pastures, and not to carry more animals, which should be fewer and of better quality More use should be made of cultivated land in producing animal rather than human foods The meat market could be enormously extended and the demand for maize proportionately reduced, by educating the natives and raising their standard of living

Prof Leppan considers that the land in South Africa is overstocked with men as well as with animals and that a white peasant class is undesirable in South Africa He recommends fostering urban activities to relieve pressure on the land and the State purchase of derelict farms which might be rented on long leases with due safeguards against overstocking and other maltreatment All economic and political measures, however are useless unless they are supplementary to controlled veld management

G V J

The Physical Basis of Geography

an Outline of Geomorphology By Dr S W Wooldridge and R S Morgan (University Geographical Series) Pp xxi + 445 (London New York and Toronto Longmans Green and Co 1937) 12*s* 6*d* net

IN the first part of this book, the authors have deliberately taken sides, in an endeavour to place much debated topics in geophysics and tectonics clearly before the student For example Wegener s continental drift theory is presented in a much more favourable light than customary No harm will be done to the student by this method of treatment provided he realizes that he is receiving one point of view Incidentally it is pleasant to see that regrettable term betwixt mountains somewhat frowned upon

The second and more important part of the book has a different tone Here the central theme is the cycle of erosion as conceived by W M Davis and elaborated and modified by Johnson and others The development of landscape under many environments is critically discussed in the light of the orderly sequence of this cycle Examples of the chronology of denudation, as for example in the Appalachians and the Weald, are fully described Marine erosion, arid erosion, and erosion in limestone regions are considered Under this last topic there is given a full account of the development of the land forms of the chalk in Great Britain—forms in their way as remarkable and as interesting as those of the more fashionable Dalmatian Karst The book closes with a critical discussion of the influence of glaciation upon scenery, in which the views of the erosionists and protectionists are fairly presented, and with a short account of the possible part played by glacial control in certain major physiographic effects of the Ice Age.

This book, and especially the more important second part of it, should be read by geographers and geologists alike, as it is a sound and critical exposition of erosion processes

Arctic Harpooner
a Voyage on the Schooner *Abbie Bradford*, 1878–1879 By Robert Ferguson Pp xii+216 (Philadelphia University of Pennsylvania Press, London Oxford University Press, 1938) 9*s* net

MR L D STAIR, evidently with great care, has converted the diary of Robert Ferguson into a narrative It is certainly a readable book, but there is at times the slightest uneasiness in the reader's mind lest the editor may have been carried away by his theme the feeling is probably unjustified Matters of precise interest are (*a*) the accounts of the Eskimo and of Ferguson's success on his land journeys, short though they were due to adopting completely the native mode of life, long before Stefansson, and (*b*) the information regarding the Greenland whale, at that time *the* whale

Ferguson mentions a whale about 95 ft long, this can scarcely be correct since the Rev William Scoresby, D D, F R S, considered 65 ft unusual and 70 ft the absolute limit of size for this species On the other hand, Ferguson's figure of 130 barrels for this individual seems surprising, but the careful Scoresby measured a whale of 52 ft which gave 24 tons of oil and says that whales yielding 20 tons of oil are by no means uncommon' and whales have been caught that afforded nearly 30 tons of pure oil He states further that the ton or tun of oil is 252 gallons wine measure', this is still the basis of the barrel of whale oil, which is reckoned in round figures at 40 gallons or 6 barrels to the ton These whales therefore gave 120–180 barrels, which would be most remarkable for the gigantic Blue whale of the South It should be mentioned on Scoresby's authority that the blubber of the Greenland whale is from 8 or 10 to 20 inches thick

J E HAMILTON

Industrial Chemistry
an Elementary Treatise for the Student and General Reader By Prof Emil Ramond Riegel Third edition Pp 851 (New York Reinhold Publishing Corporation, London Chapman and Hall, Ltd, 1937) 28*s* 6*d* net

PROF RIEGEL'S book provides an admirable survey of modern industrial chemistry which is suited to the needs of the student and the general reader The various sections have been written with the collaboration of experts and give in a concise form a wealth of authoritative information The topics include mineral acids and alkalis, nitrogen products, phosphates, fertilizers, cements, ceramics, glass, fuels, water, coal products, electrothermal and electrolytic processes, petroleum, and the important organic chemical industries such as the manufacture of dyes, pigments, oils, explosives, rubber, etc There are also good chapters on chemical plant and instruments of control, and on the metallurgy of iron and steel, copper and other common metals, and on the platinum metals and radium The treatment is sufficiently detailed to be really useful, and the book is well illustrated and indexed There are references to standard treatises and to recent articles in journals—the latter mostly American

Physikalische Methoden im Chemischen Laboratorium
Pp v+267 (Berlin Verlag Chemie, G m b H, 1937) 3 60 gold marks

DURING 1936–37, a series of thirteen articles on the application of new physical methods to the solution of chemical problems appeared in the German technical journal *Angewandte Chemie* these have now been reprinted and collected in the book under review The subjects treated are X ray methods, ultra sonic waves, chromatography (three articles), Raman effect, dielectric loss, spectrum analysis (two articles), polarographic methods (two articles), photo electric spectrophotometry, and colorimetry with colloidal solutions Some of the articles, for example, those on the application of X ray methods and of ultra sonic waves, are mainly concerned with a description of the results obtained, but in others, as those on chromatography and the polarograph, adequate experimental details are given The authors of the various sections have had practical experience of the subjects about which they have written, and so the matter may be regarded as authoritative, although as is to be expected the style is not uniform Altogether the compilation should prove of considerable interest to chemists who wish to become acquainted with some of the recent developments in experimental technique The book is well produced, in spite of its paper covers, and is excellent value for its relatively small price

S G

The Modern Mind
By Michael Roberts Pp 284 (London Faber and Faber, Ltd, 1937) 8*s* 6*d* net

THE special interest of this brilliant and well written essay is the development given to the view that the history of thought shows that there are attitudes of mind corresponding to various historical periods, and that so far as the English mind is concerned, such attitudes are evolutionary products involving the intuitions and inhibitions of our medieval ancestors This is coupled with the author's effort to re establish truth as poetry and religion apprehend it, though he seems to think that poetry and religion have no concern with facts at all In the exposition of these views, the author displays great learning and a gift for discovering striking analogies However controversial some of his conclusions may be, the reading of his book will be found to be both beneficial and pleasant

T G

A Scheme of Inorganic Qualitative Analysis
By Dr E M Stoddart Pp vii+39 (London William Heinemann, Ltd, 1937) 1*s* 6*d*

THIS small manual contains some useful tables for group separations and confirmatory tests. By omitting equations, which the student can find in the text books of inorganic chemistry, it has been possible to get the material into a small space, convenient for bench use, and to produce an inexpensive guide to qualitative analysis The book is very clearly written and should prove useful in school and college laboratories The standard is that of the London Intermediate and General B Sc

Foundations of Physics

By Prof. A. S. Eve, C.B.E., F.R.S.

THE relative fields of physics and metaphysics, and the relation of theory or speculation to experiment in the pursuit of natural knowledge, have been the subject of several contributions to NATURE in recent months In May of last year, under the title of "Modern Aristotelianism", Prof. H Dingle presented Aristotle and Galileo as examples of opposing schools of thought in a discussion in which the main question raised was "whether the *foundation* of science shall be observation or invention". A month later, NATURE published a special Supplement containing communications from many leading scientific workers on the desirable balance to be maintained between observational methods and deduction by pure reasoning from speculative assumptions One aspect of this wide subject was developed further in a discourse on "Science and the Unobservable" delivered by Prof. Dingle at the Royal Institution and published as a Supplement to NATURE of January 1 of this year; and this was followed by two articles by Dr Harold Jeffreys on "Science, Logic and Philosophy" in the issues of April 16 and 23, dealing with relationships between what is understood as idealism and realism. A week later, in an article entitled "The Pragmatic and the Dogmatic Spirit in Physics", Prof J. Stark attempted to divide physics into two groups or tendencies; and at the same time made an unpardonable attack on the Jewish people in general and Einstein in particular The article was based upon a communication made by Prof Stark to *Das Schwarze Korps* in connexion with the movement to purge German science of Jewish influence and was contributed to NATURE by invitation of the Editor in order to obtain an authoritative statement from Germany upon what this influence was supposed to signify.

Prof. Stark's article has been met with cold disfavour by the generality of physicists, who have made no reply to it, deeming that the statements in question carried with them their own refutation so obviously that no answer was required. There was, however, another reason for this silence. Men fear to pour oil, not on troubled water, but on a blazing furnace, which if left undisturbed, might reach exhaustion by its very violence. Yet it may be desirable not to let the case go by default, but to avert strife and discord by an examination of the true state of affairs.

Early in the nineteenth century, Fourier in his "Analytical Theory of Heat" stated the principles which guide us in our scientific outlook

> "Primary causes are unknown to us; but are subject to simple and constant laws, which may be discovered by observation, the study of them being the object of natural philosophy." He then referred to the triumphs of Galileo and Newton, where so many great effects follow from so few causes, and then continued, "but whatever may be the range of mechanical theories, they do not apply to the effects of heat These make up a special order of phenomena, which cannot be explained by the principles of motion and equilibrium. . . . Profound study of Nature is the most fertile source of mathematical discoveries. . . . There cannot be a language more universal and more simple, more free from errors and from obscurities, that is to say more worthy to express the invariable relations of natural things. Considered from this point of view, mathematical analysis is as extensive as Nature itself, . . . its chief attribute is clearness; it has no marks to express confused notions. It brings together phenomena the most diverse and discovers the hidden analogies which unite them"

No apology is needed for quoting Fourier—a man who combined observation and theory, and found relations which, to so great a degree and in so many cases, could represent what we believe to be as close an approach as is possible to natural phenomena, which we sometimes rather vaguely call reality.

There are to-day no physicists who do not seek and encourage tests by experiments and observations in order to verify, modify or reject their ideas and theories Thus, Rutherford said that it would be time to abandon the theory of radioactivity (at first strongly opposed by some great authorities as a most revolutionary idea) as soon as a single, definite, experimental result contradicted it. Einstein actually named and described three fundamental observational results which, if not verified, would necessitate the abandonment of his theory of relativity Is this dogmatism ? Consider, too, how that theory arose The test experiments of Michelson, Morley and Miller had failed to indicate the swift motion of the earth through the "luminiferous æther" and it was necessary to revise Newtonian mechanics and to bring them into harmony with electromagnetic theory. The efforts of Fitzgerald, Larmor and Lorentz indicated a road which, extended and widened, enabled Einstein to enunciate his great principles of special and general relativity. The experiments of Kaufmann and Bucherer showed that the masses of electrified particles increased with high velocities an idea never contemplated by Newton The relation between energy and mass the greatest result of our times largely due to Einstein has received confirmation in the balance sheet of energy in nuclear transformations In the field of statistics the Bose Einstein relation takes high rank in physics with its counterpart the Fermi Dirac Nor must we allow prejudice to blind us to the fact that Einstein received his Nobel prize for his discoveries apart from relativity and indeed his photo electric relation is one of the most fundamental in the realm of atomic physics[1]

The history of science is full of remarkable chains of which successive discoveries are the links Thus Rutherford surmised the existence and stated the properties of the neutron in 1921 Four years later Chadwick was writing that the time had come to make a determined search for it—a search which was made in vain until the Curie Joliots obtained strange and unexpected results when bombarding beryllium with alpha particles and Chadwick then saw his goal in sight Would Rutherford be termed pragmatist or dogmatist in 1921 ?

An equally remarkable development came from Faraday s researches His work on electrolysis needed no development it was simple and complete Not so his work on induction which required the mathematical genius of Maxwell to bring it to fruition by his remarkable conception of an electric displacement current in regions devoid of matter surely a conception as revolutionary as any of our modern ideas The whole electromagnetic theory was born and the relation between electricity and light established Ten years after the death of this great physicist who blended theory and practice in the highest degree Hertz started his remarkable and successful investigations on the production of electromagnetic waves and these radiations were explored by a host of able workers until eventually Marconi achieved his triumphs with far flung radio messages

A more remarkable chain of discovery is that which originated with Planck who found it *inevitable* to believe that energy passed between atoms as quanta proportional to their frequencies and thereby succeeded using the most revolutionary idea of our times in a rational theory where Wien, Rayleigh and Jeans had in part succeeded, but then met with insurmountable obstacles To-day Planck s constant takes a permanent place in physics with other fundamental constants such as the mass of a hydrogen atom the electronic charge or the velocity of light There must be many who remember the staunch resistance that the quantum theory in its early days met from many most distinguished men of science who to day accept it as part of the ordinary nature of things—but who dares to say that he understands it ? How rash it would be at any time to trammel or despise those who are working on the fascinating borderline of the known and the unknown

In due course Bohr was able to blend the idea of quanta with the electrons around the Rutherford nucleus and to obtain a remarkable theory of radiations for hydrogen ionized helium and for X rays connected with the inner rings of the heavier atoms His marvellous theory still the background of the periodic table and spectral analysis showed signs of cracking in 1925 when applied to numerous cases of atomic radiation A way out of these serious difficulties has been found by L de Broglie Schrodinger Bohr Heisenberg Dirac and others The problem was one of the most difficult ever presented to the human mind

It was the many bodied problem complicated with electric charge spin and magnetic moment Complete failure might well have been anticipated but the remarkable sharpness of many spectral lines even when powerful magnetic or electric fields were applied by Zeeman or Stark showed that there was some ordered simplicity in apparent chaos Following the lead of experimental results certain rules were formulated so that equations were found showing something in the nature of standing waves which indicate the probable position of the electron at any time These equations approach reality in the sense that they give the right answers ! It is as though a man used logarithms without understanding the theory underlying them

The fact that physical interpretation lags far behind the mathematical calculation (which are nevertheless based on experimental results) in no wise detracts from the work of these men of genius who belong to various nationalities If these men are to be deemed dogmatists then it would indeed be an honour to be included in their ranks But the whole theory of pragmatists and dogmatists is pure moonshine and to link such discoveries mainly with the Jewish people is a poor compliment to the rest of mankind

A more just estimate of the true situation is that due to Maurice Duc de Broglie who wrote in NATURE of May 7 1933

> Recent theoretical views suggest that a mechanistic view of Nature cannot be pushed beyond a certain point, and that the fundamental laws can only be expressed in abstract terms, defying all attempts at an intelligible description The philosophy of science has always swung between these two points of view The work of the great physicist [Rutherford] to whom these lines are dedicated shows however to what brilliant discoveries the method followed by Lord Rutherford can lead '

There are nevertheless many great leaders notably Bohr who believe that we are still merely approaching the problem and that in due course the reasons for the correctness of the quantum theory and wave mechanics will be made clear This further step if it is ever achieved will not detract from the fame of the present pioneers At least it has been made certain that novel ideas due to many great men of science often revolutionary in type have first been scorned and later accepted but there has certainly never been any necessity for what has been called advertising Let us name Copernicus Galileo Newton Fourier Maxwell Planck Rutherford Bohr Einstein Other names might be added of men whose just fame is not yet so firmly established men belonging too to various nationalities— a matter of no real importance in science

Rutherford indeed frequently lectured on his discoveries to a variety of audiences in many countries all over the world He believed that it was one of his duties to interpret and spread the good news of scientific discovery and progress He would be a rash man who dared to use the word advertising in this connexion and no fair minded man will connect the word with Einstein for his views quickly and naturally caught and held the attention both of the well informed and the general public

Although Rutherford made no incursions into wave mechanics and held fast wherever and as long as he could to classical views yet he was honest enough to admit when the latter failed and he was eager to adopt anything however modern or revolutionary its source which might assist him in his research work such as the use of resonance to secure low voltage transmutation an idea due to Gamow and to Condon and Gurney (1928) derived from wave mechanical theory and impossible from a classical viewpoint We must also admire that abstruse analysis of Dirac involving negative energy which led him to the conception of a positive electron before its discovery in cosmic rays by Anderson and its confirmation by Blackett Here as in so many cases ideas which might be termed dogmatic by some have led directly to the pragmatic In fact theory based on experiment or observation (and who bases it on anything else ?) will often yield results at first unexpected just as Faraday s experiment led through Maxwell s theory to wireless telegraphy telephony and broadcasting on one hand and to our gigantic power houses and electrical supply on the other

That is the gist of the whole matter and there is nothing more to be said The search for truth or reality is common to all but there may be different avenues of approach Let us throw these open without hindrance and give full credit to all who extend by any means our natural knowledge setting aside all prejudices and determined that the rule of reason and the law of liberty shall prevail throughout the realms of science

See also Prof C G Darwin s presidential address to Section A Mathematics and Physical Science of the British Association delivered at Cambridge The Advancement of Science 1938 London Burlington House

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Sir William Herschel, 1738-1822

By Sir Frank Dyson, K B E , F R S

At the age of thirty five years William Herschel a distinguished and prosperous musician was impelled to explore the heavens He found a small telescope which he had hired insufficient for his needs and with great skill and patience constructed larger and larger instruments After his day s work, he spent a great part of the night observing the stars The conclusions he drew from his observations were characterized by an originality boldness and splendour of outlook which have placed him among the greatest astronomers We ought he writes to avoid two opposite extremes If we indulge in a fanciful imagination and build worlds of our own we must not wonder at going wide from the path of truth and nature On the other hand if we add observation to observation without attempting to draw not only certain conclusions but also conjectural views from them we offend against the very end for which observations ought to be made I will endeavour to keep a proper medium but if I should deviate from that I would wish not to fall into the latter error

Frederick William Herschel was born at Hanover on November 15 1738 His father was a hautboy player in the Hanoverian Guards and at the age of fourteen William was engaged as a musician in that regiment He left in 1757 as he had taken no oath binding him to military service He received a formal discharge in 1762 The legend that he deserted from the army and received a pardon from George III in 1782 is a fiction

Towards the end of 1757 Herschel came to England and for some time had hard work to earn a living by copying music and giving occasional performances His musical abilities were gradually recognized, and in 1760 he was appointed instructor of the band of the Yorkshire Militia stationed at Richmond In 1762 he resigned this post he composed symphonies, conducted concerts at Leeds, was for a short time organist of the Halifax parish church until in 1766 he became organist at the Octagon Chapel at Bath He was soon the centre of musical activity in this fashionable watering place and had a busy life, composing conducting concerts and taking pupils

As music was not sufficient for his boundless energy, Herschel studied Italian, Greek harmonics, mathematics, optics and astronomy In 1773, he hired a small telescope and commenced to search the heavens He soon wanted a larger telescope, and after many experiments and failures succeeded in making a Newtonian reflector of six and a half inches diameter and seven feet focal length The parabolic mirror was of speculum metal in the proportion of 5 lb of tin to 9 lb of copper He cast the disk himself ground it and polished it with his own hands With this instrument, he repeated and extended a previous survey of the heavens His intention was to find bright stars with faint stars near them on the supposition that the difference of magnitude was the effect of distance and might thus serve to determine stellar distances

On March 13 1781 Herschel made this entry in his note book In the quartile near ζ Tauri, the lowest of the two is a curious either nebulous star or perhaps a comet After several cloudy nights, he found on March 17 that the star had moved and was presumably a comet He communicated his discovery to Maskelyne the Astronomer Royal who wrote to him on April 23 "It is as likely to be a regular planet moving in an orbit nearly circular round the Sun as a comet moving a very eccentric ellipsis I have not seen any coma or tails to it" The evidence of its great distance and uniform movement soon showed that the body was, in fact, a new planet This was an astounding discovery, as no one had ever imagined there could be more than the five planets Mercury, Venus, Mars, Jupiter and Saturn, which had been known for ages Herschel was awarded the Copley Medal of the Royal Society in November 1781 and was elected a fellow of the Society in December

The attention of George III was directed to the fame of the Hanoverian astronomer, with the result that Herschel was appointed King's Astronomer with a salary of £200 a year He was now relieved of the necessity of snatching astronomical observations in the intervals of concerts or sitting up all night after a hard day's work He had at this time a 7 foot telescope of 6 inches aperture and a 20 foot telescope of 12 inches aperture He now proceeded to make a 20 foot telescope with an 18 inch speculum, and commenced his famous 'sweeps' to find what was in the sky and to gauge the depths of the heavens Some years later, he constructed the great 40 foot telescope with a 40 inch speculum Before he had made the flat mirror so as to use the telescope in the Newtonian form he looked down the tube directly with his eyepiece and found the definition good, and the brilliancy greater owing to the absence of a second reflection He accordingly adopted what is known as the 'Herschelian" type of reflecting telescope in later work

Herschel continued his observing with, if possible, increased vigour, finding in his 'sweeps' objects which enrich the natural history of the sky and classifying them according to their species, hundreds of double stars, thousands of clusters and nebulæ Double stars attracted him because he hoped to find a parallactic displacement between a bright star and its faint neighbour, and thus obtain an idea of stellar distances He published a list of 269 double stars in 1782, giving their position angles and their angular distances apart inferred roughly from the size of the disks In 1784 he published a further list of 484 stars, with their distances apart now measured by a micrometer He seems to have suspected that some of them might be real binary systems By 1802 he was satisfied from the changes in position angle that a considerable number of these stars were binary systems moving in elliptic orbits under their mutual gravitation Newton's law thus held in these distant regions in space

In 1760 Mayer had indicated the perspective effect which would be shown in the proper motions of stars by the movement of the sun in space, but had failed to find it In 1783, from the proper motions of seven bright stars given by Lalande, Herschel determined that the sun was moving in the direction of λ Herculis From a larger number of stars he obtained a slightly different and not quite so good a direction as that found by later researches from thousands of stars arranged in all manner of ways according to magnitude size of proper motion, and type of spectrum

Herschel's ideas about the physical nature of the sun now seem to us very extraordinary He regarded it as a dark, cool, solid globe, possibly inhabited, protected by a layer of cloud from the light and heat of the upper luminous region This solid part of the sun is revealed in the openings of the luminous region shown in sun spots This theory held the field for many years Erroneous facts are harmful, but erroneous theories are better than none at all and act as incentives to better ones

With his large telescopes, Herschel examined the planets He discovered two satellites revolving around Georgium Sidus' or Uranus, and thus encouraged found two additional satellites of Saturn He found that Venus was covered with clouds, noticed the changes in the white spots at the poles of Mars, and concluded that Mars was most like the earth as regards habitability He determined the direction of the axes, periods of revolution and oblateness of the planets He found that a spot in the atmosphere of Jupiter had a different period of revolution from the rest of the planet

Herschel's name is inseparably associated with great telescopes, but for the years 1795–97 he interrupted his work to arrange the stars in different constellations, according to their magnitudes This was largely done with the naked eye The work was not estimated at its full value until Prof E C Pickering reduced and discussed the observations Herschel furnished observations of nearly 3 000 stars from which their magnitudes a hundred years ago can be determined with an accuracy approaching that of the best modern catalogues '

Herschel was attracted by Messier s short list of nebulæ and clusters published in the *Connaissance des Temps* for 1783 In the belief that all nebulæ could be resolved into stars he commenced a survey of the whole sky with his new 20 foot reflector of 18 inches aperture At the same time, by counting the number of stars in equal areas in different parts of the sky, he purposed to 'gauge' the depth of the sidereal universe He began these famous 'sweeps' of the heavens on October 28, 1783 He first placed his telescope in the meridian and standing in a gallery at the end of the telescope could give it a motion in azimuth of 10° or 12° either way He moved the telescope slowly backwards or forwards and noted what he saw He then changed the telescope 8′ or 10′ in altitude Twenty or thirty of such operations he called a 'sweep' They were very fatiguing and spoiled the sensitiveness of his eye for faint objects After the forty first sweep he discarded this method and had recourse to vertical sweeps, employing a workman to move the telescope, and calling out his observations to his sister Caroline, who noted them down In 1789 he published a catalogue of 1,000 clusters and nebulæ "As a mere explorer of the heavens," wrote Agnes Clerke, "his labours were prodigious He discovered no less than 2,500 Nebulæ, 806 double stars, and passed the whole firmament in review four several times, and counted the stars in 3,400 *gauge* fields "

In these 'gauges', Herschel counted the number of stars in the field of view of his eyepiece, which had a diameter of 15′ His telescope revealed all the stars to about the fourteenth magnitude, at least a thousand times as faint as the faintest star visible to the naked eye He found that the number of stars diminished with increasing distance from the Milky Way until they were only one thirtieth of the number at its pole He was thus led to the 'grindstone' theory of the 'Construction of the Universe His views were modified in his later papers in 1811 and 1814 and he realized that the Milky Way is more complex and that nebulæ are not always irresolvable clusters "We may have surmized nebulæ to be no other than clusters of stars disguised by their very great distance but a longer experience and better acquaintance of their nature will not allow of such a principle " He gave the name "planetary nebulæ ' to bodies which, notwithstanding their planetary aspect retain a haziness by which they are surrounded and evinces their nebulous origin " He regarded the Orion nebula as true nebulosity and typical of other extended nebulæ, but retained his belief that some nebulæ were resolvable into stars and were comparable in size with our own Galaxy

Only the briefest reference can be made to an important paper published in 1800, when he discovered that the heat derived immediately from the sun or from candescent terrestrial substances is occasioned by rays emanating from them, and that such heat making rays are subject to reflexion and refraction He gives in a diagram the intensity of the heat in what we should now call all wave lengths extending from the infra red to the violet

We must on no account overlook the help Herschel received all his life from his devoted sister Caroline From 1772 she was his constant companion, housekeeper and assistant in his music and astronomy She accompanied him to Slough and would sit up whole nights taking down his observations and copying them out the following day When William married she took lodgings in Slough and still continued as his assistant At her brother's suggestion, she searched for comets and discovered no fewer than eight After Herschel's death she returned to Hanover and prepared a catalogue of 2,500 nebulæ and clusters discovered by him For this she was awarded the Gold Medal of the Astronomical Society She died in 1848 after a prolonged and cheerv old age

On May 8, 1788, Herschel married Mary, daughter of Mr Adee Baldwin, a merchant of the City of London, and widow of John Pitt, Esq Their son John was born on March 7, 1792 Mrs. Herschel was of an amiable and gentle character and lived on friendly terms with Caroline, whom she had displaced In 1791, Herschel visited Glasgow and was given the freedom of the City and a doctorate of laws by the University, and on his return called on Michell, an astronomer of distinction and originality In 1802 he went to Paris and met Messier Delambre, Laplace, Count Rumford and Napoleon In 1816 he was knighted by the Prince Regent In 1820, when the Astronomical Society was founded, he was made its first president He was too feeble to attend the meetings, but allowed his last paper to be published in the Memoirs of the Society He died at Slough on August 25, 1822, and was buried in the Church of St Lawrence at Upton *

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* In the preparation of this article I have used to a great extent the admirable introduction to The Scientific papers of Sir William Herschel written by Dr Dreyer and am also indebted to a conversation with Dr W H Steavenson —F W D

Obituary Notices

Sir Robert Mond, F R S

ROBERT LUDWIG MOND the elder son of the late Dr Ludwig Mond F R S, was born at Farnworth, near Widnes Lancashire, on September 9 1867 and was brother of Alfred Moritz Mond the late Lord Melchett He was educated at Cheltenham and at Peterhouse, Cambridge Later he worked at the Polytechnicum Zurich, and at the Universities of Edinburgh and Glasgow, and had the privilege of being private assistant to Sir William Thomson (Lord Kelvin) His first wife the mother of his two daughters died tragically in Egypt in 1905 and he married in 1922 Marie Louise Le Manach of Belle Isle en Terre Brittany

In consequence of his varied training in the physical sciences and the atmosphere of his home Robert Mond had an extraordinary wide outlook on scientific problems so that while never becoming a specialist in any one branch he was able to contribute materially to the solution of problems in these subjects On proceeding to Winnington he had the privilege of working not only with his father but also with such distinguished collaborators as Carl Langer and Friedrich Quincke He assisted in the investigations leading to improvements in the production of zinc by the electrolysis of zinc chloride and to the discovery of nickel carbonyl, the basis of the process for the production of pure nickel In the course of time, Robert Mond was called upon to assume positions of responsibility in various organizations arising from the exploitation of scientific investigations at Winnington He joined the board of directors of Brunner Mond and Company and the Mond Nickel Company, of which he subsequently became chairman

In connexion with the exploitation of the nickel mines at Sudbury Ontario, Robert Mond identified himself with the Royal Ontario Museum, Toronto, of which he became trustee and to which he gave considerable sums of money and also enriched by valuable contributions arising from his archæological investigations in Egypt His absorbing interest in archæology dates from about 1898, when, shortly after his marriage, he had to spend winters out of England for health reasons In his earlier days, Robert Mond was a keen mountaineer, and later, although never of sound physique, his unusual vitality made it possible for him to undergo physical strain which always surprised those who knew him intimately

In 1910 Robert Mond went to live at Combe Bank, Sevenoaks—one of the first houses to have electric lighting installed—with its model farm and laboratories originally intended for his father s use Characteristically and with his usual vigour, Robert Mond took up for him new investigations in agriculture, including stock breeding and it was from here that he supplied with milk the Infants Hospital in Vincent Square founded as a memorial to his late wife The late Prof H E Armstrong used to maintain that Robert Mond was the first to appreciate the meaning of pure milk and to conduct his experiments on a satisfactory scale

It is difficult to give an adequate account of Robert Mond s scientific and industrial interests His scientific greatness lay not so much in what he himself discovered or achieved but in what he did to make it possible for those to achieve who were less fortunately placed Especially after his father s death, he regarded his wealth and position as a trust to be used in the advancement of knowledge and appreciation of beauty, and through that of international peace and fellowship, and he worked incessantly to achieve this ideal

The large number and extent of Robert Mond s benefactions will probably never be known to the outside world and if by chance he happened to mention any one of them to an intimate friend one felt that he had been guided by his ideals rather than by the mere amelioration of a difficult financial situation Some of them in Great Britain are known There is his large benefaction to the University of Liverpool, of which he held the honorary LL D degree Another typical example of what he has done for the advancement of scientific knowledge is his work for the Royal Institution Sir Robert Robertson, the honorary treasurer, has written

> "By the same deed of trust (1896) of Ludwig Mond in which he conveyed the Davy Faraday Research Laboratory and its endowment to the Royal Institution, Robert Ludwig Mond was named Honorary Secretary of the Laboratory Committee for life When in London he came occasionally to the meetings of the Committee and read the minutes To the equipment and furnishing of the Davy Faraday Laboratory, he gave much thought and travelled over the Continent and in America studying arrange-

ments of laboratories and purchasing apparatus for his father's foundation. Although forty years have passed since the laboratory was fitted up according to his designs, the arrangements of benches and of electrical distribution are still in use. At the celebration of the centenary of Faraday's discovery of electricity from moving magnetism (1931), he represented the Faraday Society and gave £5 000 towards the reconstruction of the theatre. His interest in the Davy Faraday Laboratory continued unabated and recently he gave £2 000 to its funds. He also caused to be collected and printed a list of workers in the laboratory from 1896 to 1932 with their publications. The Royal Institution has lost a good friend.

It is interesting to note that Robert Mond's knowledge of the Royal Institution and the unique place it occupies as a scientific centre guided him to a large extent in what he did later in Paris. Much more recently, he gave a sum corresponding to the amount he gave to the *Maison de la Chimie* in Paris to the funds of the National Council for Chemistry. Like his father, keenly interested in the documentation of scientific knowledge, he hoped that this might be a nucleus from which the more satisfactory documentation of chemical literature and, possibly, a British House for Chemistry might arise.

In celestial chemistry and other related branches of astronomical research, Robert Mond also took keen interest and encouraged in many ways. He was one of the seven original subscribers to the Hill Observatory Corporation, registered in 1916 to establish an observatory at Salcombe Regis, Sidmouth, Devon, the name being changed in 1921 to the Norman Lockyer Observatory, in memory of the distinguished astronomer who founded it. He became chairman of the corporation twenty one years ago and occupied that position when he died. Since its foundation, the Observatory has been equipped and maintained entirely by private donations, and Robert Mond was one of its chief benefactors. Six years ago, he generously presented to the Observatory a completely new form of photographic equatorial telescope, which he termed an 'astronomical robot' for the photography of extensive celestial fields with long exposures and on different scales.

In recent years, Robert Mond became as much at home in France as in Great Britain. This was partly a result of his ardent desire to improve international understanding among scientists generally and chemists in particular. In France, he was a generous benefactor of the British Institute in Paris, and he worked wholeheartedly for the France Grande Bretagne Association. Our French colleagues realized his unique qualities and honoured him (and us) by electing him president of the Société de Chimie industrielle, an office which he held at the time of his death.

The founding in Paris of the Maison de la Chimie as a memorial to Marcelin Berthelot appealed to Robert Mond intensely. In his own words, "L'idéal que matérialisent ces bâtiments a permis de créer mieux qu'une maison : un état d'esprit international. Et c'est cette foi commune qui, loin des luttes de la politique, cherche à élever toujours plus haut les manifestations de l'intelligence scientifique et le rayonnement du génie humain." He became Membre du Conseil d'Administration de la Maison de la Chimie and, apart from contributing 1,000 000 francs to its funds and in order that its future and development might be secured he founded and became president of the Société des Amis de la Maison de la Chimie. What he did for the Maison de la Chimie was typical of many other benefactions in France all carried out in the spirit of furthering the accomplishment of his ideals. France fully recognized the high quality of his efforts, and none of his friends were surprised at his promotion from Officier' to Commandeur de la Légion d'Honneur. In 1937, he was elected Membre de l'Académie des Inscriptions et des Lettres, becoming Membre de l'Institut de France.

Robert Mond received the order of knighthood in 1932. Of his election this year to the fellowship of the Royal Society he was immensely proud. His letter to the present writer contained the following sentence: "To be considered worthy of admission to the same distinguished Society which recognised my father is the greatest honour I could receive." Arrangements had been completed for conferring on him, by the University of London, the rare distinction of the honorary D.Sc. degree.

Robert Mond's interests in human knowledge and progress were so wide that it is difficult to realize how he found time and strength to maintain them. Recently he suffered considerable physical disability, but his amazing spirit and the constant care of Lady Mond carried him through. In spite of ill health, he never hesitated to accept an office to which arduous duties were attached when he believed that thereby he might contribute to the realization of his ideals. The international character of the meetings of the Faraday Society was a deciding factor in accepting its presidency, and his interest in photography and especially in colour photography from his early days led him to accept the honorary treasurership of the building appeal (now in progress) of the Royal Photographic Society.

Robert Mond died at his Paris residence on October 22. All who knew him and enjoyed his friendship will warmly endorse the sentiments so ably expressed at the funeral by Prof. Auguste Béhal and Louis Hauzeur. The ashes are interred at Belle Isle en Terre. To Lady Mond and to the family we can only express our deepest sympathy and feel proud that we have been privileged to know a great man who described himself as "un serviteur modeste mais dévoué de la Science".

CHARLES S. GIBSON

IN the passing of Sir Robert Mond, Egyptology has lost one of its most generous supporters, as well as a most devoted student. Ever ready to help in financing explorations in the field, he himself took the keenest pleasure in the actual work of excavating and enjoyed nothing better than being at the bottom of a tomb shaft, sifting the sand with his own hands in the hope of finding some hidden treasure.

It was my privilege to meet Mond first at his father's house in London in 1896, and when he visited Egypt a few years later he came to me at Thebes and expressed the wish to collaborate in the exploration of the Mortuary Chapels of the Nobles which I was then carrying out on a very small scale in the Theban necropolis In 1902 when I relinquished this work in consequence of other duties Mond took over the concession which I then held from the Egyptian Government and early in 1903 began working the concession himself This work he continued for the next three winters and published his reports in the *Annales du Service des Antiquités* then being edited by Prof Maspero Later when he was prevented from personally supervising the excavations Messrs Howard Carter and Arthur Weigall the successive inspectors of antiquities in Upper Egypt continued the task with the financial aid of Mond and others In 1909 he sent out from England Mr Jelf an Oxford graduate to assist Weigall In 1913 was published the Topographical Catalogue of the Theban Tombs by Dr Alan Gardiner and Weigall with the assistance of Mond which is a record of what had up to then been accomplished In the introduction to this book, Gardiner wrote that it was due in large part to the personal endeavours and enlightened liberality of Mr Robert Mond that the Theban Necropolis is now on the whole well protected and in a satisfactory condition

Mond now set himself whole heartedly to work out a well considered and continuous scheme of restoration and preservation of the Theban tombs In a lecture which he delivered before the Royal Institution in May 1914 he told his audience that this object which had been one of my day dreams for many years took shape when the opportunity arose which enabled me to secure after many consultations with the most competent Egyptologists and especially with Dr Alan Gardiner the services of Mr Ernest Mackay for many years the chief assistant of Prof Flinders Petrie and he announced that Mackay will now devote his whole time to the systematic inspection excavation restoration and preservation of these chapels But Mackay had been employed only a little more than a year when the Great War broke out and soon afterwards the work at Thebes had to be abandoned

It was not until the winter of 1923 that Mond again began explorations at Thebes when he employed Mr Yeivin in the autumn of that year to superintend the excavations The same year Mr Walter Emery a student of the late Prof Peet at the University of Liverpool, was sent out to Egypt and in 1924 took charge of the work Mond's work was now carried out in association with and under the ægis of the University of Liverpool Institute of Archæology an institution that he had long been interested in having joined the Committee in 1910 On going over the necropolis with Emery it was decided to clear and restore the famous tomb of Ramose, vizier of Amenhetep III and Akhenaton This took three winters to complete, and the publication of the scenes and inscriptions in it has been entrusted to the skilled hands of Mr Norman de Garis Davies, of Oxford, and for many years on the staff of the Metropolitan Museum of Art, New York Mond's and Emery's reports for the years 1923 to 1926 are printed in the *Liverpool Annals of Archaeology and Anthropology*

In the spring of 1926 Mond and Emery prospected on a new site at Armant the ancient Hermonthis ten miles up river from Thebes A concession covering about fifty square miles was applied for in the name of the Liverpool Institute of Archæology and when this was granted Mond began excavating there The burial ground of the Buchis Bulls sacred animals famous in Egyptian history was soon discovered Mond then had a motor road some ten miles long cleared from Thebes to Armant to enable him to visit Emery two or three times a week to inspect the work and record progress In 1928 the Armant concession was transferred to the Egypt Exploration Society of which Mond had been elected president on the death of General Sir John Maxwell A large staff was sent out under the direction of Dr Frankfort Mond bearing the whole expense In the following year Frankfort resigned on being appointed field director of the Iraq Expedition of the Oriental Institute of the University of Chicago and the Armant excavations were supervised for a season by Mr F W Green, of the Fitzwilliam Museum Cambridge Emery having been appointed by the Egyptian Government to carry out the Nubian Archæological Survey Then Mr Oliver Myers was appointed director a position he has held ever since

How ably this work has been carried out is evidenced by the three volumes published in 1934 entitled The Bucheum by Sir Robert Mond and Oliver Myers and by two volumes issued last year on The Cemeteries of Armant by the same authors To these books no fewer than sixty nine scholars and scientific workers have contributed among them many bearing distinguished names It is interesting to note that two Egyptians have written chapters one G Mattha a student of the late Prof Griffith writes on Demotic Ostraca the other Suliman Huzayyin contributes an able paper on The Flint Industry These volumes show how wide was Mond's outlook in Egyptology and how catholic were his interests Although much more remains to be published of the work he was engaged on it is pleasant to know that he lived to see these five volumes distributed During the last two years Mond also financed the work of Dr Hans Winkler in the Eastern and Libyan deserts, a small volume Völker und Völkerbewegungen im vorgeschichtlichen Oberägypten im Lichte neuer Felsbilderfunde was issued last year and Rock drawings of Southern Upper Egypt by the same writer has just appeared

Before concluding this notice of Sir Robert Mond's Egyptological activities as an example of his keenness in the preservation and provision for the careful publication of antiquities may be mentioned his acquisition of a unique series of papyri When we were at Thebes in the spring of 1904, we heard that native diggers had made a 'find of Hebrew papyri at Elephantine Mond at once telegraphed to the dealer who had secured the documents, asking that they should be kept for his inspection Next morning, he set off for Aswân and at once bought the papyri with the intention of presenting them to the British

Museum But the Service des Antiquités, hearing of the purchase, requested Mond to sell the documents to the Cairo Museum Recognizing that this was really a command, he at once presented the collection to the Cairo Museum authorities on condition that he should have the right of publication He then commissioned Prof Sayce and Dr Cowley, of Oxford, to edit and translate the documents, and in 1906 was published the splendid volume Aramaic Papyri discovered at Assuan This was due entirely to Mond's munificence Mond possessed a collection of antiquities at his home in Cavendish Square but it was his invariable habit to give the best pieces he bought to museums rather than keep them himself He was the first to contribute on a munificent scale toward the purchase of the important Petrie Collection of Egyptian Antiquities for the University of London, and the Toronto Museum has benefited greatly by his gifts

PERCY E NEWBERRY

WE regret to announce the following deaths

Mr H G Billson C I E, formerly chief conservator of Indian forests on October 27

Paul Helbronner free member of the Paris Academy of Sciences who made a geodesic survey of the French Alps from Lake Geneva to the Mediterranean and later extended the network to Corsica on October 18, aged sixty seven years

Dr Volkmar Kohlschutter professor of inorganic and physical chemistry in the University of Bern on September 10 aged sixty five years

Prof P A Murphy, professor of plant pathology in the Albert Agricultural College University College Dublin on September 27 aged fifty one years

Prof Georges Urbain professor of chemistry in the Sorbonne on November 6 aged sixty six years

Miss Clotilde von Wyss formerly lecturer in natural history in the Institute of Education (University of London) on November 7

News and Views

Royal Society Awards

THE following awards of medals have been made by the president and council of the Royal Society Copley Medal to Prof Niels Bohr For Mem R S in recognition of his distinguished work in theoretical physics and particularly in the development of the quantum theory of atomic structure, Rumford Medal to Prof R W Wood, For Mem R S, in recognition of his distinguished work and discoveries in many branches of physical optics Davy Medal to Prof G Barger, F R S, in recognition of his distinguished researches on alkaloids and other natural products, Darwin Medal to Prof F O Bower, F R S, in recognition of his work of acknowledged distinction in the field in which Darwin himself laboured, Hughes Medal awarded jointly to Dr J D Cockcroft, F R S, and Dr E T S Walton, in recognition of their discovery that nuclei could be disintegrated by artificially produced bombarding particles

Lord Lugard, G C M G

A BRONZE statuette of Lord Lugard has been presented to the Imperial Institute by members of the Royal African Society as an addition to the collection of statuettes of empire builders in the Institute's galleries The presentation took place on November 7, when the statuette, which stands in the Nigerian Court, was unveiled by the Earl of Athlone, president of the Society, and formally accepted by Sir Harry Lindsay, director of the Institute The statuette which is half life size, is the work of Mr Herbert H Cawood, who has executed the effigies of Cabot, Van Riebeck, Raffles, and Livingstone in the collection Lord Lugard is the only living subject represented The presentation marks the fiftieth year since Lord Lugard's first service in Africa His brilliant success as an administrator of native affairs has been due to his application of the policy now known as indirect rule to tribal government in order to secure maintenance of law and order through the least disturbance of tradition by the imposition of civilized authority His book The Dual Mandate in British Tropical Africa (1922) not only gained him the award of the Gold Medal of the Royal Geographical Society, but immediately became a classic as Lord Athlone said in his address of presentation when he also spoke of Lord Lugard as the father of indirect rule Owing to his advocacy and the practical demonstration of its efficiency in Nigeria the principle of indirect rule with or without modification, has been extended to the other British colonial possessions in Africa In 1922-36 Lord Lugard was the British representative on the Permanent Mandate Commission of the League of Nations while as Chairman of the Council of the International Institute of African Languages and Cultures, he has inspired and guided a great work of scientific research on the peoples and languages of Africa

Miss Lise Meitner

MANY readers of NATURE will wish to join with her friends in offering their congratulations to Miss Lise Meitner on the occasion of her sixtieth birthday, which she celebrated in Stockholm on November 7 It is now more than thirty years since Miss Meitner left Vienna for Berlin to begin work on radioactivity with Prof Hahn, and throughout the whole of that period, both alone and in collaboration she has contributed as much almost as any one person to the subject to which she devoted all her energies During the years 1908–10, in collaboration with Hahn, she studied in detail the radiations from the active deposits of radium, thorium and actinium, obtaining the first indications of the existence of the C″ bodies and of the radiations from radium D. Between 1911 and 1915, with v. Baeyer and Hahn she studied the groups of β particles by the direct deviation method showing that α ray as well as β ray bodies give rise to such groups. After the Great War, Miss Meitner turned to the semicircular focusing method for the further study of the β ray groups, regarding them now as secondary radiations associated with γ ray emission, and was the first to maintain that in the process of disintegration the emission of radiation follows, rather than precedes the emission of the particle. Experiments on the long range α particles with Freitag on the heating effect of the β particles of radium E with Orthmann and on the scattering of hard γ rays in collaboration with Hupfeld, occupied the years 1926–32. Since 1932 Miss Meitner has devoted her attention more and more to studies of nuclear transmutation and artificial radioactivity. With Hahn and Strassmann she has investigated particularly the complicated series of bodies obtained by bombarding uranium and thorium with neutrons.

R.A.F. Long-distance Non-stop Record Flight

THREE R.A.F. Vickers Wellesley bombers, two of which landed at Darwin, Northern Australia, at 4 a.m. (G.M.T.) on November 7, have broken the world's long-distance record held by the Russian airmen who flew from Moscow to San Jacinto (California) a distance of 6,306 miles. The two Vickers machines covered a distance of 7,162 miles non stop, from Ismailia to Darwin while the third was forced to land at Koepang, Timor, 400 miles short of this, owing to lack of fuel. It afterwards completed the journey, arriving at Darwin at 7.36 a.m. Their speed averaged about 149 miles per hour, as compared with 102 miles per hour for the Russian record. The actual machines and their crews are a flight known as the Long Range Development Unit of the R.A.F., under the command of Wing Commander Gayford, specially charged with the duties of investigating service problems associated with long distance flying. Early in the flight, they flew in formation under the command of Squadron-Leader Kellett, but later they separated, the other two machines under Flight Lieutenants Hogan and Combe each flying independently.

THE aircraft are standard Vickers Wellesleys as supplied as bombers to R.A.F. squadrons, modified for very long distance flights, principally having greater fuel tank capacity. They are cantilever monoplanes built with Vickers geodetic method of construction. The exceptional lightness of this structure allows a correspondingly large weight of fuel to be carried within the limitation of their maximum weight. They are fitted with retractable undercarriages, totally enclosed cabins and all other devices for reducing their drag to a minimum, thus keeping the power required as small as possible. The Bristol Pegasus XXII engine with its very low fuel consumption, adding to these refinements, has given the combination that makes a flight of this length possible. The machines were fitted with automatic pilots, which relieve the pilots of much of the necessity for actually holding the controls on a long fixed course. Sleeping accommodation was arranged in the cabins, and the other two members of each crew, navigator and wireless operator, were qualified pilots, able to control the aircraft when required.

Planning for Defence

A BROADSHEET issued by PEP (Political and Economic Planning) entitled "Planning for Defence" directs attention to the necessity for fundamental thinking as to the values upon which the society that is being planned is to be based. The dangers of running a world by standards which are largely distorted for immediate material ends is clearly revealed by the events of September last, and realization of those dangers may well compel a reassessment of values, checking the drift towards opportunist materialism, and the evolution of a more explicit code of values on which the democracies and people in all countries who are not prepared to succumb to temporary illusions can take their stand as a basis for working towards a more tolerable human society. Simultaneously, specific thinking about the problems of a society and economy functioning under the shadow of war is urgently demanded and reinforces the case for eliminating waste in distributive services and elsewhere, the conservation of national resources, the adoption of economic operating units for public services and the rationalization or decentralization of some of the local government services or functions and staffs concentrated in London.

THE broadsheet suggests that such adjustment must be based on three principles: maximum efficiency (which in wartime might not coincide with efficiency in peace), the maintenance or even extension of ultimate democratic control, particularly in the economic sphere whatever special powers might be needed, and the framing of emergency measures so far as possible in accord with the long term needs of social and economic reconstruction. The importance of local self reliance is stressed, for an educated democracy requires both resolute leadership and information on which to base its judgment and actions. It will be necessary to think out very carefully the respective functions of the local committee or council, of the executive officers who perform the local service and of the officer who represents the requirements of the central government. While the central government would require decentralization, many local services require larger operating areas for efficiency. The broadsheet further refers to the need for public information, for rationalizing transport and distribution, for keeping a balance between demands and the normal economic life of the community. The structure of industry and especially the location of new plant present special problems, and, in regard to man power, one of the most serious problems is that of utilizing professional and technical workers. Nutrition policy and food control, land policy, the acquisition of development rights are other questions to which the broadsheet briefly directs attention.

Protection against Propaganda

Science Service of Washington, D.C., has published under the title "Propaganda Protection" a series of short articles forming an exposition of the methods and aims of war propaganda. The chemist and physicist are frequently criticized for discovering poison gases and high explosives, but without the will of the fighter the destructive compounds would be powerless. The aim of the propagandist is to make people willing to act in a particular way, and his general means are the arousal of emotion and the stifling of reason. The specific methods are the appeal to prejudice and hate by the use of slogans, by the demand for haste since delay may bring reason into play, by the use of statements that can neither be proved nor disproved, by concealing the source of the statements, and by persuading the hearer or reader to associate particular evils, for example, conspiracy, plotting, oppression, injustice, and particular virtues, for example, bravery, sympathy, humanity, patriotism, with some particular creed, party, or country. The propagandist knows the weaknesses of mankind and in many cases consciously exploits them for his own ends. The general methods are not new in the history of mankind, but the development of the means of communication by travel and radio has made all of us much more vulnerable to the propagandist attack. It is commonly asserted that more knowledge is the best immunizing agent against propaganda; but to be effective we need much more knowledge of our own mental make-up, as well as greater knowledge of facts outside ourselves. It is unfortunate that our knowledge of psychology lags so far behind our knowledge of other aspects of reality.

Physical and Mental Welfare Society of New Zealand

On July 22 last, a body known as the Physical and Mental Welfare Society of New Zealand was formally incorporated; the object of the Society is, broadly, to promote the application of current scientific knowledge to physical and mental welfare. The Society originated in a movement which has existed and operated throughout the Dominion for several years. It was promoted by a group of voluntary workers in the social services, under the leadership of Mrs. Ysabel Daldy, who has hitherto worked under the *noms de plume* of "Mother Machree" and "Silent Peter". In numerous weekly articles contributed to some twenty New Zealand newspapers, she has interpreted current scientific knowledge in its bearings on social welfare to the general reader in simple and attractive language, thus moulding public opinion and preparing the way for necessary reforms. She has been assisted by the "Silent Peter" group of specialist advisers, which is stated to include representatives of the medical profession and others well qualified severally to advise and write on health, nutrition, agriculture, education and some branches of science. Through her articles in newspapers and by correspondence with Government departments and with individuals, Mrs. Daldy has done valuable work in guiding and stimulating public opinion, and the increased opportunities afforded by the new Society of reaching the public by lectures, publications and other means, should enable this body of scientific opinion to exert its full influence in promoting the application of science to social problems in New Zealand.

Archæological Investigations in the Hadramaut

Further details of archæological investigations in the Hadramaut of southern Arabia were given by Miss G. Caton-Thompson in a lecture before the Royal Geographical Society on November 7, in which she described the results of the expedition undertaken by Miss Elinor W. Gardner, Miss Freya Stark and herself in the winter of 1937–38. The uniform, but crude character of the palæolithic industry of the region, to which she referred in her preliminary report (see Nature, 142, 139; July 23, 1938) was again emphasized. This industry falls well within the limits of the Levallois flake industry; but its crudity is strikingly apparent on comparison with the corresponding industries of Africa, North Arabia and Palestine. It represents a low ebb in contemporary standards, which Miss Caton-Thompson is inclined to attribute either to the influence of a harsh and impoverished environment, or possibly to the absence of technical stimulus from contact with more progressive groups such as, for example, might have been supplied from East Africa. The latter alternative postulates the separation at an early date in the Pleistocene or before of south-west Arabia from East Africa. The conception of an early marine separation of the two regions is reinforced by the fact that of the three culture groups classified morphologically by the hand-axe, the flake, and the blade industries, the hand-axe culture group, which covers practically the whole of Africa, failed, so far as the evidence goes, to reach south-west Arabia. The huge numbers of flint implements of Levallois type argues a *status quo* so far back as the middle or later Pleistocene. Of the evidence of plant life found in the tufa in the Wadi Luqrun, absence of structure makes identification impossible; but one is a species of *Celtis*, another type, the commonest, resembles the fig in leaf; and some kind of palm is certainly present.

The Government Laboratory

Seventeen thousand samples in excess of the number submitted in the previous year are recorded in the report of the Government Chemist as having been examined in the year ended March 31, 1938. The total number was substantially larger than half a million. The work of the Laboratory, however, is not to be measured by numbers alone, for it involves much research into the reliability of existing methods of analysis, and many investigations into new methods of detection and determination of substances. Further, the staff is constantly being consulted on technical matters, while, in addition, its members contribute notably to the advance of pure and applied chemistry both by publication and by personal service on numerous committees. In its analysis of the results of the examination of 848 samples of imported butter, the report shows that the water content of considerably more than half of the samples was between 15 and 16 per cent, the Reichert value of the fat varied from 24·0 to 34·0 (in 555 cases from 28 to 32), while the Polenské value varied from 1·0 to 3·35. Of 87 samples of tinned cream, 81 contained between 20 and 29 per cent of fat; of 127 samples of cheese, 17 per cent had been prepared from milk containing less than one half of its fat. In neither case is it at present possible to take exception to such importations. The examination of water included sea water studies for the use of hydrographers and biologists, on rivers in connexion with fish and fish food, and on water-cress beds in relation to the use of the national mark. Of 2,270 samples of brewing materials, 18 contained arsenic in slight excess of the accepted limit. It is satisfactory to learn that owing to the stringency of the tobacco laws and the high standard of the tobacco industry in Great Britain, adulteration is almost non-existent. The Laboratory has also been concerned with such widely different matters as the pollution of foreshores, the manipulation of radioactive materials, the carriage of dangerous cargo, and the work of the Bed-bug Infestation Committee.

Carrier Telephony

An instructive address on carrier telephony was delivered to the London Students' Section of the Institution of Electrical Engineers, on October 31 by its chairman, P. H. Pettifor. The frequencies present in the normal speech range are included between the limits 75–9000 cycles per sec., but for intelligible and 'natural' speech, it is only necessary for the listener to hear a very small portion of that spectrum, and in normal telephone practice the range lying between 300 to 2700 cycles per second only is used. This possible restriction in the range necessary for satisfactory speech is fully utilized in carrier telephony. The lower the frequency of the transmitted band the greater the number of channels which can be accommodated for that band. A carrier-current telephone system is one in which the normal voice frequencies are raised to a band of higher frequencies before being transmitted over the open-wire line or cable, conversion to the normal voice frequency band taking place at the receiving station. If different circuits have their voice frequencies raised by amounts such that the high-frequency bands do not overlap one another, then one cable pair can be used to transmit speech to several circuits, without the circuits interfering with one another. In this way the signals in several circuits can be transmitted over one cable pair without any interference taking place. The development of the principles of carrier telephony has been slow; the early experiments were made by Ruhmer in 1909, before the present-day thermionic devices were developed. A brief description was given of the post-War development in this field, including the latest cable design technique. Amongst the types of cable described was a cable containing a pair of air-spaced self-locating conductors. This type of cable is laid around London for television purposes. Another type containing four coaxial conductors has been laid between London and Birmingham. A similar coaxial cable containing only one coaxial conductor insulated with para-gutta has also been found very useful. With modern systems the level of cross talk between channels is practically negligible when compared with the normal voice frequency systems.

A 'New Deal' in Education

President Roosevelt's Advisory Committee on Education, appointed in September 1936, has presented a report (Government Printing Office, Washington, 1938. Pp. 244. 35 cents) on the whole subject of Federal relationship to State and local conduct of education. After a comprehensive study of the entire field of educational service, the committee found that there is great need for improvement of the public schools in a number of broad geographical regions and in the rural areas generally. To redress the existing gross inequalities of educational opportunity it submits a set of carefully articulated proposals forming, as is justly claimed, "a unified and coherent pattern of Federal policy" and involving a six years plan for Federal grants for educational services amounting in the aggregate to 1,200 million dollars. Most of the new grants recommended fall under the headings: general aid to elementary and secondary education, preparation of teachers and other educational personnel, school buildings, administration of State departments of education, educational services for adults, library service for rural areas. A system of co-operative research accompanied by demonstration projects throughout the country has proved its value in the field of agriculture, and the committee recommends the establishment of a special Federal fund for the immediate application of such a system in the field of education. In the first instance it would be utilized especially for elucidating in advance problems bound to arise in connexion with the operation of the six years plan for Federal grants.

The Colombo Museum

The administration report for 1937 of the acting director of the Colombo Museum, P. E. P. Deraniyagala, shows that in many directions the activity of the museum is maintained. Steady additions are being made to the zoological collections, notably by expeditions carried out by the staff or by the staff jointly with representatives of the British Museum, so that the director considers that the accumulation of material is now sufficient to justify the publication of detailed monographs. At the same time, attention ought to be directed to the public galleries, and the replacement of the misleading and faded specimens in the bird gallery would doubtless be appreciated by the half-million visitors who pass through the galleries each year and especially by the large number of school-children (12,288) who make use of the exhibits in the course of their nature study instruction.

A suggestion that the collection of living animals should be transferred to the Government Zoological Gardens at Dehiwala was strenuously opposed by the Committee of Management, and instead efforts are being made to improve and extend this museum zoo, which is an invaluable educational adjunct to the mounted collections. The Ethnological Department has begun a survey of the native population, and various expeditions have been carried out for a study of cultural institutions and social and economic conditions.

Trachoma in Tunisia

In a recent study (*Thèse de Paris*, 1938, No. 142), Dr. C. Koskas states that trachoma was probably imported into Tunisia by immigrants from North Africa, Italy, Malta and Spain. Although it is a notifiable disease, the natives, who do not recognize the gravity of the condition, evade the law, and comparatively few cases are actually notified. The only means of determining in any way the frequency of the disease is by medical examination of school children or of recruits for the army. There is no doubt, however, that infection rarely occurs in adults or in the schools; but that it is usually contracted in the early months of life. The incidence of the disease is much higher in the south where the climate is hot, the sirocco violent and frequent, the atmosphere laden with dust and sand, and the inhabitants poverty stricken and underfed than in the north of Tunisia. Flies play an important part in the transmission of the disease, as was shown by Nicolle and Cuenod in 1921, Petit in 1925 and Mme Delanoe in 1930; but race does not influence the incidence or gravity of the disease. Good work has been done by the establishment of ophthalmic departments where free advice and treatment are given.

Electrical and Allied Manufacturers' Association

The eleventh edition of a pamphlet giving information about the British Electrical and Allied Manufacturers' Association (BEAMA) has just been published. The president of the Association is the Earl of Derby. The objects of the Association are to foster and protect the electrical and allied industries in Great Britain. It aims at securing the co-operation of every firm in the electrical and allied industries so that, by co-operative action, it can speak for the whole of those industries on all matters affecting them. The Standardization Committee acts as a centre and clearing house for the many activities of its members in connexion with standardization and the British Standards Institution. The Association's numerous technical and other committees are continuously at work in the interests of the sections by which they are appointed and of the members generally. The address of the Association is 36 Kingsway, W.C.2.

Earthquake in Bulgaria on November 6

At approximately 21 h. G.C.T., an earthquake damaged property and felled chimneys in the Gabrovo district in north Bulgaria. Many people were alarmed, but no loss of life is reported. Bulgaria as a whole must be considered an earthquake country, though the north has not been subjected to so many as the south. The chief epicentral region in north Bulgaria is around Tirnovo, and the next in importance is the Déli-Orman. Further information concerning the shock will probably come shortly from Dr. K. T. Kiroff and his colleagues at the observatory at Sofia.

Japanese Earthquake of November 5

An earthquake was experienced in the Miyagi Prefecture in the north-east of the main island of Japan at 8 h. 44 m. G.C.T. (5.44 p.m. local time), and an after-shock followed two hours later. The focus appears to have been at some considerable depth, as the shock was felt in the four Prefectures of Miyagi, Iwate, Fukushima and Ibaragi, and even as far as Tokyo, though no damage is reported from this city. In this part of Japan there is a well-defined belt of earthquake epicentres stretching from Kamagata through Wakamatsu and Utsunomiya to Choshi. Severe earthquakes happened in the north end of this belt in 1893, 1894 and 1895, the last two from the same epicentre, though more recently strong earthquakes have been more frequent along parallel belts to the south, west, north, and seaward of this. The shock which was recorded on seismographs at Kew and elsewhere in Great Britain at 8 h. 55 m. 59 s. G.C.T. and mentioned in the general press in connexion with the above, was not due to the Japanese earthquake but was from some epicentre at about 87 from Kew, though the exact location is not yet determined.

Commonwealth Fund Fellowships

The total number of Commonwealth Fund Fellowships offered for award in 1939 is thirty four. These fellowships are tenable at certain American universities. Candidates for Ordinary Fellowships must be of British descent who are domiciled in the United Kingdom of Great Britain and Northern Ireland, and are degree graduates of recognized universities therein. Candidates for Dominion Fellowships must be of British descent from the British Dominions, who have studied, but not necessarily graduated, at a university in the United Kingdom of Great Britain and Northern Ireland, who are degree graduates of a recognized university in a British Dominion or Colony. Candidates for Service Fellowships must be of British descent and must hold appointments overseas under the British Government, or the Government of India, or the Government of a British Dominion, Colony, Protectorate or Mandated Territory; and those for Home Civil Service Fellowships must be holding appointments in the Home Civil Service. None of these fellowships is open to women. Further information can be obtained from the Secretary to the Committee, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

International Union of Geodesy and Geophysics

The International Union of Geodesy and Geophysics will hold its seventh general assembly in Washington, U.S.A., on September 4–15, 1939.

Invitations have been extended on behalf of the President of the United States to the participating countries to be represented by delegates on this occasion The American Geophysical Union is the American section of the International Union of Geodesy and Geophysics, and its executive committee is the Committee on Geophysics of the National Research Council The Council is collaborating with the American Geophysical Union as host to the assembly The last general assembly of the International Union was held at Edinburgh, Scotland, in September 1936 The thirty five nations at present adhering to the International Union are Argentina, Belgium, Brazil, Bulgaria, Canada, Colombia, Chile, Czechoslovakia, Denmark, Egypt, Finland, France, Germany, Great Britain, Greece, Holland, Hungary, Indo China, Italy, Japan, Morocco, Mexico, New Zealand Norway, Peru, Poland, Portugal, Rumania, Siam, Spain, Sweden, Switzerland, Union of Soviet Socialist Republics, United States, and Yugoslavia

Another Large Sunspot

The giant sunspot which crossed the sun s disk between October 5 and 18 broke up before its return due at the eastern limb on November 2 Meanwhile, another large spot had formed in solar longitude 273° and in latitude 9° south This spot came round the limb on November 4, though it was not completely seen until the following day, when its area was 2000 millionths of the sun s hemisphere The time of central meridian passage was November 10 8 U T , its date of disappearance around the western limb will be November 17

Announcements

Dr W D Lang, keeper of the Department of Geology of the British Museum (Natural History), is to retire on December 29 The principal trustees of the Museum have appointed Mr W N Edwards, deputy keeper of the Department, to succeed Dr Lang Mr Edwards was born in 1890 and was a scholar of Christ s College, Cambridge He entered the British Museum (Natural History) as an assistant in the Department of Geology in 1913 and became deputy keeper in 1931 He is an authority on fossil plants and has travelled extensively

Dr T S Wheeler, principal of the Royal Institute of Science, Bombay, has left India and will shortly take up his new appointment as State Chemist, Eire

Mr J Wickham Murray, secretary of the Association of Teachers in Technical Institutions, has been appointed an official for higher education by the executive of the National Union of Teachers

At the anniversary meeting of the Mineralogical Society on November 3, the following were elected officers *President* and *Editor of the Journal*, Dr L. J Spencer, *Vice Presidents*, Prof C E Tilley and Lieut -Colonel W Campbell Smith, *Treasurer*, F N Ashcroft, *General Secretary*, G F Claringbull, *Foreign Secretary*, Sir Thomas Holland

A symposium on ' Gas Temperature Measurement" will be held by the Institute of Fuel in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W C 2, on December 2 It will commence at 10 30 Further information can be obtained from the Secretary, Institute of Fuel, 53 Victoria Street, London, S W 1

The Royal Sanitary Institute Congress of 1939 will be held at Scarborough on July 3–8 and the Congress of 1940 at Torquay on July 1–6 Further information can be obtained from the Secretary of the Institute, 90 Buckingham Palace Road, London, S W 1

A fourth Farming Conference will be held at Oxford under the joint auspices of the School of Rural Economy, the Agricultural Economics Research Institute and the Institute for Research in Agricultural Engineering of the University of Oxford on January 3–5 1939 Further information can be obtained from the Conference Secretary, 10 Parks Road Oxford

The Far Eastern Association of Tropical Medicine will hold its tenth Congress at Hanoi, Tonkin, on November 24–30, when discussions will be held on feeding in deficiency diseases, cholera malaria, plague, tuberculosis, venereal disease surgery, diseases common to man and animals parasitology and local anthropological characteristics

The next International Congress of Surgery will be held in 1941 at Stockholm under the presidency of Dr Leopold Mayer

The Congress of Comparative Pathology will be held in Rome on May 15–20 1939 under the presidency of Prof Rondoni, director of the Cancer Institute at the University of Milan The following subjects will be discussed ultra virus diseases, heredity in pathology, the association of antigens and their function, regressive processes in plants The secretary of the Congress is Prof Zavagli at Consiglio Nazionale delle Ricerche, Piazzale delle Scienze, Rome, from whom further information can be obtained

The Home Secretary proposes to make regulations under the Factory Act 1937 extending the provisions of Section 66 to compressed air illness Copies of the draft regulations may be ordered through any bookseller from H M Stationery Office

The Pasteur Institute of Algiers, of which Dr Edmond Sergent is director, has been authorized by the French Government to sell a serum against scorpions prepared from immunized horses

Erratum In Nature, November 5, p 843 "Origin of the Solar System", last line of first paragraph, for "internal" read "external".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 879

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Formation of a New Phosphate Ester in Kidney Extracts

THE phosphorylation of sugars and glycerol in kidney extracts is increased by addition of fumaric or malic acid and this effect is caused by a stimulation of the tissue respiration[1]

If fumaric or malic acid is added to extracts from washed kidney pulp the phosphorylation, which is very slight in preparations without substrate is increased considerably and the respiratory rate is also accelerated Since these extracts are very poor in phosphate acceptors, it is most likely that fumarate and malate are converted through oxidation to a phosphate acceptor A more detailed investigation definitely established the formation of a new phosphoric ester quite different from the hexosediphosphate formed from glucose and fructose[2] The characteristics of the phosphoric ester formed from the oxidation products of malate agree completely with those of phosphopyruvic acid[3]

Kidney cortex from a fasting rabbit was minced and washed twice with two volumes of ice water The washed tissue was then ground with sand and extracted with an equal volume of *M*/15 sec phosphate which contained 0 2 per cent fluoride Aliquot parts (1 5 c c) were incubated in an oxygen atmosphere at 37° for 30 min

The phosphate analyses were calculated to mgm P in the entire extract

	O_2 uptake	P_{dir}	P_{alk}	P_{iod}	P_{merc}	P_{30}
Control (initial sample)		1 16	1 17	1 18		1 16
Incub without substrate	474	1 00	1 00	1 02		1 11
Incub with glucose 40 mgm	823	0 75	0 83	0 77	0 75	0 96
Incub with malate 15 mgm	720	0 78	0 78	0 98	1 00	1 12

P_{dir}	phosphate determined directly
$P_{alk.}$	phosphate after 20 min incubation in *N*/1 caustic soda
P_{iod}	phosphate after 20 min incubation in *N*/10 alkaline iodine
$P_{merc.}$	phosphate after 10 min incubation in neutral mercuric chloride
P_{30}	phosphate after 30 min hydrolysis in *N* 1 hydrochloric acid at 100°

The ester derived from malic acid has not been isolated, but since it is hydrolysed by mercuric chloride, which is a specific reagent for the hydrolysis of acetal esters, it is probably the phosphoric ester of the enolic form of pyruvic acid The phosphopyruvic acid could not originate from traces of sugars because fluoride inhibits the formation of this compound from phosphoglyceric acid The esterification product, however, contains no phosphoglyceric acid, since the P_{30} value indicates that no acid resistant ester is formed from malate. It therefore appears that the phosphopyruvic acid had its origin from oxalacetic or pyruvic acid derived from the oxidation of malic acid Malate is converted to carbohydrate in the kidney cortex[4], and it appears from these facts that phosphopyruvic acid is an intermediate in the formation of sugars from malate and lactate (cf Green[5], Meyerhof[6])

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Sept 22

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[1] Kalckar XVI Internat Congr of Physiology Zurich (1938)

[2] Kalckar *Enzymologia* 2 47 (1937)

[3] Meyerhof and Lohmann *Biochem Z* 273 60 (1934)

[4] Bencey M Baker Z and Elliott K *Biochem J* 31 1268 (1937)

[5] Green Needham and Dewan *Biochem J* 31 327 (19 7)

[6] Meyerhof Ohlmeyer and Möhle *Biochem Z* 297 90 (1938)

Diffusion of Phosphate Ions into Blood Corpuscles

WE find on shaking labelled (radioactive) sodium phosphate of negligible weight with blood, that phosphate ions quickly enter the erythrocytes In the course of three hours nearly half the phosphate ions present in the plasma of rabbit s blood diffuses into the corpuscles When labelled phosphate ion enters the cell, it becomes available for esterification processes Simultaneously non labelled phosphoric acid ester molecules decompose, producing non labelled phosphate which diffuses into the plasma, this process is going on incessantly There is thus a rapid interchange of phosphorus atoms between plasma and cells In *in vivo* experiments, using a newly developed technique[1], we find the same rate of penetration of phosphate ions into corpuscles as occurs *in vitro* In both cases, not all the acid soluble organic phosphorus compounds exchange their phosphorus for the labelled variety and it is of interest to note that a large part of the phosphorus esters which resist hydrolysis when heated for an hour at 100° with mineral acids do not become labelled in the course of a few hours

In order to compare the rate of diffusion of the phosphate ion and that of ester molecules, in some of our experiments we added labelled hexosemonophosphate (kindly presented to us by Prof Parnas) to blood We find that if hexosemonophosphate diffuses at all into cells, the rate is at least ten times less than that of phosphate ions In *in vitro* experiments, labelled hexosemonophosphate was found to be to a large extent decomposed, presumably by Robison's bone phosphatase present in blood The rate of hydrolysis is that of a monomolecular reaction, the velocity constant being 0 0024 $\min^{-1}$ The enzymatic decomposition of the ester also takes place in the absence of corpuscles In the intact animal, the blood comes in rapid and intimate contact with the large surface of bone tissue containing the enzyme and in *in vivo* experiments a rapid decomposition of hexosemonophosphate was observed In the course of an hour and a half, more than 99 9 per cent of labelled hexosemonophosphate injected into the vein of a rabbit left the circulation As mentioned in a previous communication[2] no labelled phosphatides, or at most only a minimal amount was formed in the blood, these substances being liberated from the liver and other organs into the circulation

A detailed report of our experiments is being published in the proceedings of the *Kgl Danske Videnskabernes Selskab Biol Medd* We wish to express our thanks to Profs Niels Bohr and Einar Lundsgaard for putting numerous facilities at our disposal and to Miss Hilde Levi for making the determinations of activity of the preparations

A H W Aten jun
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Sept 30

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[1] Cf Hevesy G Enzymologia (in the Press)
[2] Hevesy G and Rebbe O NATURE 141 1097 (1938)

Bone Tumours and Œstrone

RECENT experiments on mice from our sarcoma strain are producing results of sufficient importance to be communicated now although the experiments are by no means complete

We have shown[1] that there is a very marked sex difference in the incidence of bone tumours 77 3 per cent of the females and only 29 6 per cent of the males dying from this cause The mean bone tumour age for females is 15 3 months and for males is 17 7 months, the youngest tumour bearing female was five months and the youngest tumour bearing male was six months old

In an attempt to increase the tumour incidence in males, experiments with œstrogenic compounds were begun less than three months ago Through the generosity of the Organon Laboratories, we were supplied with a number of 5 mgm tablets of œstrone Young males between three and four weeks old, each received one tablet implanted subcutaneously into the left flank

During this last week a number of these animals have shown symptoms of retention of urine causing death in two cases, five other mice were killed before the symptoms became too pronounced Both the dead mice had enlarged pituitary glands, but the others seemed to be normal in this respect All the animals were undersized, and showed atrophy of the genital organs, retention of urine seemed to be due to prostatic enlargement One mouse had bilateral hydronephrosis

Three of the animals which were killed had bone tumours, one had osteomata of the right femur and right tibia, another had an osteoma of the right femur and two osteomata on the ribs, the third had an osteoma on a rib and early neoplastic changes in the right femur These mice were all 3–3 5 months old, the implants had been in position for about 2 5 months Another animal of the same age showed signs of early neoplastic changes in the femora, and the fifth mouse, only two months old and implanted with a tablet one month previously, had definite alterations in the right femur It is impossible without microscopic examination to say anything concerning the bones of the two mice which died, yet they appeared to be abnormal All the bones suspected of neoplastic changes will be examined microscopically, but there may be some delay before this can be done, of the gross changes there is no doubt

The implanted tablets were recovered from each animal and weighed it was found that each mouse had absorbed 20 000–30 000 international units of œstrone

Painting experiments are also in progress in which the animals receive a much smaller dose of œstrone An adequate number of control mice is being kept so far these show no sign of tumour formation

It is not suggested that as is probable in the case of mammary carcinoma, these bone tumours arise directly by the action of œstrone on the tissues concerned In this respect it is worth noting that the sarcoma strain has a much lower incidence of mammary tumours (14 1 per cent) than its parent Simpson stock (50 73 per cent) Recent work by Cramer and Horning[2], Zondek[3], and others shows that there is a close relationship and balance maintained between the different endocrine glands and a large overdose of one hormone may upset the balance and alter the rate of hormone production in other glands These experiments may provide evidence as to which gland is responsible for the formation of the hereditary bone tumours

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Oct 3

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[1] Pybus F C and Miller E W *Amer J Cancer* **33** (in the Press)
[2] Cramer W and Horning E S *Lancet* i 247 (1936)
[3] Zondek B *Amer J Cancer* **33** 5 (1938)

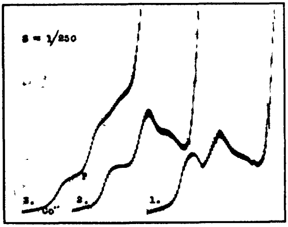
Polarographic Proof of Proteolysis in Diagnosis with Enzyme Reaction

DURING recent years, Fuchs's reaction has been widely applied for the diagnostics of malignant tumours Fuchs[1] has found that normal serum is able to decompose the fibrin prepared from carcinomatic blood on the other hand serum from a patient suffering from a malignant tumour decomposes the fibrin obtained from the blood of a normal individual He proved the proteolysis by the increase of the non protein nitrogen—a method proposed already by Abderhalden[2]—or by determining the ratio of carboxylic and amino groups before and after the proteolysis

The determination of the non protein nitrogen increase due to the proteolysis is the most delicate problem of this procedure, and often leads to difficulty in interpretating the experimental results On the basis of the polarographic investigations of proteins as carried out by R Brdička[3], a new way has been made possible by which the proteolytic cleavage can be followed exactly[4] Thus we applied Brdička's test which indicates the disulphidic or sulphydryl groups of proteins and their decomposition products, for the proof and measurement of the proteolysis

We followed in our experiments a modification of the original Fuchs reaction described by Chrometzka and Gottlebe[5], in which method the aseptic ultrafiltrate of the serum is used instead of serum We filtered the sera in the Tisen apparatus, which was carefully sterilized, through membrane filters "impermeable to proteins" and we used the filtrate for the modified Fuchs reaction It has been shown by the above-named authors that the proteolytic activity of the serum is increased when the serum is freed from proteins. A further advantage of using the serum filtrates consists in the fact that the liquid, after the proteolysis, does not need to be deproteinated Such a deproteination in the case of serum leads to the precipitation of higher proteolytic products with proteins, whereby the effect of the proteolysis is lessened.

We put 0·5 c.c. of the ultra-filtrate into each of three sterilized test-tubes The first sample served as a control, to the second sample 5 mgm. of fibrin prepared from the blood of a normal man was added, and to the third one the same amount of a carcinomatic fibrin After an incubation period at 37° C, the samples were filtered through a hard filter paper and a certain amount of the filtrates were mixed with an equal amount of the Brdička buffered cobalt solution These solutions were then submitted to polarographic analysis and the usual current-voltage curves were recorded. It should be mentioned that the fibrin filtrate alone does not show any protein reaction.



Polarographic evidence of proteolysis in the Fuchs modified reaction

Curve 1 Polarographic effect of the serum ultrafiltrate Curve 2 Proteolysis of carcinomatic substrate with carcinomatic serum (slightly positive) Curve 3 Proteolysis of normal substrate with a carcinomatic serum (strongly positive). The serum was taken from a patient suffering from Ca mammæ

The result of such an experiment is shown in the accompanying curves.

The first current-voltage curve, due to the ultra-filtrate in the Brdička buffered cobalt solution, proves that the membrane filter does let some small amount of protein substances, giving the Brdička protein test, pass through. Curves 2 and 3 are due to solutions of ultra-filtrates incubated with carcinomatic and normal fibrin respectively; in the test solution of ultra-filtrate where the proteolysis of fibrin took place, an appreciable 'double wave' (*P*)—the Brdička protein reaction—appears on the current voltage curve (see Curve 3), whereas in the ultra-filtrate which reacted with the corresponding substrate to a small extent only, this effect is slight (Curve 2). Thus it is evident that the proteolysis proceeds in both ultra-filtrates, but the effects differ in the height of the 'double wave' caused by the products of proteolysis Hence the height of this 'wave' indicates objectively the degree of proteolysis in a way similar to the determination of the increase of non-protein nitrogen, the latter method being beyond comparison more difficult from the technical point of view

From similar experiments—altogether fourteen have been carried out—it follows that the Brdička polarographic test for proteins and their decomposition products enables one to prove in a simple and exact way that proteolysis occurs in reactions of serum filtrates with substrates. A similar mode of procedure was used by Brdička and Klumpar[4] in their study of proteolytic cleavage of proteins with pepsin We believe that these findings will lead to far-reaching applications of the polarographic effect to various reactions based on the proteolysis of specific substrates It will be useful also for the study of different organic dysfunctions and physiological disorders

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[1] Fuchs, H J, *Biochem Z*, **170**, 76 **175**, 180 **176**, 32 (1926), **178**, 155 (1927)

[2] Abderhalden, E, "Abwehrfermente' (Berlin, 1922) ' Handbuch d biol Arbeitsmethoden" (Berlin, 1932)

[3] Brdička, R, *Collection* **5**, 112 (1933), *J chim Phys*, **35**, 89 (1938), Acta, Unio Internationalis contra cancrum, **3**, 13 (1938) Heyrovský, J, Nature **142**, 317 (1938)

[4] Brdička, R, and Klumpar, J, Čas čsl lékárnictva, **17**, 234 (1937)

[5] Chrometzka, F, and Gottlieb, P *Z exptl Med* **86**, 436 (1933)

Colorimetric Determination of *dl*-α-Tocopherol (Vitamin E)

Investigations of Evans[1] and Karrer[2] have demonstrated that α-tocopherol possesses reducing properties, so that it can be determined by potentiometric titration with gold chloride

Our colorimetric determination is based upon the reducing power of α tocopherol against ferric chloride The ferrous salt which is formed has been determined by us with α-α' dipyridyl The reaction is carried out in ethanol and the red colour of the ferrous-dipyridyl complex has been determined with a Zeiss-Pulfrich photometer (screen 50 and 1 cm. cell). The quantities of α-tocopherol which have been determined varied from 0 01 to 0·4 mgm.

We also have determined α-tocopherol (Hoffman – La Roche) by Karrer's potentiometric titration with gold chloride, and the two methods give results in good agreement. In both methods carotene may cause difficulties

Details and applications will be published elsewhere.

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[1] *J Biol chem*, **113**, 319 (1936).

[2] *Helv chim Acta*, **21**, 939 (1938).

Colour Reactions of Urine

A **sample** of urine containing about 2 per cent of free sulphuric acid and treated with certain oxidizing agents, as for example, potassium dichromate potassium permanganate, ammonium persulphate iodine or iron sesquichloride respectively (the latter two at a high temperature), produces a reddish pigment which may be destroyed even by a slight excess of those reagents A chromogen of urine which is responsible for this colour reaction is derived probably from some nutrient material for urine of carnivora (lion and wolf) develops only a brownish colour, while that of man and pig is an intense wine red and urine of herbivora (cow, horse and sheep), fed on a plant material containing photoxan[1], gives a rose red pigment[2]

This colour reaction may be very helpful in physiological investigations of metabolism, and also for certain diagnostic purposes

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[1] Kozlowski *Acta Soc Bot Pol* **15** 1 (1938)

[2] Kozlowski *Acta Soc Bot Pol* **15** 227 (1938)

Dioxymaleic Acid Oxidase

In a previous paper[1] two of us reported on the existence of a vegetable dioxymaleic acid oxidase We wish to correct our statement that this enzyme is not sensitive to cyanide The function of this catalyst, prepared from sorrel (*Rumex acetosa* L) by acetone precipitation of the juice of the leaves is inhibited completely by 0 0001 *M* hydrogen cyanide at *p*H 4, where the enzyme has a sharp optimum Comparative studies suggest that this ferment is one of the three basic ærobic oxidases of the vegetable kingdom, the other two being the polyphenol and ascorbic oxidase The enzyme oxidizes the acid reversibly the H being oxidized to H_2O_2

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[1] *Z physiol. Chem* **255** 57 (1938)

Artificial Production of Uranium Y from Thorium

Artificial radioactivity induced in thorium by neutron bombardment has been studied by various authors[1] Meitner, Strassmann and Hahn[2] especially have recently published the results of their detailed investigations, according to which they ascertained the production of a thorium isotope ^{233}Th (26 min) and three isomers of a radium isotope ^{229}Ra ($<$ 1 min , 15 min and about 4 hours)

We have also been studying the same problem for some time, and so far as the above results are concerned, we seem to be in general agreement with the last-mentioned authors Besides these isotopes, moreover, we obtained another thorium isotope which we identified with uranium Y, the parent substance of protactinium, the thorium series thus being changed over to the actinium series

Thorium nitrate, carefully freed from mesothorium as well as from other disintegration products except radiothorium, was exposed to fast neutrons which were produced by bombarding lithium with 3 Mv deuterons obtained by means of our cyclotron After the exposure, which ranged from three to fifteen hours thorium was chemically separated from the sample This showed two periods of β decay, one of which we identified with that of ^{233}Th as above mentioned

The other period of 24 5 hours was surmised to be due to a thorium isotope which was produced from thorium through loss of neutrons This ought to give uranium Y according to the following reaction

$$^{232}\mathrm{Th} + {}^{1}n \rightarrow {}^{231}\mathrm{UY} + 2\,{}^{1}n$$

In fact the above period coincides with that of uranium Y (24 6 hours) in accordance with our supposition

The sign of the β rays was shown to be negative and the measurements of their absorption in aluminium gave an absorption coefficient of 246 per cm which is not very far from 300 per cm found by Antonoff, and lies between 52 95 and 585 per cm, given for two components by Erohova[3] All these facts support the above conclusion The detailed account of the experiments will be published elsewhere

We wish to express our thanks to the Japan Wireless Telegraph Company for the electromagnet and other pieces of equipment used for the cyclotron, and to the Mitsui Ho onkwai Foundation and Tokyo Electric Light Company for financial support

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[1] Fermi E Amaldi E D Agostino, O Rasetti F Segré, E , *Proc Roy Soc* A **146** 483 (1934) , Hahn O , and Meitner L *Naturwiss* **23** 320 (1935) Amaldi E , D Agostino O Fermi E Pontecorvo B Rasetti F Segré E *Proc Roy Soc* A **149** 522 (1935) , Curie I v Halban H , and Preiswerk, P *C R* **200** 1841, 2079 (1935) *J Phys et Rad* 7 361 (1936) Rona, E and Neuninger E , *Naturwiss* **24**, 491 (1936) *Mitteil Inst Radiumforschung* No 384 479 (1936)

[2] Meitner L Strassmann F and Hahn O *Z Phys* **109** 538 (1938)

[3] Erohova *J Phys* **8** 501 (1937)

Magnetic Properties of Superconductors

Using a ballistic method, we have measured the magnetization curve of the superconducting alloy Au_2Bi , for a specimen built up of separate small crystals we obtained the curve in Fig 1 It will be seen that there is practically no 'tail' to the curve, and that the hysteresis is much less marked than for a typical superconducting alloy , in fact, the magnetic behaviour approximates to that of an 'ideal' superconductor Such hysteresis as there is, is probably due to very slight impurities in the specimen, rather than to the irregular shape, since a similar specimen made up of small irregular lumps of very pure tin (an 'ideal' superconductor) showed much less hysteresis

Since Au_2Bi is an alloy of definite composition (it is not soluble in either gold or bismuth[1]), this resemblance to the behaviour of an 'ideal' superconductor confirms the view that the anomalous

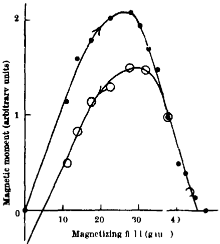

Fig 1

behaviour of superconducting alloys is due not to the fact that they are alloys but to some secondary cause such as inhomogeneity of composition

In Fig 2*a* we show the *H T* curve obtained for Au_2Bi, and it will be seen that the H_c values are considerably lower than those obtained in Leyden from resistance measurements on the Au Bi eutectic[2] and that the transition temperature of our specimen (about 1·73° K) is lower than that found in Leyden (1·84° K) These discrepancies may be due to the presence of very fine threads of Au_2Bi (separated from each other by free bismuth) in the eutectic, which, on account of their thinness may perhaps remain superconducting at higher fields and temperatures than the crystals used in our measurements

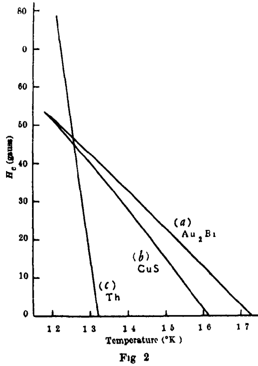

Fig 2

We did not succeed in obtaining ideal behaviour in the case of the superconducting compound CuS (this may have been due either to insufficient purity of the constituents, or to the presence of Cu_2S in our specimens), although there was a marked hysteresis, the 'tails' of the magnetization curves were not very pronounced, and it was possible to determine the critical field at different temperatures The $H_c T$ curve is shown in Fig 2*b*, and the transition temperature (1·61° K) agrees with that found by Meissner[3] It will be noticed that both Au_2Bi and CuS have low values of dH_c/dT, of the same order of magnitude as the soft group of superconductors[4], this may be connected with the fact that in the case of both these alloys the two components lie immediately on one or the other side of this group in the periodic system

While testing the measuring apparatus we measured also the $H_c T$ curve of thorium (not previously measured) shown in Fig 2*c* As with all the other hard superconducting elements dH_c/dT is considerably higher than for the soft superconductors[4], and also (probably due to impurities) the magnetic behaviour resembles that of a typical alloy rather than of an 'ideal' superconductor The difference between the transition temperature of our specimen (1·32° K) and that found by Meissner[5] (1·49° K) is probably due to difference of purity

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Sept 10

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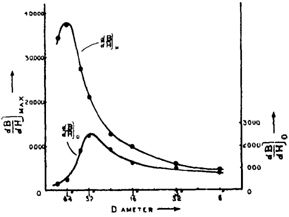
[1] J rriaanse *Z Krist* **90** 3 (193)
[2] J Haas van Aubel I V g I *Leiden Comm* 1 b (19 9)
[3] Meissner *Z Phys* **58** 5 0 (19 9)
[4] Daunt and Mendelssohn *Proc Roy Soc* A **160** 127 (193)
[5] Meissner *Z Phys* **60** 181 (193)

Magnetic Quality of Iron Wire as influenced by the Diameter

In a previous note[1] the results were given of tests on Armco iron wire of various diameters when heated in hydrogen to a condition of maximum permeability at a temperature of 1 200° C A number of the magnetization curves so obtained have been analysed and the values of the maximum slope $\left.\frac{dB}{dH}\right]_{\max}$, and



also the values of the slope at the origin, $\left.\frac{dB}{dH}\right]_0$, respectively, have been plotted as a function of the diameter of the wire In this way the two curves shown in the accompanying graph have been obtained

Each of the curves has a well defined maximum value, and the general character of each curve can be accounted for if it be assumed that (i) the wire has a magnetically hard surface layer, (ii) the process of magnetization commences at the surface of the wire and proceeds progressively towards the axis by a kind of chain effect, so that the magnetic induction is greatest near the surface and progressively decreases towards the axis of the wire

Further tests are being carried out at higher temperatures, and a full account of the results will be published elsewhere in due course

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[1] NATURE 141 [illegible]0 (Jan 29 1938) also *The Engineer* June 24 1938

Diffraction Patterns Produced by Surfaces in Sunlight

THE reflection of sunlight from various surfaces, including those of finger nails, skin, paper wood, plant leaves, and glass slides covered with thin films of dried blood, produces mosaic like varicoloured patterns which yield to the unaided eye an impression of the presence of many small but discrete coloured granular particles The coloured mosaics are particularly brilliant when the surfaces are viewed near grazing incidence, although in some instances the effect is clearly evident from other angles Such patterns are not evident on the polished surface of glass The optical irregularity of the former surfaces is commonly evident to the unaided eye only by the generalized cloudiness or haziness The mosaic pattern is readily seen when the reflecting surface, adjusted to an appropriate angle, is placed at a distance of approximately four to fourteen inches from the eye At greater distances the detail of design is lost At lesser distances the chromogenic features are not apparent An illusion of flow of the coloured 'particles' is produced by slight tilting of the surface while under observation It thus appears as if different groups of surface projections come into play with a resultant rearrangement of the coloured spots

The production of coloured patterns by reflection of white light from surfaces is a commonly recognized phenomenon However, the mosaic effect produced by the above mentioned surfaces is different, in appearance at least, from those which have been described previously Among the well known colour effects produced by reflection are the colours of striated surfaces and the colours of fine laminar structure The former, usually seen as a pattern of concentric rings upon the finely scratched surface of glass and metal, was attributed by Tyndall[1] to interference of light reflected from the opposite sides of the furrows or scratches The coloured areas seen in certain shells and pearls are associated with fine laminar structure and are attributed to the class of phenomena associated with Newton's rings There is a conceivable similarity of the colours of the mosaic to those produced by reflection of light through multi layers of surface films spread on metal plates[2], except that in the former instance the areas of a given thickness are extremely small and the reflecting foci are tilted at different angles, hence the mosaic like effect

The fact that the mosaic effect appears in sunlight and in light from distant incandescent lamps, while not in light originating from a nearby source, suggests that the phenomenon is to be classed with the Fraunhofer diffraction phenomena[3]

The mosaic pattern is apparently a consequence of the mutual interference of diffraction bands produced when parallel light rays strike the small component parts of certain surfaces This regularity of the chromogenic interference mosaic for certain materials provides additional means of characterizing the structure of such surfaces

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Sept 9

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[1] Tyndall J Lectures on Light (D Appleton and Co N Y 1873)

[2] Langmuir I Schaefer V J, Built up Films of Proteins and their Properties *Science* 85 76 (Jan 15 1937)

[3] Wood R W Physical Optics (new and revised edition The Macmillan Co New York 1929)

Cause of Earthquake Ruptures

AT present there is no established theory of the cause of earthquake ruptures because of their diversity Observations in Cordoba of the San Luis shocks of May 1936, including records on a sensitive Richard barograph at the National Observatory, have suggested that this diversity of behaviour is due chiefly to differences of depth, of dip and strike of the faults, and that barometric pressure is often the final actuating cause which determines the hour and perhaps the day

Actual cracks observed in the surface in many places confirm that the underlying conditions in the tectonic type of earthquake is an accumulation of strains along geological faults in the earth's crust, the sudden release of which produces the shock Whatever the position and direction of these strains, the gravitational pressure of the masses must tend to hold the surfaces together Without gravitational pressure, no strain could accumulate A sufficient *release* of such pressure will cause a rupture Confirmation of this is found in the cases where shocks have occurred chiefly at low tide

Tidal stresses caused by the sun and moon are alone capable of effectively decreasing these pressures Nearly all extensive series of observations have disclosed a slight preference for times of new and full moon The San Luis earthquakes referred to suggested that in deep shocks, where the gravitional pressure of the mass above was greatest, the connexion was closer than in shocks nearer the surface

To test this point, the most destructive shocks, fifty-nine in number, in the past three centuries, for which data could be found, and forty heavy shocks reported in the past two years, were examined In both these groups, approximately eighty per cent showed preference for the times of new and full moon

These same shocks showed a preference for the times of lunar perigee Extensive series of after-shocks in the disastrous earthquakes of 1891 in Gifu and 1897 in Assam show preferences during several months for the times when new and full moon occurred near perigee.

These facts establish a definite relationship with sun and moon which can only be interpreted as gravitational. From its nature gravitation, if present in some cases, must be present in all whether its effects are directly noticeable or not. Differences of dip and strike in the faults can account for deviations from new and full moon. Evidence confirmatory of this explanation is found in the Inverness earthquake of 1901 and those generally in Calabria and Japan.

Existing evidence appears sufficient to establish the thesis that *the ruptures due to earthquake stresses about geological faults are due primarily to the gravitational action of the sun and moon*

Shocks recorded in Cordoba during or just after sharp diurnal or sporadic 'lows' of the barometer suggest that these are the final controlling factor which in many cases determines the hour and even day.

A gravitational theory permits the prediction of the majority of heavy destructive shocks within two or three days

C D Perrine.

Cordoba.
Sept. 11.

Biological and Cytological Observations on Tenthredinid Parthenogenesis

During the past three years, I have made certain findings regarding two species of Tenthredinidæ, and as their detailed publication will be delayed owing to my departure abroad, I take the opportunity to state them briefly

It is well known that the species *Pristiphora pallipes* Lep reproduces by thelytokous parthenogenesis but very occasionally produces males. The chromosome constitution of the female is 16, as determined from oogonia, follicle cells, and embryo cells, that of the male appears to be 8, from spermatogonia and second spermatocytes

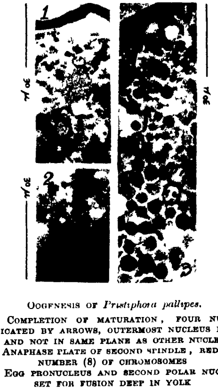
In oogenesis there are two maturation divisions (Fig 1) That reduction takes place in the first division is indicated because 8 chromosomes are found in the second anaphase (Fig. 2). These chromosomes appear double at times and this, along with the fact that the second division follows immediately after the first, can be taken to mean that the chromosomes are split ready for this second, equational, division. The result of these divisions is that four nuclei are formed in line (Fig. 1) Later, the female pronucleus and second polar nucleus approach and lie pressed together, deeper in the yolk, as if for fusion (Fig. 3).

These facts therefore indicate that egg maturation is similar to that of normal bisexually reproducing animals, and that the diploid condition is restored by fusion of egg pronucleus and second polar nucleus, a condition comparable to that already known in certain other animals showing obligatory (for example, *Artemia*), facultative (for example, *Lecanium*), and experimental (for example, *Asterias*), parthenogenesis The maturation appearances up to the four nuclear stage are similar to those figured by Doncaster[1] for *Pteronidea* (*Nematus*) *ribesii* Scop., but my findings regarding the fusion of the female pronucleus and the second polar nucleus are new.

Further support for my interpretation is seen from such details of the prophase stages of meiosis as I have worked out, leptotene, synizesis, and pachytene all appear to be normal, although the pairing of chromosomes has not yet been detected with certainty

An interesting fact concerning the first polar nucleus is that in several cases spindles have been observed which, from their position, appear to be the fusion product of the daughters of the first polar nucleus The appearances are similar to Doncaster's 'fusion nucleus', which he considers is formed from the second polar nucleus and the inner daughter of the first polar nucleus.

More than 1,700 eggs were examined, about 943 (54 per cent) proving of use Of the latter, 191 gave first division stages, 106 those of the second division, 254 the four nuclei stage, and 94 gave fusion stages. The other 298 are as yet unclassified



Oogenesis of *Pristiphora pallipes.*

1 Completion of maturation, four nuclei indicated by arrows, outermost nucleus faint and not in same plane as other nuclei.

2 · Anaphase plate of second spindle, reduced number (8) of chromosomes

3 Egg pronucleus and second polar nucleus set for fusion deep in yolk

A 'gynandromorph' showing complete male external genitalia and almost complete but distorted female external organs was also found. The gonads and internal genitalia were male in appearance. Again, a larva, the gonads of which were female in gross appearance, contained what appear to be male cells.

In the second species, *Priophorus tener* Zad., rearing experiments with six unmated females from wild larvæ gave only males However, three other unmated females from wild larvæ produced only females (six larvæ and seven flies), and from four of these another generation of parthenogonic females (four) was obtained. The oogonia showed 12 chromosomes and the spermatogonia 6. The mechanism of chromosome number control is unknown in this case. This adds another example to the few species already known to be not exclusively arrhenotokously or thelytokously parthenogenetic[2] It is evident that the biology of saw flies will well repay further study

Thanks are due to Prof A D Peacock, under whose supervision I have worked for the provision of certain material to Dr Ann R Sanderson for the benefit of her experience in similar work and to Mr A T Baxter for laboratory assistance

LESLIE C COMRIE

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[1] Doncaster L Quart J Micr Sc 49 (1906) and 51 (1907)

[2] Peacock A D *Tijdsch Entomologie* 81 (1938)

Nitrogen Fixation by Blue Green Algæ

IN India rice is grown on the same land for many years without the addition of manures to the soil Preliminary experiments have shown that a considerable amount of nitrogen is fixed in the soils of the rice fields under water logged conditions when there is an abundance of algal growth (especially Blue green Algæ) present With the object of investigating the role of the Blue green Algæ, a number of species of *Anabæna* as well as *Phormidium foveolarum* were isolated in unialgal culture from the soil of an Indian rice field The last as well as three species of *Anabæna* were afterwards obtained in pure culture altogether devoid of bacteria and other contaminating organisms by a method analogous to that employed by Pringsheim (1913) These cultures have been tested by the Bacteriological Department at the Rothamsted Experimental Station and pronounced free from bacteria

Inoculations from these pure cultures grown in mineral solutions lacking nitrogen (apart from that contained in minute traces of soil extract), showed that, while the *Phormidium* has no capacity for fixation of nitrogen, the three species of *Anabæna* are able to fix considerable quantities averaging 3–5 mgm of nitrogen per 100 c c of medium in about two months The amount of nitrogen fixed by the Algæ in the presence of *Azotobacter* and other bacteria is the same as in the pure cultures from which it appears that bacteria play a relatively unimportant part in nitrogen fixation in the rice fields

The effect of the presence of various organic compounds on the process has been examined Certain soluble carbohydrates (arabinose maltose raffinose inulin and dextrin) have a decidedly inhibiting effect on nitrogen fixation, but the process will go on in the presence of soluble nitrogen compounds Iron is not essential for nitrogen fixation

Diverse workers (Molisch 1926, Vouk and Wellisch 1931, Copeland 1932) have previously affirmed nitrogen fixation by Blue green Algæ, but the evidence as to the purity of their cultures is not adequate Drewes (1928) and Winter (1935) used several bacteriological agar media to test the purity, but the evidence is inconclusive, since on such media in the presence of Algæ, there may be no visible growth of bacteria although present A similar criticism applies to the researches of Allison and co workers (1932 and 1935)

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Oct 14

Normal Dentition of Sharks

WHEN the teeth of the various rows in the jaw of *Carcharias melanopterus* at different ages are compared, one observes an exposed row of teeth slightly smaller than the unerupted ones behind it and incomplete hindermost rows of what appear to be vestigial remains of teeth which can never come into use Mr G P Whitley, of the Australian Museum, has kindly referred me to Gudger and Smith s memoir[1] on the most primitive shark *Chlamydoselachus*, and notes unfortunately the problem of their replacement has not been touched upon else considerable light might have been thrown on the matter From fossil sharks too there are no apparent data on this point

In this memoir which I have seen from the South African Museum the small teeth of *Chlamydoselachus* are regarded as employed for retaining the food that is seized rather than for chopping off pieces like the broad teeth of *Charcharodon* and *Galeocerdo*

If the exposed teeth of these latter were constantly shed and replaced from the unerupted teeth one would expect to find in an adult the largest teeth exposed or lacking in seriation through constant use

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[1] Gudger E W and Smith B G Natural History of the Frilled Shark *Chlamydoselachus anguineus* Bashford Dean Memorial Volume Art V 23 277 (1933)

Mesotron (Intermediate Particle) as a Name for the New Particles of Intermediate Mass

THE existence of particles intermediate in mass between protons and electrons has been shown in experiments on the cosmic radiation[1] Since at present so little is known concerning the properties of these particles, for example the exact value of the mass the laws governing their production their stability against disintegration etc it may yet be too early to assign to them a name But inasmuch as several names have already been suggested, namely dynatron penetron barytron, heavy electron yukon and x particle it may be wise to consider the matter at this time

The property which so far serves to distinguish the new particles from the other two types of particles which carry the same magnitude of electric charge, namely the proton and the electron seems to be the magnitude of their mass Although from the experiments so far performed it is not possible to say definitely whether the new particles exist with a unique mass only, or whether they occur with a range of masses it does appear quite certain that the mass, whether unique or not is greater than that of an electron and less than that of a proton One must consider then three types of particles all carrying electric charges of equal magnitude electrons, the new particles and protons We should like to suggest therefore the word mesotron (intermediate particle) as a name for the new particles It appears quite likely that the appropriateness of this name will not be lost, whatever new facts concerning these particles may be learned in the future

CARL D ANDERSON
SETH H NEDDERMEYER

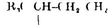
California Institute of Technology,
Pasadena Sept 30

[1] For historical summary see Wentzel G *Naturwiss* 26, 273 (1938), and Bowen Millikan and Neher footnote *Phys Rev* 53 219 (1938)

Free Radical Terminology

SOME confusion appears to be creeping into the literature with regard to the designation of molecules which function as free radicals Some authors for example, describe methylene $H_2C=$ as a diradical and the next step presumably will be to term methine $HC\equiv$ a triradical This is certain to lead to confusion, since methylene contains a carbon atom with an electron sextet, while a diradical such as $-CR_2-CR_2\ CR_2-$, contains two carbon atoms with an electron septet or free valence Accordingly, methylene with its electron sextet should be regarded as a bivalent radical It is true that oxygen, in virtue of its high paramagnetism is considered to be a diradical but this refers to the oxygen molecule, O–O–, with each atom carrying a free valence

The terms odd molecule' and even molecule have now lost much of their original significance, since we are now familiar with even numbered diradicals and also with charged molecules containing an unpaired electron Thus the molecule



$$R_3C\ \underset{|}{C}H-CH_2\ CH_2$$

is an even molecule since it contains an even number of electrons In view of the fact that it is both an ion and a free radical it is conveniently termed an 'ion radical' This serves to avoid confusion with the terms radical ion and ionized radical, which have long been in use to designate the triarylmethyl ions, R_3C^+ and R_3C and inorganic ions such as NH_4^+ and ClO_4

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Oct 21

Points from Foregoing Letters

A TABLE showing the amount of phosphate which enters into combination, in presence of oxygen, when glucose or malate is added to minced kidney cortex of a fasting rabbit, is given by Dr H Kalckar The author concludes that malic acid is oxidized to pyruvic acid which combines with phosphate to form phosphopyruvic acid, as an intermediate step in the synthesis of sugars

Experiments with labelled radioactive phosphate injected into the blood stream show, according to A H W Aten, jun, and Prof G Hevesy that there is a rapid exchange of phosphorus atoms between plasma and cells that is, between inorganic phosphate and the phosphoric ester in the red blood corpuscles Hexosemonophosphate penetrates the cells less rapidly but is decomposed within an hour in the blood stream by an enzyme derived from the bones

F C Pybus and Miss E W Miller report that œstrone tablets, weighing 5 mgm each, were implanted subcutaneously into young male mice belonging to a strain in which 77 3 per cent of the females and 29 6 per cent of the males develop bone tumours Three of these mice have developed osteomata at the age of 3–3 5 months, 2 5 months after the tablets were implanted, the bones of two others showed definite early changes The average tumour age in males is 17 7 months, and the earliest tumour in an untreated male appeared at the age of six months

A M Kotljar and V Podroužek submit polarographic curves' indicating that the method can be conveniently used to detect the products of protein break up, such as are formed when normal serum is added to fibrin from a cancer patient, or vice versa

By exposing thorium nitrate to fast neutrons, obtained by bombarding lithium with 3 Mv deuterons, Dr Y Nishina, T Yasaki, Prof K Kimura and M Ikawa have produced a radioactive substance with half-period and beta ray penetrating power identical with those of uranium Y, parent of the protactinium series

The magnetization curve of superconducting Au_2Bi has been measured by Dr D Shoenberg, and it is found to resemble that of an 'ideal' superconducting element rather than that of a typical alloy Since Au_2Bi, unlike most superconducting alloys, has the same composition and structure throughout its volume, it is inferred that the anomalous properties of most superconducting alloys are connected with inhomogeneity rather than with the fact that they are alloys

The relationship between the diameter of iron wire and the maximum slope and the initial slope respectively, of the magnetization curves after the wires had been heated to a condition of maximum permeability have been obtained by Dr T F Wall The results obtained imply that the process of magnetization commences at the surface and proceeds progressively towards the axis

Out of 59 major earthquakes during the last 300 years, eighty per cent occurred at the time of new or full moon C D Perrine considers this as evidence in favour of the view that the time when ruptures due to earthquake stresses about geological faults take place is determined by the gravitational action of the sun and moon the tidal action of which brings about the rupture by releasing the pressure

L C Comrie finds in the thelytokously parthenogenetic saw fly, *Pristiphora pallipes* Lep that the diploid number in the female is 16, that in the rare male 8 In oogenesis there occur two maturation divisions, reduction, and the subsequent juxtaposing of pronucleus and second polar nucleus, which usually indicates that diploidy is restored by fusion of these nuclei Two sexual abnormalities have been found In the species *Priophorus tener* Zad, both arrhenotokous and thelytokous parthenogenesis have been discovered, the female and male counts are 12 and 6 respectively

Prof F E Fritsch and P K De report that pure cultures of the Blue-green Alga *Anabæna* found in Indian rice fields, has been shown to have the property of fixing nitrogen from the air, and they claim that this is the first conclusive proof of the ability of a Blue green Alga to do so

Dr S T Bowden directs attention to the confusion which is prevalent concerning odd and even molecules, and the application of the terms radical and diradical He suggests that a molecule carrying both a charge and a free valence be called an ion radical in order to distinguish it from the ionized radical and radical ion

Research Items

Indian Culture and the Native States

PROF. L. F. RUSHBROOK WILLIAMS, in an address to the Royal Society of Arts on the cultural significance of the Indian States (*J. Roy. Soc. Arts*, **86**, Sept. 16, 1938) stressed the position of the States as embodiments of traditional Indian conceptions of socio-political organization, and hence important for the rightful understanding of India's political development. No Government has ever ruled the country from a single centre. Under every Indian empire there have been numerous subordinate kingdoms performing many of the most essential functions of government in territory nominally under imperial control. There are certain fundamental differences between the Western and the Indian views of the State. In Indian ideas, the State deals with the individual, not as such, but as a member of overlapping communal or local groups carrying out many forms of corporate action, which the State cannot compass but essential for the well-being of the citizen. Hence India is a country of communities—village communities, castes or guilds, and the joint family—and it is only recently that the State has taken over such functions as police, education, or poor relief. Before British rule, the State scarcely came into contact with the individual. The political separatism resulting from these social institutions has been powerfully reinforced by the different cultures, races and languages, which have poured into India since historic times. The subordinate States have played an important part in crystallizing these socio-political institutions, and as supporters of the traditional arts of India which, but for them might have perished in the pursuit of Western ideas and culture under the British *raj*.

Properties of the Protoplasmic Membrane

IN a recent review of the literature, Harvey and Danielli (*Biol. Rev.*, 13, 319; 1938) propose a relatively simple model of the surface layers of the cell, based on their physical properties. The tension of the surface lies between 1·0 and 0·1 dynes/cm., which is too low for a simple oil-water interface. The presence of an adsorbed protein film is shown, however, materially to reduce the interfacial tension. On this and other grounds, it is suggested that the surface of the cell involves, as a minimum, a bimolecular layer of lipoid molecules between two layers of protein molecules. Measurements of the thickness of the surface film (about 50 A.), of its permeability, and of its wetting properties are found to be compatible with this model. A simple explanation is given of the Na-Ca type of antagonism in terms of the acidic groups of the protein and lipoid films. Thus, on the alkaline side of the iso-electric point of the membrane cations will be adsorbed to form salts. It is well known that water is less soluble in the calcium salts of the probable active groups (carboxyl, phosphate, sulphate) than the sodium salts. High temperature coefficients of penetration are also explained without the necessity of the intervention of chemical processes. The membrane allows for preferential absorption of lipoids, and for pore and mosaic effects.

Histamine and Tyramine in Lung Diseases

J. L. HERRENSCHMIDT (*Thèse de Paris*, No. 634, 1938), has made a study of histamine and tyramine in the blood of thirty-one cases of respiratory disease including pulmonary tuberculosis, and comes to the following conclusions: (1) Severe ulcero-caseous tuberculosis is as a rule accompanied by an excess of tyramine and a normal amount of histamine in the blood. (2) In cases of tuberculosis complicated by hæmoptysis, involvement of the pleura or allergic or cutaneous manifestations, there is little change in the tyramine content but always an excess of histamine in the blood. (3) Broncho-pulmonary suppuration is usually associated with a rise of tyramine and in many cases also of histamine in the blood, and there is always an appreciable or considerable proportion of these two substances in the sputum. (4) In tumours of the lung there is always a considerable quantity of tyramine in the blood. (5) In asthma there is a large quantity of histamine in the blood during an attack and a normal quantity apart from the attacks. The tyramine is normal throughout.

Synthetic Preparation of Ephedrine

THIS alkaloidal drug is obtained from a shrub growing in a small area near Tientsin, China, and since the recent hostilities in China its price has fluctuated widely. Thus attention is directed to efforts to synthesize the drug, upon which Dr. J. Kamlet of the Israel Zion Hospital, New York City, reported (according to Science Service) at the meeting of the American Chemical Society at Milwaukee in September 1938.

Maturity of Salmon Parr

IT has long been known that male salmon parr may mature before leaving the river. These fish were regarded by some as precocious males and it was not known to what extent maturity was normal. An examination of parr has been made recently in the Welsh Dee (J. H. Orton, J. W. Jones and G. M. King, "The male sexual stage in Salmon Parr (*Salmo salar* L. juv.)", *Proc. Roy. Soc.*, B, **125**, 103-114, 1938). The results showed that 40 per cent of the population of two- and three-years old salmon parr became sexually mature in October 1937. Successful fertilizations were made in November. There is some indication that the parr spawn on the redds before migrating to the sea as smolts. It is suggested that all or most of the males normally attain their first sexual maturity in the river before migrating to the sea. This interesting observation should be followed up by similar work on other rivers.

Insects in Petrified Wood

EVIDENCE of ancient insect activity has lately been brought to light in the fossilized logs of Triassic age found in the Petrified Forest National Monument, Arizona, U.S.A. In many of these fossil trees there are ridges, channels and tunnels which seem to represent the burrows of larvæ of certain beetles. Some of these are channels just under the bark and appear to be the work of Scolytidæ Others take the form of tunnels into the heart wood and are perhaps the work of Buprestid or allied beetles The only species of tree attacked is *Araucarioxylon arizonicum*, and it seems probable that many were killed as the result of girdling by the Buprestid beetles A short account of these fossilized remains has recently been published by Mr M V Walker (*Proc United States Nat Mus*, 85, 137–141, 1938), who classifies them into four new genera

Biology of the Cockroach

THE life history of the very common and cosmopolitan *Blatta orientalis* L has long remained very imperfectly known A contribution towards a knowledge of this subject by Dr M A H Qadri has recently appeared (*Bull Entom Res*, 29, 263–276, 1938) Breeding of the insect was at a constant temperature of 27 5° C It appears that the œthecæ are normally laid in May and June and the time taken for the emergence of the first nymphs is from seven to ten weeks At the time of its escape from the œtheca the insect is in the so-called pronymph stage which has been overlooked by most observers It lasts but a few minutes, after which the first ecdysis takes place There are six true nymphal instars and at the seventh ecdysis change into the adult occurs The average developmental period, after exit from the œtheca up to the adult stage, is 279 days The formation and structure of the little known spermatophore is described together with the changes during development of the male gonads and their associated parts

Leaf Abscission in Healthy and Diseased Leaves of *Picea*

A H Campbell and A E Vines have re-examined the abscission mechanism in *Picea excelsa* (*New Phyt*, 37, No 4, October 1938) It has long been known that this abscission mechanism is actuated by the drying of the leaf, the structural features associated with abscission having been present in the leaf from a very early stage in its development The authors give grounds for attributing abscission not merely to the loss of water from the leaf but also to its relatively rapid loss In these circumstances, hygroscopic movements are set up in a thick walled hyaline layer at the base of the leaf, as the water loss is apparently greater from this layer, in which hygroscopic movements result, than from the leaf cushion, and the tissues separate in this region The cause of the water deficit in the leaf, it is suggested, may be wound gum deposits in the tracheids, these are seen after leaf fall but their presence just prior to leaf fall has still to be established In one form of the disease attacking spruce needles, *Lophodermellina macrospora*, the infected leaves remain attached to the tree The authors show that in this case the stomata on the infected leaf are blocked by substomatal sclerotia formed by the fungus hyphæ which, on the evidence of porometer experiments, may be expected to reduce materially the water loss from the leaf, and thus throw out of action the drying mechanism upon which leaf abscission normally depends

Anthracnose of the Watermelon

THE watermelon plantations of Egypt cover about fifty thousand acres, the produce of which is damaged to the extent of several thousand pounds each year by the fungus *Colletotrichum lagenarium* Dr Amin Fikry has given the results of his researches into the incidence and control of this disease in a recent paper (Min Agric Egypt, Mycol Sect, *Bull* 190, Govt Press, Bûlâq, Cairo Price P T 4 1938) The fungus causes leaf spotting or anthracnose upon a wide range of varieties, and symptoms usually appear when the plants are about two months old Almost complete control of the disease has been accomplished by dusting twice with sulphur The crop must be treated first as soon as the fungus appears, and again three weeks later Symptoms and control are illustrated in the bulletin by ten half tone plates

Past Seismic Activities in Japan

THIS subject has recently been reconsidered by Prof Akituno Imamura (*Japanese J Astro and Geophys* 15, No 3, 1938) He examines chiefly the activity in Honsyu and Sikoku since the earthquake history of Taiwan dates only as far back as A D 1655 The principal catalogues used in the work are the Dainippon Disin Siry (*Reports Imp Earthq Inv Comm*, 46, 1904) and Omori's catalogue (*ibid*, 88 *B*, 1919), both going back as far as A D 416 The authenticity of the reports of earthquakes mentioned in these catalogues is weighed with records of volcanic outbursts and also with records of tunamis Imamura considers that the catalogues do not omit any great earthquake though small ones may not be mentioned It appears that since A D 416 there have been three great periods of seismic activity in Japan namely, between the years 684 and 887, between 1586 and 1717, and since 1847 continuing at the present time The table of earthquakes divided into four intensity classes which are defined, and the maps of epicentral regions during the three periods, are very valuable additions to the paper

Storms in the China Sea

A PAMPHLET entitled The Law of Storms in the China Sea by C W Jeffries and G S P Heywood has been produced to replace an earlier publication of the Hong Kong Observatory The earlier work appeared in 1904 under the title ' The Law of Storms in the Eastern Seas and was written by W Doberck, formerly director of the Observatory The need for revision arose partly through the virtual disappearance of the large sailing ships, which made a large part of the text of the earlier work meaningless, and partly through the increase of information available about the storms, these it need scarcely be said are the dreaded typhoons of the Far East The present work contains synoptic charts showing part of the life histories of some typhoons of recent years and some typical barograms obtained at the Observatory during the approach and recession of storm centres at various distances, with a curve of normal daily pressure variation for comparison The most interesting and valuable part, however, is the section dealing with the precursory signs of the approach of a typhoon from the point of view of a forecaster at Hong Kong Swell is noted sometimes 1,000 miles from the centre, it moves outwards from the centre and gives a fair indication of the position of the centre, besides being probably the earliest indication of its approach It is interesting to note that the barometer is not an unfailing guide to the near approach of a storm centre, an example being the disastrous typhoon of September 18, 1906, which gave no definite barometric indication of its proximity four hours before it was at full strength in Hong Kong harbour Microseisms are also unreliable as premonitory signs

Research on Safety in Mines

THE sixteenth annual report of the Safety in Mines Research Board* including a report on matters dealt with by the Health Advisory Committee has been published recently by the Mines Department

In Part I a reference is made to the award by the Institution of Mining Engineers of the Medal of the Institution to Prof R V Wheeler (director of the research stations) in recognition of his eminent services in the application of Scientific Knowledge and Research to industry with special reference to problems of health in coal mining and of the Utilization of Coal

In order to promote interest in safety work each year large parties of miners are invited to visit the Research Station at Buxton to see large scale coal dust explosions and last year on each Sunday during the summer these demonstrations were given The Annual Conference of Mining Teachers was held at Buxton so that modern methods of research and the latest information could be given to them on safety matters About eighty mining teachers together with representatives of the Board of Education and of the Mines Department attended this conference Addresses were given on the following subjects Education and the Mining Engineer , Films and their Use for Instructional Purposes and Haulage Investigations

For many years stone dusts have been used for suppressing explosions by sprinkling the dust on the roof, sides and floor of the roadways in the mine The dusts used for this purpose have been obtained from shales, limestone and gypsum In the report the importance of special material of higher efficacy than the usual stone dusts is mentioned, and the results of the research on this subject are given It appears that common salt is the cheapest and most effective of these materials Unfortunately, this material would not fulfil its purpose if exposed to atmospheres of more than 70 per cent relative humidity, on account of its tendency to cake Experiments with various mixtures have shown that the tendency of powdered crude common salt to cake is much reduced if it is mixed with 20 per cent of finely ground talc (French chalk), precipitated chalk (whiting) or coal Its caking is entirely prevented by the presence of 10 per cent of tricalcium phosphate or 5 per cent of magnesium carbonate levis Equally good results were obtained more cheaply with only 2 per cent of magnesium carbonate and 20 per cent of talc or precipitated chalk

Tests have been made with mixtures of salt, talc and magnesium carbonate under standard conditions of test in a gallery at Buxton 4 feet in diameter, and the calculated efficacy of the salt present in the mixture is approximately ten times that of shale

In the report for 1936 stress was laid on the importance of choosing a dust of high and lasting dispersability It has been found that the finer particles are not dispersed as separate particles, and that a dust can be too fine A dust of fineness between 50 and 70 per cent through a 240 mesh B S test sieve containing about 20 per cent of fairly coarse particles over 60 mesh is recommended

In all mines where coal is won, firedamp is given off This is diluted by passing pure air round the workings But if the ventilation is impeded, the percentage of firedamp present in the mine atmosphere may increase or an excessive and unusual amount of gas may be given off for possibly a short period

It is desirable therefore for the mine manager to have information about the percentage of firedamp in the return air In the past this has been done by analysing spot samples by means of a Haldane or Bone and Wheeler apparatus The principle which is used for this purpose is to burn the combustible gas and measure the contraction produced

A very ingenious firedamp recorder is described capable of giving a continuous record of the percentage of gas present in the atmosphere over a period of a few weeks The electric current for the combustion chambers is supplied by a small generator, and the mechanism is arranged to control a sufficient number of these chambers to obtain almost a continuous record The principle used is similar to that of the Haldane apparatus, except that the control is mechanical and does not require constant attention

The belief is expressed that due to the development of the principle of sheathing explosives, and research on their compositions freedom from ignition underground will be assured It is significant that last year no ignition of gas occurred and many collieries were using sheathed explosives

A sheathed explosive consists of the ordinary bobbin of explosive contained in waxed paper but surrounded by an extra layer of sodium bicarbonate This bicarbonate is either held in position by a further layer of paper or it consists of a paper felt impregnated with sodium bicarbonate When the shot is fired, the hot gases which are produced are wholly enclosed in a cloud of fine particles of this inert material, and cooling of the gases takes place so rapidly that there is very little danger of ignition of firedamp

The obvious need for personal protection has been realized during the last few years, but at first considerable scepticism was displayed by managers and workmen with regard to the use of various items of apparel It has been proved that many men have escaped serious injury due to the use of hard hats, gloves, shin guards, knee pads, safety boots and goggles fitted with safety glasses The importance of this subject cannot be over stressed, and much thought has been given to the production of these articles More than 147,000 hard hats were supplied during the year, making a total of some 435,000 for the past three years

Many of the special appendixes are reports of the district investigators on researches on the problem of falls of ground These investigations are carried out under the direction of committees of local mining engineers, and a large amount of information is being collected on this extremely important subject

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* Sixteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee 1937 Pp 136+15 plates (H M Stationery Office 1938) 2s net.

Some Oxidation-Reduction Reactions

THE dihydric phenol catechol, 1,2-$C_6H_4(OH)_2$, has been widely used as a substrate in the study of the enzyme action of an oxidase, and it has been supposed that the utilization of molecular oxygen during the respiration of certain types of plants is largely dependent on such action. It was shown by Robinson and McCance in 1925 and others that the enzymatic oxidation of catechol involves the absorption of two atoms of oxygen per molecule of dihydric phenol, and it has been definitely established that *o*-benzoquinone is one of the initial products of the action of a phenolic oxidase such as tyrosinase on catechol. The conversion of catechol to *o*-benzoquinone theoretically requires only one atom of oxygen, and the fate of the second oxygen atom has been the subject of controversy. Since aerobic oxidations are often attended by the initial formation of hydrogen peroxide, it was suggested that the second oxygen atom was converted into hydrogen peroxide:

$$C_6H_4(OH)_2 + O_2 = C_6H_4O_2 + H_2O_2$$

Onslow and Robinson, and Platt and Wormall, claimed to have detected traces of hydrogen peroxide in the enzymatic oxidation of catechol, and they attributed the difficulty of detecting this substance to its decomposition by peroxidase and catalase in the enzyme preparations. Others suggest that the decomposing activity of small amounts of some metals accounts for the removal of peroxide. Doubts have also been expressed as to the formation of hydrogen peroxide. Pugh and Raper in 1927 pointed out the possible decomposing action of catalase, and they suggested that the second oxygen atom might act by further oxidation of the *o*-benzoquinone. Nobutani in 1936 found that catalase has no effect on the oxygen consumption during the enzymatic oxidation of *p*-cresol, 1,4-$CH_3.C_6H_4.OH$, and hence concluded that hydrogen peroxide is not formed in this reaction.

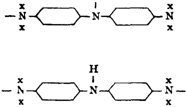
C. R. Dawson and B. J. Ludwig[1] consider that the conclusions of Pugh and Raper and of Nobutani are not wholly convincing, since the strengths of the catalase preparations used were not indicated and it was not shown that the catalase remained active throughout the oxidation process. Keilin and Hartree in 1935 had also shown that under certain conditions catalase may promote a secondary oxidation involving the hydrogen peroxide formed during an enzymatic oxidation. When catalase so functions, the decomposition of the hydrogen peroxide does not result in the liberation of molecular oxygen and the return of this to the reaction system, and the formation of hydrogen peroxide would not be detected by oxygen uptake measurements.

Dawson and Ludwig have used tyrosinase preparations having no peroxidase activity and negligible catalase activity in the oxidation of catechol. They made use of the fact recently discovered by Dawson and Nelson that the production of quinone by the enzymatic aerobic oxidation of catechol can be followed by titration with iodine, and when produced under certain conditions, for example, with an optimum amount of enzyme in very dilute solutions of catechol buffered in the *p*H range 4.2–6.6, the stability of the quinone is such that the stoichiometric relationship between it and the catechol can be demonstrated[2]. Since both quinone and hydrogen peroxide liberate iodine from hydriodic acid, the indefinite status of the hydrogen peroxide controversy tended to obscure all interpretations, and Dawson and Ludwig have attempted to clear up this point. Their tyrosinase preparations were obtained from the common mushroom by suitable purification, and the activity was measured by the method proposed by Graubard and Nelson. In dilute solutions buffered within the *p*H range 4.1–6.7, the oxidation product formed in the initial stages of the catechol-tyrosinase reaction was equivalent to two atoms of iodine per molecule of catechol, which corresponds to a benzoquinone. This quinone and hydrogen peroxide were shown to be incompatible in solutions buffered to *p*H values above 4.1. It was also shown that in the *p*H range 4.1–6.7 the course of the catechol-tyrosinase reaction as followed by iodometric titration, was unaltered by large amounts of catalase or peroxidases.

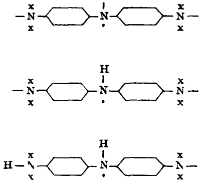
Wagreich and Nelson[3] found that under conditions of low concentration of substrate, high concentration of enzyme, and *p*H 4.5–6.5, catechol is enzymatically oxidized by tyrosinase to *o*-benzoquinone with the consumption of one atom of oxygen only per molecule of catechol, and that the consumption of the second atom of oxygen is also catalysed by tyrosinase. They obtained evidence that a substance is formed when *o*-benzoquinone disappears in aqueous solution at *p*H 4.5–6.5 which is aerobically oxidized to a quinone by tyrosinase, and that the quantity of quinone compound formed in the oxidation of this substance corresponds to one half of the *o*-benzoquinone which has disappeared. It appears, therefore, that the second atom of oxygen used up in the enzymatic oxidation of catechol is concerned with the oxidation of a product resulting from the action of water on *o*-benzoquinone, that hydrogen peroxide is not responsible for any part of the titration values, and that the consumption of two atoms of oxygen per molecule of catechol cannot be attributed directly to the formation of hydrogen peroxide. The question whether or not hydrogen peroxide has an intermediary function during the formation of the initial quinone is still open to debate, but it is considered improbable that such a view of the enzymatic oxidation of catechol can be supported on the present evidence.

Another investigation on oxidation mechanism by a different method is the study of the possible intervention of semiquinone radicals as intermediate steps in oxidation-reduction reactions by G. Schwarzenbach and L. Michaelis[4]. The indophenol dyes had been the object of an extensive and fundamental investigation by W. M. Clark and co-workers, who measured the oxidation-reduction ('redox') potentials by electro-chemical methods. They concluded that there was no evidence for the existence of an intermediate step in the process of reduction but that in reversible bivalent oxidations two electrons always go on and off in pairs. Schwarzenbach and Michaelis now present evidence for the existence of such intermediate steps in the form of semiquinone radicals in the case of phenol blue and Bindschedler's green, two dyes closely related to the group investigated by Clark. Potentiometric redox titrations of these dyes were carried out at various *p*H values and the slope of the titration curves indicates that an intermediate semiquinone radical is formed. The results were checked by spectrophotometric measurements.

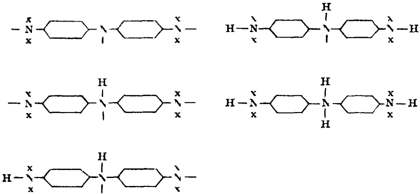
The totally oxidized semiquinone and fully reduced forms are denoted by *T*, *S* and *R*, respectively, an open structure being chosen for the *T* forms in which the central nitrogen appears surrounded by only six electrons. The fourth electron pair can be said to be delivered by the auxochrome groups $N(CH_3)_2$, OH and O, which have unshared electron pairs able to form double bonds with the adjacent carbon atom, so converting the benzene ring containing it into a quinoid ring. Both auxochrome groups can so participate and the molecule is a resonance system. The formulæ above apply to Bindschedler's green, similar formulæ are given in the paper for phenol blue and phenolindophenol. Each stroke represents an electron pair, and in the *S* form the odd electron is provisionally shown by a dot as attached to the central nitrogen atom, although this is not to be regarded as assigning a definite position to it. Methyl groups are denoted by x.



2 T forms



3 S forms



3 *R* forms

Titrations were mostly reductive, with reduced rosindulin *GG* and in a few cases titanous chloride. The air in the titration apparatus was replaced by hydrogen, and colloidal palladium ensured the removal of oxygen and produced a hydrogen potential which made possible the measurement of the *p*H of the buffer. In oxidative titrations the hydrogen was then replaced by nitrogen. Apart from the titration curves, the semiquinone could also be detected by its colour.

All three dyes showed strong semiquinone formation in the alkaline and acid range and comparatively small semiquinone formation in the middle *p*H range. The effect in the alkaline range may be explained as follows. In non-aqueous solutions the formation of *R* and *T* forms from a free radical is generally negligible and only the equilibrium between the dimeric form and the radical occurs. Such solutions, however, correspond with a solution of very high *p*H since the *R* form cannot take up a proton. The sensitivity of the solutions to water follows from the proton donation of the water being equivalent to a strong lowering of *p*H by converting the *R* form into H*R*

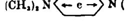
$$R + H_2O \rightleftharpoons RH + OH$$
$$2S + H_2O \rightleftharpoons T + RH + OH$$

This is the main reason for the dismutation effect caused by the addition of water to the radicals.

The general treatment of oxidations and reductions of organic compounds must take account of the equilibria

$$\begin{tikzcd} R \arrow[r, leftrightarrow, "e"] & S \arrow[r, leftrightarrow, "e"] \arrow[d, leftrightarrow] & T \\ & \tfrac{1}{2}D & \end{tikzcd}$$

The reaction $D \rightleftharpoons 2S$ in non-aqueous solutions is standard for the preparation of radicals, redox potentials refer to $R \rightleftharpoons T$. The two processes were linked simultaneously by Friedheim and Michaelis[5] and Elema[6] who noticed the formation of free radicals in oxidations and reductions even in aqueous solutions. Michaelis and Fletcher[7] also found the dimeric form (*D*) in equilibrium with the radical. The semiquinones all contain two equal atoms (other than carbon) symmetrically located in the molecule, and these atoms can be regarded as carriers of an odd electron, e, which resonates symmetrically between the two positions, for example, as in Wurster's blue



$$\overset{+}{(CH_3)_2N}\langle \leftarrow e \rightarrow \rangle \overset{+}{N(CH_3)_2}$$

The older free radicals, on the other hand, contained one atom which might be considered as the carrier of the odd electron, so that it was reasonable to speak of tervalent carbon, bivalent nitrogen or univalent oxygen. These radicals were found to be very sensitive to water. The present investigation closes the gap between the two groups of radicals, examples of the second type having been found which exist in aqueous solution in equilibrium with *R* and *T* forms. As Hückel and Pauling have shown, all free radicals owe their existence to resonance energy, the odd electron and the π electrons of the aromatic nuclei not being in a definite position but appearing as a time average of charge distributed over a wide range of the molecule

Schwarzenbach and Michaelis discuss in detail the relative stability of the molecules involved, that is, those given in the above and similar tables, on the basis of qualitative valency considerations An atom in an 'ideal' state is assumed to be surrounded by four equal and indistinguishable electron pairs Reactivity may then arise from (1) a deviation from the stable electron number 8, for example, in the fluorine atom (oxidation-reduction instability), (2) a deviation from the ideal state of equality of the four electron pairs, for example, in the NH_3 molecule giving rise to basic properties (acid base instability) It follows that the *R* forms show primarily acid base instability, which is great in alkaline solution, that the *T*-forms show greater instability (oxidation reduction unstability) in acid solution, the radical *S* is stabilized by a resonance phenomenon differing from the resonance of the *T* form ((*a*) *T* form reson ance between two halves of molecule, (*b*) *S* form resonance of semiquinone type, which can be exhibited in one ring containing two nitrogen or oxygen atoms in symmetrical positions, *o* or *p*, but also in double rings, as in benzidine or γ,γ' dipyridyl)

It is emphasized that practically none of the organic radicals known prior to the discovery of the semiquinones exhibit the peculiar type of strongly symmetrical resonance structure characteristic of the semiquinones Correspondingly, these older radicals are usually not stable enough to be capable of existing to any appreciable extent in the presence of water, in contrast to the semiquinone radicals

In a further paper, L Michaelis, M P Schubert, R K Reber, J A Kuck and S Granick[8] deal with a paraquinone, duroquinone (tetramethylbenzoquinone), which shows stability to alkalis Potentiometric and magnetometric methods agree in showing that in sufficiently alkaline solution a free, strongly para magnetic, semiquinone radical of brown colour is formed as an intermediate step of reversible reduction This radical has no measurable tendency to form a valency saturated dimeric form in the dissolved state

Benzoquinone and hydroquinone form the solid quinhydrone, but no corresponding compound can be formed by ordinary methods from duroquinone The dimeric form is assumed to be formed by hydrogen bonds

$$\left\{\begin{matrix} CO - H - OC \\ CO - H - OC \end{matrix}\right\}$$

involving a resonance between two fictitious structures in which alternately the one and the other half of the molecule (represented by brackets) is in the quinoid or benzenoid state In orthoquinones there is no steric restriction in forming these bonds In paraquinones, the two bonds can be formed only by applying the two rings flat upon one another In duroquinone, however, the voluminous side chains prevent a sufficiently close approach

[1] *J Amer Chem Soc* **60** 1617 (1938)
[2] *J Amer Chem Soc* **60** 250 (1938)
[3] *J Amer Chem Soc* **60** 1545 (1938)
[4] *J Amer Chem Soc* **60** 1667 (1938)
[5] *J Biol Chem* **61** 305 (1931)
[6] *R c trav chim* **50** 907 (1931)
[7] *J Amer Chem Soc* **59** 2460 (1937)
[8] *J Amer Chem Soc* **60** 1678 (1938)

New Satellites of Jupiter

IN NATURE of September 24, p 564, reference was made to the various orbits that had been computed for Satellite x by Dr Paul Herget and Dr M Davidson Dr Herget obtained two orbits with high eccentricities, exceeding 0 6, but the orbits differed essentially, one being direct and the other retrograde As the latter gave smaller residuals, it was adopted, and it appeared that the least and greatest distances from Jupiter were 6 million and 30 million miles, respectively As this last distance is probably outside the stable region for a satellite, it was obvious that further investigation was necessary before any definite pronouncement could be made

Dr Davidson's orbit was quite different from those of Dr Herget. He found that the motion was direct, almost circular, and that the distance from Jupiter was about 7 million miles, but expressed some doubt whether it was just inside the orbit of Jupiter vi or outside that of vii

Further observations have been made, and from these Dr. R H Wilson has computed a new orbit (Harv. Card 460) It now appears that the very eccentric orbit was in error and that the satellite has a small eccentricity, 0 14051, its mean distance from Jupiter being just over 7 million miles, as previously given by Dr. Davidson Its inclination is 28° 24′ and its period of revolution 254 days The satellite belongs to the same group as Satellites vi and vii, and it may be conjectured that there is a family of small satellites in this region, most of them too small to be detected Even the existence of three is a puzzle How did they originate? They are very far outside the Roche limit, and so cannot have been disrupted by Jupiter

Dr P Herget has also computed an orbit for Satellite xi It is moving in a retrograde orbit at an inclination to the plane of the ecliptic of 16 6° and a mean distance of 14 million miles from Jupiter Its eccentricity is 0 207 and its period 692 5 days The elements of the orbit will probably be improved later when more observations are available

In a letter to NATURE of October 8, p 670, Mr J Miller suggested that the retrograde satellites followed an arithmetical progression law, not a geometrical progression law to which the direct satellites conformed approximately, and suggested that Satellite xi would be about 16 million miles from its primary Actually the satellite does not obey either rule, but it is much closer to the arithmetical progression law than to the other It is very remarkable that there are three satellites with direct motion, vi, vii, and x, at a distance of about 7 million miles, and three with retrograde motion, viii, ix, and xi, at distances between 14 and 15 million miles Cosmogonists will find something here on which they can speculate

Science News a Century Ago

The Trogon

Dr Daubeny who had recently returned from a visit to America and the West Indies, on November 12, 1838, at a meeting of the Ashmolean Society, Oxford described some of the zoological specimens including about sixty birds which he had brought back and intended for the Ashmolean Museum Among the birds was a very rare trogon, from the island of Cuba Mr Holme, of Christ Church College, observed that the specific name of the trogon was *Temnurus*, from the ends of the tail feathers appearing as if cut and spread out The only other specimen in Europe was in the Museum at Paris and had been figured in Temminck s Planches Coloriées There was also an uncoloured figure, from a drawing by Colonel Hamilton Smith, in the seventh volume of Griffith s Animal Kingdom

Asiatic Society

At a meeting of the Asiatic Society on November 17, 1838, two of the communications read were from Dr Falconer superintendent of the Honorable East India Company s Botanical Garden at Saharanpore, in lat 30° N The first referred to the cultivation of plants in the garden likely to become important articles of commerce The tea plant was thriving in the nurseries in the neighbouring hills the Otaheite sugar cane had been a success, the Egyptian cotton seemed likely to thrive while among other plants mentioned were the Ceylon cinnamon American annotto, Bombay mangoes and the Chinese litchee (*sic*) Dr Falconer s other letter was written from Cashmere

Another paper read was On the Yellow Colour of the Barberry , in which Mr E Solly stated that the root of the common barberry or *Berberis vulgaris* was used for dyeing leather yellow, and that from experiments made by him in the Society s museum he was convinced that the root would prove an article of considerable value to dyers

F J V Broussais (1772-1838)

November 17 marks the centenary of the death of François Joseph Victor Broussais, the founder of the so called physiological medicine and one of the most eminent physicians of his time He was born at St Malo on December 17 1772 qualified in Paris in 1803 took part in the Napoleonic campaigns in Holland, Germany and Spain, became physician in chief to the Val de Grâce Military Hospital in Paris, and was the author of several works of which the principal are the following Histoire des phlegmasies ou inflammations chroniques (1822), Examen de la doctrine généralement adoptée ' (1816) and "De l'irritation et de la folie (2nd edition, 1839) The main features of his doctrine were the denial of specificity, the attribution of all diseases to gastro enteritis and the reduction of therapeutics to the application of leeches and a restricted diet His teaching, which for many years had an enormous vogue, was finally overthrown by P C A Louis

M Gaudin's Lime Light

On October 19, 1838, M Gaudin had shown some experiments to the Paris Academy of Sciences on his new method of illumination On November 17 the *Mechanics Magazine*, under the heading "Substitute for the Sun , said The newly invented light of M Gaudin on which experiments were recently made in Paris, is an improved modification of the well known invention of Lieutenant Drummond While Drummond pours a stream of oxygen, through spirits of wine upon unslaked lime, Gaudin makes use of a more ethereal kind of oxygen which he conducts through burning essence of turpentine The Drummond light is fifteen hundred times stronger than that of burning gas , the Gaudin light is, we are assured by the inventor, as strong as that of the sun or thirty thousand times stronger than gas M Gaudin proposes to erect on the island of the Pont Neuf in the centre of Paris, a lighthouse five hundred feet high, in which is to be placed a light from a hundred thousand to a million pipes strong, the power to be varied as the nights are light or dark Paris will thus enjoy a sort of perpetual day , and as soon as the sun of the heavens has set the sun of the Pont Neuf will arise

Horticultural Society

In its column of Weekly Gossip , the *Athenæum* of November 17 1838 said We understand that in consequence of the disturbed state of Mexico, and the difficulty of obtaining any package from that country, because of the rigour with which the French squadron maintains the blockade of Vera Cruz and Tampico, the Council of the Horticultural Society have decided upon withdrawing their collector, Mr Hartweg and sending him to investigate the botany of the State of Guatemala The mountainous region, which cuts this magnificent country into two parts and which abounds with most noble vegetation to an elevation of more than 13 000 feet above the sea cannot fail to afford Mr Hartweg a rich harvest

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University Events

Cambridge —An appointment to a research studentship at Christ s College will be made at the end of July 1939 Candidates must be men who will have graduated before October 1, 1939 at some university other than Cambridge, and who have not commenced residence in Cambridge at the time of election Preference will be given to those who will by then have already devoted at least a year to research Every candidate must declare that he intends, if elected, to proceed to the degree of Ph D in the University of Cambridge Further information can be obtained from the Master, Christ s College, Cambridge

Oxford —P M Medawar has been elected to a fellowship at Magdalen College for his work in zoology Dr K N Bahl, Merton College, has been granted the degree of D Sc for his work on earth worms The following have been elected to Theodore Williams scholarships C W M Whitty, Brasenose College (pathology), G I M Swyer, St John s College (anatomy), W D M Paton, New College (physiology)

The Rolleston Memorial Prize for 1938 has been divided between Dr N V Polunin, Christ Church and New College, and H M Sinclair, Magdalen College

Societies and Academies

Edinburgh

Royal Society of Edinburgh, October 24

J L **Baird** Development of television The discovery of the light sensitive properties of selenium led to many schemes for the accomplishment of television These schemes remained theoretical until 1926, when Baird succeeded in transmitting true images by television An experimental television service with his apparatus was commenced by the B B C in 1929 and continued until superseded by the present ultra short wave transmissions The various systems used for large screen television were discussed The progress of colour television was described

Paris

Academy of Sciences (*C R* 207 605–648 Oct 10, 1938)

P **Montel** Families of restricted non uniform holomorph functions

A **Caquot** J **Villey** and P **Blanchet** Law of inflation of geometrically similar pneumatic tyres for aircraft

R **Bourgeois** Daily exploration of the atmosphere by *radio sondes*, its development on land and on sea From near Trappes (Seine et Oise), a *radio sondes* has been released daily since January 1, 1938 the altitude of the bottom of the stratosphere varied from 7,200 m to 14,600 m, and the lowest temperature recorded was − 73°, on January 21 at 12 500 m *Radio sondes* have also been released from the *Carimaré*, cruising about 1 800 km west of the Azores, the bottom of the stratosphere varied from 11 000 m to 15,000 m, and the lowest temperature was − 68° on May 4, 31 and June 16

A **Guillet** Precise measurement of the acceleration *g* of the fall of bodies in a vacuum

A **Marcelin** Increase of the velocity of a mineral oil at rest

G **Ribaud** A differential pneumatic micrometer

M **Rouault** Structure of the molecule PCl_5 by electron diffraction

P **Brun** Study of the electric phenomena which accompany the formation of organo metallic compounds of calcium and of aluminium

P **de Beco** Oxidation reaction at the positive pole in electrolysis by a spark

A **Berton** Comparative study of the visible and ultra violet of mineral oxides and of their hydroxides and hydrates

P **Bary** and J **Herbert** Determination of the density of glasses by the law of additivity

M **Paić** Determination of the sedimentation constant with the aid of ultra centrifuges without an observation system

C **Bedel** Solubility of some slightly soluble silver salts Solubility has been found of the halides produced by double decomposition

C **Legoux** A lithium phosphide

Mlle Y **Khouvine** and F **Valentin** Tritylation of α *l* sorbose

M **Frèrejacque** Some heterosides of weakly basic amines

R **Souèges** Embryogeny of the Boraginaceæ development of the embryo in *Lycopsis arvensis* L

F **Kahane** and **Mlle** J **Lévy** Water soluble cholines of blood and of organs

H H **de Balsac** Ornithophile commensalism of staphylinid Coleoptera its determinism by the thermal requirements of maturation of the gonads

A **Peyron** Mode of symmetrical division of the amnio ectoblastic vesicules in the embyronic buds in multiple tissue tumours of the testicle and its analogies with the polyembryony of the armadillo

Brussels

Royal Academy (*Bull Classe Sci* 24 Nos 8–9, 1938)

G **Cesàro** and J **Mélon** The plane method for the identification of crystallizable substances Study of the lamella of $Na_2S_2O_3$ $5H_2O$ deposited by a thin film of its aqueous solution on a plane sheet of glass New zone of faces parallel to the binary axis

L **Derwidué** The fundamental surfaces of the birational transformations of four dimensional space

Moscow

Academy of Sciences (*C R* 20 No 1 1938)

B **Fuchs** Localizometric analytical figures

S **Soboleff** A theorem of function analysis

I **Berstein** Fluctuations of almost periodic motion of an auto oscillating system

S I **Kretschmer** and S N **Rshevkin** Direct observation of Rayleigh waves in the case of total reflection

M **Kozodaev** and G **Latyshev** Pulse chopper of the Geiger Muller counter

M **Kozodaev** A tube circuit for the Geiger Muller counter

W M **Iletz** Organic derivatives of scandium and yttrium

A V **Nikolaiev** and N M **Selivanova** Synthesis of hydroboracite

V A **Plotnikov** and D P **Zosimovich** Galvanic cells in the formation of alloys

A N **Fedorov** Mode of occurrence of Permian deposits in the neighbourhood of Kirillov

N V **Kagan** Influence of bacteriophage on phagocytosis

E N **Shmargon** New data on the morphology of rye chromosomes

H F **Kushner** and O N **Kitaieva** Blood composition in sheep and in their hybrids with *Ovis polii karelini* (Sev) in connexion with the power of acclimatization

A S **Kasparyan** Haploids and haplo diploids among hybrid twin seedlings in wheat

M I **Neuhaus** An additional method of studying gene action

A S **Krujilin**, V I **Samoilov** and M S **Shestialtynov** Change of carbohydrate and nitrogen content in sunflower under the influence of irrigation

B S **Moshkov** and I E **Kocherzhenko** Optimal light conditions for the cultivation of *Cinchona succirubra* Pav at Sukhumi

E G **Andreeva** Macro and micro structure of metacarpal bones in some breeds of sheep

A I **Ibikhimovich** Growth of extremities in tadpoles on heterotropic transplantations

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday November 14

Royal Geographical Society at 8 30—Dr H A Brouwer Exploration in the Lesser Sunda Islands

Tuesday November 15

University College London at 5—Dr L Margaret Kerly Muscle Chemistry (succeeding lectures on November 22 and 29) *

Eugenics Society (at the Royal Society) at 5 15—Prof C Spearman Intelligence Tests *

London School of Hygiene and Tropical Medicine at 5 30—Dr H Lyndhurst Duke The Pathogenic Trypanosomes of Africa and the Tsetse Flies (*Glossina*) that Convey Them (succeeding lectures on November 16 and 17) *

King s College London at 5 30—Dr R Pendennis Wallis Steam Boiler Plant (succeeding lectures on November 22 and 29) *

Gresham Lectures (at Gresham College Basinghall Street E C 2) at 6—A R Hinks F R S A Retrospect to Herschel (Gresham Lectures succeeding lectures on November 16 17 and 18) *

Thursday November 17

Royal Society at 10 30—Discussion on The Protein Molecule to be opened by Prof The Svedberg

Royal College of Physicians at 5—Prof J B S Haldane F R S Some Problems of Human Congenital Disease (Lloyd Roberts Lecture)

Chemical Society at 8—Prof W N Haworth F R S Some Carbohydrate Problems

Friday November 18

University College London at 5 30—Dr Julie Moscheles Some Aspects of the Geography of Czechoslovak Cities *

Royal Institution at 9—R M Lockley The Seabird as an Individual Results of Ringing Experiments

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Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Lecturer in Mechanical Engineering in the Battersea Polytechnic London S W 11—The Principal (November 21)

Principal of the Paddington Technical Institute—The Education Officer (T 1) County Hall S E 1 (November 24)

Senior Scientific Officers Scientific Officers and Junior Scientific Officers (physics mathematics or engineering) in the Admiralty Scientific Pool—The Secretary of the Admiralty (C E Branch Quote ref No C E 9791/38 November 25)

Physicist to the British Cotton Industry Research Association—The Director of Research Shirley Institute Didsbury Manchester

Senior Lecturer in Mining in the University of Melbourne—The Secretary Universities Bureau of the British Empire 88A Gower Street W C 1

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

A R P a Report on the Design Equipment and Cost of Air Raid Shelters (Reprinted from *The Architects Journal* for July 7 1938.) Second edition Pp 15–48 (London Association of Architects Surveyors and Technical Assistants) 1*s* [2010

Institution of Civil Engineers Subject Index to (1) Minutes of Proceedings Vols 225–240 (2) Selected Engineering Papers Nos 57–180, Sessions 1927 28 to 1934–35 Pp iii+83 (London Institution of Civil Engineers.) [2110

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1938 with Appendices Pp 48 (London H M Stationery Office) 9*d* net [2110

Sale of Food and Drugs Extracts from the Annual Report of the Ministry of Health for 1937 38 and Abstract of Reports of Public Analysts for the Year 1937 Pp 17 (London H M Stationery Office) 4*d* net [2110

The Price of Peace Notes on the World Crisis By Harold Macmillan Pp 20 (London Printed for Private Circulation) [2210

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The State and Medical Research

IN the Harveian Oration delivered by Sir Edward Mellanby before the Royal College of Physicians on October 18 and summarized in NATURE of October 29 certain points were raised of such importance particularly at the present time that it seems desirable to underline and amplify them

A realization of the urgent need for medical research makes no call on the imagination and demands no special medical knowledge We have all seen pain disease and death at close enough quarters to wish that we were better armed against them and it is evident that the only effective arms we can hope for are those fashioned for us by science

What is not so fully realized at least by the general public is that the case for extended research is stronger than ever before because the prospects are brighter As always in the growth of science each new discovery brings other discoveries a little nearer so that the potential rate of advance continuously increases It would not have been easy fifty years ago to indicate how large sums of money could best be spent to hasten our acquirement of the knowledge that alone will enable us to control disease It is certainly true to day that our rate of advance is mainly determined by finance We can spend to advantage more than there is any likelihood of our obtaining and the date at which mankind will be freed from the dread of such killing or disabling diseases as cancer tuberculosis and rheumatism depends in the main on how much we are prepared to pay This does not mean that a frontal attack is necessarily the best or the speediest method of gaining the knowledge that we require The sure road to success is to stimulate the growth and development of the medical sciences as a whole Lister followed Pasteur aseptic surgery was the outcome of studies on fermentation We cannot tell where we shall find the key to any of the more obstinate puzzle locks of medicine

It is only by adequate and wise endowment that such a growth of the medical sciences can be secured The return such endowment would give us may reasonably be assessed in the light of our gains in the past To take only recent advances diabetes and pernicious anæmia incurable and fatal diseases not many years ago are now readily controllable We can if we choose eliminate diphtheria as an important infection of childhood We are at last in sight of an effective attack on influenza one of the major killing diseases of adult life The discovery of the therapeutic action of sulphanilamide and its related compounds has not only given us our first effective weapon against puerperal septicæmia the main cause of maternal mortality but also has brought bacterial infections in general into the field of chemotherapy which hitherto seemed to be limited to protozoal diseases

The funds required to maintain a healthy activity throughout the whole research field involved and to concentrate additional resources at any point which promises a rapid advance are large—large at least in terms of the inadequate resources that have been available in the past, though trivial in comparison with the sums expended on health administration that is often ineffective because it lacks the necessary knowledge on which to act Some part of the money required may be provided by the munificence of private donors or by public subscription Sir Edward

Mellanby instanced some of the funds available for this purpose, such as those administered by the Leverhulme Trustees, the Halley Stewart Trustees, and the British Empire Cancer Campaign. There is an expectation of additional support from the Wellcome Trustees, and British medical research already owes much to the generosity of the Rockefeller Foundation of America—a generosity which, as Sir Edward emphasized, might well prick the conscience of some of our own countrymen. It is reasonable to expect more help from industry in the future than we have received in the past, particularly in the rapidly expanding field of chemotherapy, and it is perhaps not too much to hope that our large life insurance companies, which benefit directly from the increased expectation of life consequent on the increase of medical knowledge, may one day be stimulated by the admirable example set by similar bodies in the United States. But, whatever help is available from such sources as these, it is inevitable that the greater part of the burden should be carried by the State, for the State bears the ultimate responsibility for national health and for financing the measures that are necessary to secure it. It is in relation to the form in which State endowment can best be supplied and utilized that Sir Edward Mellanby's account of the working of the Medical Research Council is of particular interest.

Bureaucracy, giving the term its common and well justified implication, is the inveterate enemy of research. State endowment means State control, and if 'State' and 'bureaucratic' were synonymous terms the outlook would be dark. But the Medical Research Council, under the wise guidance of its two secretaries, the late Sir Walter Fletcher and now Sir Edward Mellanby, has shown that bureaucracy is a malignant growth that a Government department can quite easily prevent by a simple willingness to delegate, not final authority, but provisional decisions, and the carrying out of plans that have been approved. Incidentally, the Council has also shown that bureaucracy is as expensive as it is obstructive, and that its elimination leads to a great saving of public funds. Working through a large number of unpaid expert committees, the Council has encouraged those who know how research can best be stimulated and assessed to do these things for nothing. As a result, the Council's administrative expenses are a very small fraction of the total funds at its disposal, and the greater part of its financial resources are expended on the salaries of research workers, or on the laboratory expenses associated with their work.

Moreover, by enlisting the voluntary help of a large number of senior workers in universities, research institutes and hospitals, the Council has been able to co-ordinate investigations in a way which no other body could approach, and to ensure, so far as is humanly possible, that economy is safeguarded by terminating lines of research that have served their purpose or have failed to fulfil their promise, and by concentrating the available resources in the most promising fields. Its ability to do this, it should be noted, is largely due to the fact that it acts on the advice of those who know what is actually happening, and, as a result, has won their trust and willing co-operation. It does not seem impossible that a method which has proved so successful in one branch of Government activity might be equally effective in others. We are an empirical people, and learn more readily from experience than from argument.

One other point that was stressed by Sir Edward Mellanby deserves further amplification—the unnecessary lag that is apt to occur between the discovery of a method that is applicable to the diagnosis, cure or prevention of human disease and its adequate practical exploitation. This lag is far less conspicuous on the curative than on the preventive side. A new therapeutic agent tends to be tried out at once, and on a wide scale. The trouble is that the trial is often uncritical and uncontrolled, and that the factors that determine the use, or abuse, of the new remedy take longer than they need to win general recognition. The Medical Research Council has made a start towards removing this defect by setting up a Therapeutic Trials Committee.

It is on the preventive side, and particularly in relation to the application of new methods of preventing infective disease, that the lag is longest, and the position in Great Britain is most discreditable, perhaps because this field of activity, on its applied side, has not hitherto been regarded as falling within the Council's sphere. It is not flattering to our sense, humanity or self-respect that we have no central or regional institutes of hygiene, or State laboratories, comparable to those that have been established in the great majority of other civilized countries. The United States, in addition to the National Institute of Health at Washington, has numerous State institutes such as the Division of Laboratories and Research of the New York State Department of Health. Germany has the Reichsgesundheitsamte in Berlin Denmark the State Serum Institute in Copenhagen Italy the Institute of Public Health in Rome Poland the Institute of Hygiene at Warsaw Hungary the Institute of Hygiene at Budapest Turkey at Ankara Czechoslovakia at Prague Rumania at Bucharest Jassy and Cluz Yugoslavia at Belgrade and Zagreb and so on

All these institutes though varying in their detailed functions and in their exact relation to the State serve as national or provincial centres which stimulate the scientific attack on infective disease aid in the practical application of new discoveries to preventive problems and provide for public health administrators facilities that they could obtain in no other way

Other parts of the British Commonwealth are in this matter well ahead of Great Britain as is shown for example by the admirable work carried out by the Connaught Laboratories in Toronto Our neglect of this obvious deficiency is humiliating and not without its dangers to health even in ordinary times In times of emergency it may unless remedied entail improvisations that with all their attendant difficulties and disadvantages would be unnecessary if our peace time organization were less defective

In many ways the practice of medicine in Great Britain is as good as anywhere in the world British public health legislation and practice have a proud history since the days of Chadwick and Simon Our universities and our institutes of medical research have made outstanding contributions to knowledge and are fully capable of adding to them Our future position in the world of medical science which in addition to its national importance plays no small part in international relationships and co operation will depend mainly on the willingness of the Government to provide the necessary funds and on the extension to wider fields of the wise methods by which the Medical Research Council has encouraged integration while allowing freedom and initiative within the territory it has covered in the past In particular there must be a clearer recognition of the interdependence of research and practice A problem in the prevention or cure of disease has not been solved until a finding reached in the laboratory has been tested and applied in the ward or in the field and has been exploited to the limits of its usefulness The method of approach that will succeed in the earlier stages will succeed in the later and other methods will fail The bureaucratic method is is incapable of applying discoveries effectively as it is of making them State endowment and encouragement of those who alone can do the work required will yield the results we need and yield them at the minimum cost

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Modern Methods in School Science

A Modern Introduction to Science

By Dr W P D Wightman and A O Chesters Part 1 Pp vii+158+4 plates 2s 3d Part 2 Pp vii+170+4 plates 2s 6d Part 3 Pp vii+248+4 plates 3s 6d Part 4 Pp viii+275+6 plates 3s 9d (Edinburgh and London Oliver and Boyd 1936–1938)

THERE is something arresting in the title which Dr Wightman and Mr Chesters of the Edinburgh Academy have given to this series of books An Introduction to Modern Science might mean many things but A Modern Introduction to Science suggests that the authors have a new method of approach and so in fact they have They have shared the dissatisfaction of many teachers with the traditional ways of teaching elementary science, and their main aim is to guide a young reader towards reasoned answers to questions to which his own curiosity naturally leads him Accordingly each topic is presented as a problem to be attacked in a spirit of discovery and not as a verification of something already known In elucidating problems the authors often follow historical lines and usually they have done so with admirable discretion In general it may be said that they present science as a matter of personal concern to the young students who are enabled to pluck the fruits of knowledge from all the main branches of the subject

The first two parts of the series were already printed before the Science Masters Association made its interim report (1936) on The Teaching of General Science In their preface to the last two parts of their work the authors comment upon the close agreement between the findings in the report and the principles which they had quite independently come to regard as basic The similarity is indeed quite remarkable for the work reads almost as if it had been written with the report as its basis

The agreement is even closer than the authors themselves realize for their method of presentation which they call the unitary approach is in complete accord with the findings in the report The authors are mistaken in thinking—to quote from their preface—that the Committee were of the opinion that the tripartite division of science was so natural and convenient that to depart from it savoured of artificiality What the Committee said on this point—and it was stated in italics—was that general science should seek to elucidate the general principles observable in nature without emphasising the traditional division into specialised subjects until such time as this is warranted by the increasing complexity of the field of investigation by the developing unity of the separate parts of that field and by the intellectual progress of the pupils That again seems to be exactly as the authors think desirable for as they state in their preface they cast Part IV of their book in sections corresponding roughly to the principal branches of science The agreement in principles between the authors and the Committee seems to be complete and as might therefore be expected there is close similarity in the choice of teaching material as well as in the method of presenting it

One can imagine a classically trained sixth form boy who wished to know what science was about simply revelling in this work but there are a few points which cause misgivings about its application to the small boys for whom the earlier parts of the book are designed The style of the English in the first part of the book since it is no simpler than that in the last seems too hard for the younger boys The chemical balance is introduced too soon The general treatment is too logical for the beginners who are at an age when they hunger for facts and experience and soon tire of trying to follow a long train of reasoning It might have been wiser to sacrifice some of the logical connexions in order to crowd the first part with things which are easily comprehended by young minds In Part II which one may suppose will be studied by boys of thirteen or fourteen years of age the historical method of approach to electrical ideas seems to be laboured and one wonders (page 121) how many boys will remember the shapes of graphs of the type $y=x^2$ These however are debatable points which have been mentioned didactically for the sake of brevity They should not be allowed to detract from a favourable opinion of a series which marks a notable advance in methods of teaching science to beginners

C I Bryant

The Theory of Allotropy

Die Theorie der Komplexität und der Allotropie
Von Prof Dr A Smits Pp xii + 372 + 5 plates (Berlin Verlag Chemie 1938) 19 50 gold marks

THE views held by Prof Smits as to the complexity of phases which are usually considered to be simple were set out in his Theory of Allotropy published in 1922 Since then many new results have been obtained and the present volume lays special emphasis on the new experimental data and their interpretation from the point of view of the theory

The book opens with a chapter describing the experimental evidence for pseudo components from vapour pressure and melting point anomalies The fundamental hypothesis is then defined ' all phases including the gaseous and solid phases of a so called simple substance are composed of different kinds of molecules which are inter convertible The remainder of the volume consists of a full theoretical discussion of the consequences of this hypothesis when the rate of interconversion is slow together with a detailed description of experimental studies of systems in which the rate of interconversion is slowed down by intensive drying or by low temperatures

One of the most interesting points which arises from the theory concerns the physical or chemical nature of the different kinds of molecules which form the pseudo components A brief discussion in one chapter suggests that apart from chemical isomerism in more complex molecules one may have to consider differences of nuclear spin as with ortho and para hydrogen or rotational energy differences as in crystals of ammonium chloride In the limit it may even be necessary in a gaseous phase to regard each group of molecules with a given rotational energy quantum as a pseudo component ! For systems of the type of SO_2 and intensively dried benzene the data are interpreted as indicating interconversion between polymers and simpler molecules

Both theory and experiment are described with admirable clarity and the book is enriched by a large number of well chosen diagrams S S

Modern Organic Chemistry

Organic Chemistry:
an Advanced Treatise Editorial Board Henry Gilman, Roger Adams, Homer Adkins, Hans T Clarke, Carl S Marvel, Frank C Whitmore Contributors (other than Members of the Board) C F H Allen, W E Bachmann, A H Blatt M T Bogert, W R Brode, L F Fieser R C Fuson, E Heuser, C D Hurd, J R Johnson T B Johnson, J A Leermakers, P A Levene, K P Link L Pauling, A L Raymond, A Rothen R L Shriner, L Small W H Strain, E S Wallis, M L Wolfrom Vol 1 Pp lvi+857 Vol 2 Pp lvi+858–1890 (New York John Wiley and Sons, Inc , London Chapman and Hall Ltd , 1938) 37*s* 6*d* net each volume

THE very rapid growth of organic chemistry alike on the descriptive side and in the theoretical aspects of the subject, has produced acute problems for teachers of chemistry particularly for those concerned with final honours or post-graduate students Whilst numerous and excellent elementary and intermediate text books are available for use in the early stages of the curriculum, comprehensive advanced treatises are few in number

The volumes under notice, planned by an editorial board of American chemists and written by American chemists, go far towards filling the gap, and their publication is to be regarded as an outstanding event in the bibliography of organic chemistry The variety and extent of the subjects to be considered render it inevitable that a treatise of this type must be a joint effort, and the two volumes under review consist in effect of a series of monographs written by acknowledged authorities on these special subjects The names of the members of the editorial board and of the contributors, given above, are sufficient indication of the high quality of achievement to be expected in the various chapters, and their success in providing readable, authoritative, and well-balanced accounts of the various subjects is amply confirmed by a study of the work Each of the chapters is a fully documented monograph, complete in itself but carefully related to the general scheme of the work, giving a review of the subject as it stands at the present day, with many references to new work published so recently as 1937 It is a welcome feature that by adopting the method of separate sections, the editorial board looks forward to flexibility in bringing new editions up to date and including in them chapters on subjects omitted from the present volumes

In a short review no attempt can be made to refer in detail to each of the twenty two separate monographs but some idea of the wealth of subject matter may be derived from a brief consideration of the subjects selected for discussion A masterly survey of the theory of the structure and reactions of aromatic compounds by L F Fieser occupies some 100 pages whilst the related subjects of modern electronic concepts of valency and the significance of resonance to the nature of the chemical bonds are dealt with in important chapters by J R Johnson and L Pauling respectively Carbohydrates are included in three sections the first by M L Wolfrom, who deals with the general problems of stereochemistry, ring structure etc , and the chemistry of the simple sugars and oligosaccharides A L Raymond writes on substituted and derived sugars including vitamin C, and on the isomerization and degradation of sugars, including fermentation In the third section E Heuser provides a comprehensive account of the chemistry of cellulose The long article (256 pages) on stereoisomerism by R L Shriner, Roger Adams and C S Marvel amounts practically to a complete and much needed text book on this branch of organic chemistry, and there are further chapters by P A Levene and A Rothen on optical rotatory dispersion one of the newer and potentially very valuable methods of investigating organic substances, and on the theory of strain by R C Fuson Amongst the groups of natural products included are amino acids (H T Clarke), pyrimidines, etc (Treat B Johnson) alkaloids (L Small) anthocyanins and flavones (K P Link), carotenoids (M T Bogert) and sterols bile acids and related compounds (W H Strain) There are sections on organometallic compounds (H Gilman), free radicals (W E Bachmann), unsaturation and conjugation (C F H Allen and A H Blatt), open chain nitrogen compounds (C D Hurd) and other aspects of organic chemistry are considered in sections on molecular rearrangements (E S Wallis), comparison of chemical reactivity (H Adkins) and on constitution and physical properties (W R Brode and J A Leermakers)

When so much is given, and given in a manner which it is difficult to praise too highly, it would appear invidious to wish for more It seems unfortunate, nevertheless, that the really excellent sections on the carbohydrates, which include cellulose, should contain no account of starch, glycogen, hemicelluloses, polyuronides or other related polysaccharides Furthermore, the account of the nucleic acids is scarcely adequate in its references to modern work It is inevitable, however, that a work of this kind should be incomplete as regards subjects selected for discussion and in the preface the editor in chief promises additional chapters on polymerization and on chlorophyll for inclusion in the next edition When it is found that the present edition runs to nearly 2,000 pages, some idea is gained of the scope of modern organic chemistry The work is well produced, and the clear type and the excellence of the numerous formulæ and diagrams deserve special mention These are quite certainly volumes the merits and importance of which render them indispensable to all serious students of organic chemistry

E L H

Research near the Absolute Zero

Low Temperature Physics
By M and B Ruhemann Pp ix + 313 (Cambridge At the University Press 1937) 18*s* net

APART from the determination of the characteristics of the liquefied gases used to produce low temperatures, the original aim of low temperature research was to investigate the fundamental properties of matter in the absence of the disturbing effects produced by thermal agitation Although this aim has been to a large extent achieved, its attainment has been complicated and research made more exciting by new phenomena which have appeared in this temperature region and by previously known phenomena which have become relatively more important Incidentally the rapid advance of this branch of physics is illustrated by the fact that most physicists would now confine the term 'low temperature' to the region within a few degrees of the absolute zero

The book under review is written by experienced workers, and gives a very readable account of the whole range of low temperature research, "mainly for physicists specializing in *other fields*" It commences with a history of gas liquefaction, followed by an account of the commercial liquefaction of air, and its rectification an account full enough to include calculation of efficiencies of liquefaction processes and the methods of 'rectification calculus (It is interesting to read in this connexion that Keesom has shown that the old Pictet process can be more efficient than either the Claude or the Linde) This is followed by chapters on the laboratory methods of making hydrogen and helium and on their use in the production of the low temperatures with which the book is mainly concerned It is entirely owing to the recent improvements in the small scale production of liquid helium that we owe the fruitful extension of its use to laboratories not originally equipped for work in this field The non continuous expansion method is even more adaptable than the reader would gather from the account here as instead of the duration of the experiment being limited to "an hour or more experiments lasting more than twelve hours are often carried out after a single expansion

For work below about 1° K we have to rely on other methods So long as a property is changing with temperature we can make use of this property (at any rate in principle) to attain yet lower temperatures How the magnetic susceptibility of certain paramagnetic substances has been used for this purpose is described in a late chapter, in which is also included a clear description of the method of determining the temperatures reached on the absolute thermodynamic scale particularly interesting as perhaps the only case in which its definition is directly applied The inaccessibility, in the light of Nernst's Third Law, of the absolute zero is discussed in a useful chapter on that law The importance of low temperature measurements to processes in chemical industry is also stressed in this connexion

The remainder of the book consists of a summary of the results of research in its principal branches, including chapters on liquid solid equilibrium, thermal and other properties of the solid state, magnetic phenomena, and the remarkable properties of superconductors Although there are excellent accounts of these last elsewhere it seems a pity, in view of the appeal of this book to non specialists, that the section here is not fuller It is also to be regretted that there is no account of work subsequent to 1935, although a bibliography up to May 1937 is appended But in spite of these defects and of a very few minor misprints the authors are to be congratulated on the very successful fulfilment of their aims T C K

The Revival of Agriculture

a Constructive Policy for Britain Prepared by a Committee of the Rural Reconstruction Association Pp 138 (London George Allen and Unwin Ltd 1936) 3s 6d net

THIS book presents a policy for agricultural reconstruction with a strong bias towards economic nationalism which the authors like Signor Mussolini, prefer to call realism It gives a clear exposition of the case for national self sufficiency based on planned agricultural organization but tends to minimize the disadvantages that might accompany self sufficiency Not everyone will agree with the following sweeping statement (p 125) It is not arguable that the mere moving of goods backwards and forwards across the seas though it gives employment to both men and capital, has in itself an economic value One wonders whether the mere moving of apples from the orchard to the market and thence to the consumer could be dispensed with as easily as shipping or whether the interposition of water makes all the difference to the necessity for distribution

The main idea is that our national survival depends on getting more people back to productive work on the land and keeping them there in comfort and security Few will contend the desirability of this object The authors realize that it would involve very careful organization of both production and distribution and full protection of the rural community against price fluctuations slumps etc Much of the security however is to be purchased at the cost of the financial and commercial interests that in the past have certainly feathered their nests more effectively than has agriculture which the authors rightly regard as the foundations of our civilization It is the misfortune of foundations that they have no place in the sun What the ultimate consequences to the whole structure of civilization would be of turning the foundations into pinnacles is a question which nobody can yet answer G V J

Coordinate Solid Geometry

Being Chapters I-IX of An Elementary Treatise on Coordinate Geometry of Three Dimensions By Prof Robert J T Bell Pp xiii+175+xliii (London Macmillan and Co, Ltd 1938) 7s 6d

THIS book contains as its text, the first nine chapters of Prof Bell s well known Treatise on Coordinate Geometry of Three Dimensions It therefore leads up to and completes the treatment of the central surfaces in order to meet the needs of those students who do not desire to study mathematics beyond a pass or general degree standard

The author has made an interesting and appropriate selection of miscellaneous examples from his larger work and in addition has provided an entirely new set An appendix has also been added in which alternative and simplified methods to several parts of the original text are given

The book bears all the excellent features of the "Treatise" and should be of great use to the students for whom it has been prepared

Silicate Analysis

a Manual for Geologists and Chemists, with Chapters on Check Calculations and Geochemical Data By Dr A W Groves Pp xxi+230 (London Thomas Murby and Co 1937) 12s 6d net

THE chemical analysis of silicates is of importance not only in the pure sciences of geology, mineralogy and geochemistry but also in many branches of technology and industry The standard works in English on this subject are those of Hillebrand and Washington and the methods of analysis described in this volume include many given by these workers These standard methods, however have been modified where the author s experience has shown such modification to be necessary and further, other methods are given in detail Great attention is paid to minutiæ of manipulation and for ease of consultation the instructions concerning the procedure of the analysis are printed in large type

After introductory chapters on the equipment of the laboratory reagents sampling and routine operations the main part of this volume deals fully with the normal methods of silicate analysis The concluding chapters are devoted to such topics as special methods analyses for industrial purposes errors in silicate analysis and the geochemical distribution of the elements

This book, which is well produced provides a detailed guide in silicate analysis for both chemist and geologist

Modern Optical Projectors

a Practical Handbook on the Principles and Construction of Optical Projection Appliances for the Lecture Room Laboratory and Workshop By Edgar T Westbury Pp 124 (London Percival Marshall and Co Ltd n d) 3s 6d

THERE is a decided place for this little book in lecture room laboratory or workshop As years have gone on it is surprising what developments have taken place since the magic lantern provided the only means of illustrating a lecture Yet it remains the prototype of all the more or less elaborate instruments which are in common use to day for such a purpose

The information given by the author is severely practical and covers the whole range of problems likely to arise in the construction and care of projectors Two points are worthy of special mention One is the need for absolute darkness during the exhibition of slides It appears that some five candle power of stray light on the screen is enough to spoil the effect of five hundred candle power of illumination from the lantern This is common experience, but it is interesting to have figures The other matter is the value of optical projection in the workshop, for example, in the testing of screw threads by casting a shadow of the screw upon the screen at the same time as an enlarged working drawing Imperfections are readily revealed by this method The book is well produced and liberally illustrated

F I G R

Die mikroskopischen Boden-Pilze

ihr Leben ihre Verbreitung sowie ihre öconomische und pathogene Bedeutung Von Dr Anneliese Niethammer Pp vi + 193 + 6 plates ('s Gravenhage Dr W Junk, 1937) 13 florins

It is always a gratifying stage in the development of any department of science, when a large number of detailed investigations can be collected correlated, and woven into a coherent philosophy of the subject as a whole That stage has arrived in the study of soil mycology and the monograph under review is worthy of the occasion Literature upon the taxonomy of microscopic fungi which live in the soil has been comparatively unavailable Dr Niethammer's work collects it and the mycologist whose studies have not hitherto been specifically related to pedology may now find his way with relative ease amongst the Phycomycetes Ascomycetes and Fungi Imperfecti which provide the microscopic fungus flora of the soil

The second part of the monograph reviews the distribution of these organisms in relation to world wide geographical and climatic conditions to soil types and to the higher plants which grow thereon This leads to a discussion of the life histories of fungi under natural conditions, their pathology and chemical action upon various substances in the soil Modern conceptions of growth regulating substances are reviewed mycologically, whilst the relation of soil fungi to the practice of manuring is also discussed Many new correlations are here possible, and a large amount of such information is included in the 73 quarto pages of detailed stocktaking which follow the 100 pages of taxonomy The shortening of some generic names to their initial is sometimes disconcerting, whilst the further criticism of the paucity of plates and drawings is only emphasized by the high quality of the six which are included J G

The Conservation of Prints, Drawings and Manuscripts

By Dr H J Plenderleith (Published for the Museums Association) Pp vii + 66 + 5 plates (London Oxford University Press, 1937) 3s 6d net

This is the second member of a series of booklets issued by the Museums Association with the general idea of helping curators in their task of conservation of precious objects It may be said at once that this purpose is admirably fulfilled by the pages now before us

The scheme is, first to consider the nature of the materials in question—paper, parchment, inks and so forth—and then to discuss methods for cleaning and repair Both physical and chemical processes are involved in this work The crux of the whole matter is experience Given that experience, a very modest equipment will enable it to be utilized to the full The value of this manual is that it is the product of profound experience, presented in such a way that others may benefit from it, even if their resources are more limited than those at the author's disposal A number of good illustrations are included

F I G R

Electricity and Magnetism

an Introduction to the Mathematical Theory By A S Ramsey Pp xi + 267 (Cambridge At the University Press, 1937) 10s 6d

Vieille école, bonne école hey? said Major Pendennis and the remark is irresistibly suggested by the contents and scope of a work which covers the schedule for Part I of the Tripos untouched and undismayed by the drums and tramplings of one knows not how many conquests Here the student will find an old story admirably retold and he who would learn to deal effectively with such problems as demand a good working knowledge of Laplace's equation the method of images distribution in networks of conductors self and mutual inductance and the like will find the president of Magdalene's volume an efficient and trustworthy guide He will have much more to learn before he arrives at the confines of modern knowledge of electricity but he will have nothing to unlearn, and a careful study of the book will provide him with knowledge likely to be of great help in his later studies A F

Brompton Hospital Reports

a Collection of Papers recently published from the Hospital Vol 6 Pp iv + 183 + 6 plates (London Research Department, Brompton Hospital 1937) 2s 6d

In addition to three hitherto unpublished articles dealing respectively with multiple cystic disease of the lungs by Drs F H Young and N C Oswald an investigation of the relation of bronchography to post lobectomy atelectasis by Mr R H R Belsey and an investigation on statistical lines of the clinical aspects of senile phthisis by Drs W D W Brooks and F P Lee Lander this volume contains papers which have been published elsewhere on perspective and poise in practice, and various aspects of pulmonary tuberculosis and other diseases of the chest The index of authors for the first six volumes and the subject index for the first five are included The annual report of the Hospital for 1937 is appended

German for Students of Medicine and Science

with Notes, Grammatical Introduction and Vocabulary By W F Mainland Pp xlvii + 160 (Edinburgh and London Oliver and Boyd, n d) 8s 6d net

This useful work is intended to relieve the irksomeness of learning German for the already overworked undergraduate, medical practitioner or lecturer in a medical school, who should welcome the unconventional method adopted The book contains an indispensable minimum of grammar, a short list of German medical journals and a selection of passages from medical and lay writers, classified as easy moderately difficult and advanced, and dealing with anatomy, histology, physiology, biochemistry, pathology and bacteriology, medicine, pharmacology, surgery, hygiene and dietetics, psychology and the history of medicine A vocabulary is provided

Further Evidence on the Structure of the South African Pleistocene Anthropoids

By Dr R Broom, F R S , Transvaal Museum, Pretoria

NO apology need be given for publishing to the world at the earliest possible moment all new evidence that is discovered which seems to throw additional light on the structure of the apes that apparently are related to the ancestors of man Every month reveals some new facts of importance and it seems to me better that these should be announced at once than that they should be held back for perhaps years in the hope of publishing a detailed account

Some weeks after the Kromdraai skull was discovered (see NATURE Aug 27 p 377) I was fortunate in finding in the same matrix as the skull and within a few feet of the spot where it was found three bones of the post cranial skeleton These are the lower end of the right humerus part of the proximal end of the right ulna and a toe phalanx

As will be seen from Fig 1 the humerus resembles so closely that of man that some will doubtless be inclined to refer it to a species of man and to consider the possibility of man having been associated with *Paranthropus* and of course it is impossible to prove that the humerus belongs to the ape Still as in the caves at Sterkfontein and Kromdraai between 3 000 and 4 000 specimens have been collected and no tooth or bone of man has so far been discovered and as this humerus was got close to the skull of *Paranthropus* which in a number of points of structure is nearly man I think it practically certain that the humerus not only belongs to *Paranthropus* but also to the type individual Assuming that it is the humerus of *Paranthropus* it is interesting to note that it is nearly human in all its characters and that it differs markedly from the humeri of the chimpanzee and gorilla From which we may infer as probable that *Paranthropus* like man was a bipedal animal and that the arms were not used for locomotion but for the manipulation of sticks and possibly tools

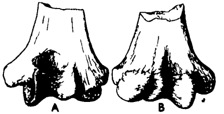

Fig 1
DISTAL END OF RIGHT HUMERUS OF *Paranthropus robustus* BROOM *A* POSTERIOR VIEW *B* ANTERIOR VIEW HALF NATURAL SIZE

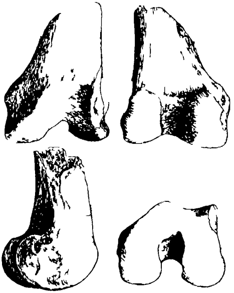

Fig 2 FOUR VIEWS OF DISTAL END OF LEFT FEMUR BELIEVED TO BE THAT OF *Plesianthropus transvaalensis* BROOM HALF NATURAL SIZE

Near the same spot was found part of the proximal end of the right ulna It is not sufficiently well preserved to afford much evidence It is nearly human

The third bone which I believe to belong to the *Paranthropus* skeleton though very small is of great importance It was also got at the same spot and within a few feet of the site of the skull It is the distal phalanx of one of the toes probably of the second (Fig 4*C*) It is too short to be the ungual phalanx of one of the fingers and it seems too long to be the ungual phalanx of a human toe It seems to show that *Paranthropus* had toes like those of man but rather longer

At Sterkfontein the distal end of a femur has been discovered which may be referred with very little hesitation to *Plesianthropus transvaalensis* A little part of the external tuberosity is lost but otherwise the fragment is perfect The accompanying drawings (Fig 2) show that it is nearly human in all its characters The intercondylar notch is relatively narrow, but not narrower than in a Bushman femur I have The femoral fragment seems to indicate that *Plesianthropus* was also probably a bipedal animal.

The intercranial cast of the type of *Plesianthropus* shows that the cranial capacity is about 440 c c As the type skull is almost certainly that of a young female, it seemed probable that the male would have a larger cranial capacity About six months ago, I was fortunate in finding a considerable part of the cranial cast of what I believe to be a male skull Not far from the spot where the cranial cast was found, I obtained part of the skull of an old male Most of the skull was so broken and crushed as to be of little value, but much of the left maxilla and malar are fairly well preserved. All the teeth except the last molar are worn down almost to the roots, and even the last molar is much worn. It seems probable that this upper jaw belongs to the same individual as the cranial cast and that the animal was an old male Though only about half of the cranial cast is preserved, it is possible to make a satisfactory restoration, and it is seen to be very considerably larger than that of the type I give figures on the same scale of the two cranial casts I estimate the capacity of the supposed male skull to be about 600 c c., but as less than half the cast is preserved and it is in part a little crushed, it is impossible to do more than make a rough estimate The capacity can scarcely be less than 600 c c and may perhaps even be 650 c c

From Fig 3 it will be seen that the supposed male cast is remarkably like that of *Pithecanthropus erectus*, and if von Koenigswald's estimate of the cranial capacity of his new skull as 750 c c be correct, our South African anthropoid ape is not very far behind this primitive human type

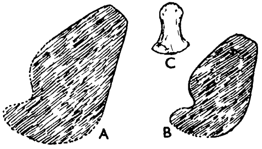

Fig 4

A Section through mandibular symphysis of *Paranthropus robustus* Broom

B Section through mandibular symphysis of ten year old male child of *Plesianthropus transvaalensis* (Broom).

C Terminal phalanx of toe of *Paranthropus robustus* Broom

(All natural size)

I give drawings (Fig. 4) of the symphyses of the mandibles of *Plesianthropus* and *Paranthropus* The former is from the symphysis of a male child of about ten years of age It is fairly complete, only the lower portion being lost. If this be compared with the symphyses of other anthropoids and of primitive human types, it will be seen that the only forms that approach it at all closely are *Dryopithecus* and the gorilla The symphysis of the adult *Paranthropus* is less satisfactorily preserved, but it can be restored with considerable confidence It is seen to be very massive—more massive than in any other known primate except the gorilla There is no very close resemblance between the symphysis in the chimpanzee and those of our fossil anthropoids

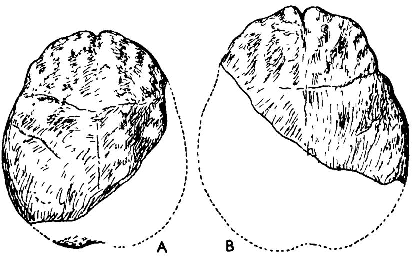

Fig 3.

A. Cranial cast of type specimen of *Plesianthropus transvaalensis* (Broom), believed to be a young female, about 440 c.c. (× ½.)

B. Cranial cast of what is believed to be an old male of *Plesianthropus transvaalensis* (Broom), about 600 c.c. (× ½)

When the Sterkfontein ape was found, I considered the geological age to be probably Upper Pleistocene, as a number of horse teeth had been found in an adjoining cave and I considered those to belong to *Equus capensis*—a fossil horse which we know survived until comparatively recently. Within the last few weeks, we have obtained many much better preserved horse teeth from the same cave, and we now find that though those belong to a large horse allied to *Equus capensis* they cannot belong to this species They will possibly prove to belong to *Equus harrisi* a species which I named ten years ago from teeth found in the diamond gravels

The positive evidence for *Plesianthropus* being Upper Pleistocene thus disappears It must belong to some part of the Pleistocene but we must wait for a more precise determination Until we have more evidence we may provisionally place both *Plesianthropus* and *Paranthropus* in the Middle Pleistocene though they were not contemporaries and the Taungs ape *Australopithecus* may be Lower Pleistocene or possibly Upper Pliocene

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Fine Structure of the Plant Cell Wall

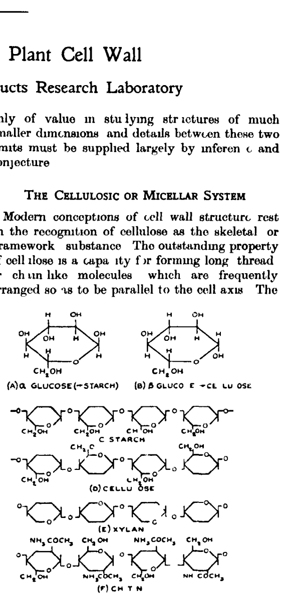
By S H Clarke, Forest Products Research Laboratory

ALTHOUGH it is almost eighty years since Nageli[1] introduced the micellar hypothesis to account for the anisotropy of certain plant structures it is remarkable how nearly his original conception satisfies the most recent discoveries It may be recalled that Nageli pictured the cell wall as composed of ultra microscopic particles to which he gave the name micelles and which were regarded as discrete units more or less like the bricks in a masonry wall In order to explain the shrinkage of wood it was assumed that water entered or left the intermicellar spaces pushing the micelles farther apart or allowing them to come nearer together and the elongated shape of the micelles was held to account for the difference between longitudinal and transverse shrinkage the optical anisotropy of the cell wall was referred to the optical properties of the micelles themselves Some revision of Nägeli s statement was however found necessary and a large body of workers rejected the conception completely postulating instead a system of continuous or connected cellulose threads or layers Neither conception is completely satisfactory and the modern tendency is to seek a compromise between the two The position has been reviewed from the point of view of physicist chemist and botanist[2,3,4,5] perhaps the fullest summaries being those of Frey Wyssling[5]* which have been freely used in the present account

The aim of the present account is not to offer a complete survey of the literature (the references quoted will lead indirectly to the more important contributions to the subject) but to give a fairly simple picture of the current conception of the different phases of cell wall structure At the outset it must be realized that a complete picture is impossible as yet because while the wave lengths of visible and ultra violet light only permit the accurate and direct observation of particles larger than about 2500 A X rays are only of value in studying structures of much smaller dimensions and details between these two limits must be supplied largely by inference and conjecture

The Cellulosic or Micellar System

Modern conceptions of cell wall structure rest on the recognition of cellulose as the skeletal or framework substance The outstanding property of cellulose is a capacity for forming long thread or chain like molecules which are frequently arranged so as to be parallel to the cell axis The molecular weight and therefore the length of the chain molecules have so far proved indeterminate there is some evidence that they may not be constant and several investigators have insisted that it is incorrect to speak of a cellulose molecule Although cellulose may be shown by X ray examination to have a definite crystal structure it has never been observed in a crystalline form



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* Dr Frey Wyssling kindly read the draft of this review

It is insoluble in all the usual chemical solvents Introductions to the chemistry of cellulose begin with reference to glucose a hexose sugar existing in two forms (formulæ *A* and *B*) both of which may undergo condensation to form larger chain molecules Whereas the molecules of the α form combine as represented conventionally in formula *C* linkage in the β form demands the rotation of alternate molecules through 180° (formula *D*) The higher degree of symmetry in the chains of β molecules is apparently accompanied by a greater stability and it is probable that on this rests the importance of the β glucosidic cellulose as the fundamental framework constituent while the less stable α glucosidic molecules of starch occur as reserve materials which are of a more temporary importance in the life of the plant It is of great interest that xylan (a pentosan commonly occurring with cellulose in the cell walls of wood) and chitin (the framework substance of fungal cell walls) may have a fundamentally similar chain structure as shown in formulæ *E* and *F* respectively it has been suggested[8] that individual chain molecules may include a variety of units for example glucose xylose glucuronic acid

X ray diffraction studies have revealed the dimensions of the spaces occupied by the individual glucose residues of the cellulose chain molecules and by the same method the length of the chains has been variously estimated at between 600 A and 750 A that is 120 150 glucose residues Viscometric determinations however give the chain molecules a length of ten or twenty times that indicated by X rays The absolute legitimacy of both methods has been questioned and it is not possible at present to decide which result is the more likely to be correct there is reason to believe however that further light will be thrown on the subject by studies of the end groups of the chains which are being carried out in several laboratories In spite of the contention of some investigators that the chain molecules may extend unbroken from end to end of the cell it is widely believed that the figures yielded by X ray studies and by viscometric determinations are both approximately of the correct order of magnitude and that the chain molecules are much shorter than the cells In this connexion it is of interest that a fairly close relation exists between the strength of whole fibres and the length of the cellulose chain molecules as revealed by the viscometric method[7] it has been shown that maximum strength is reached in chains of about 2 000 glucose residues and that further increase in chain length does not affect strength Hydrolysis such as accompanies the attack of certain fungi results in the breaking of the cellulose chains into shorter units and in a lowering of the tensile strength

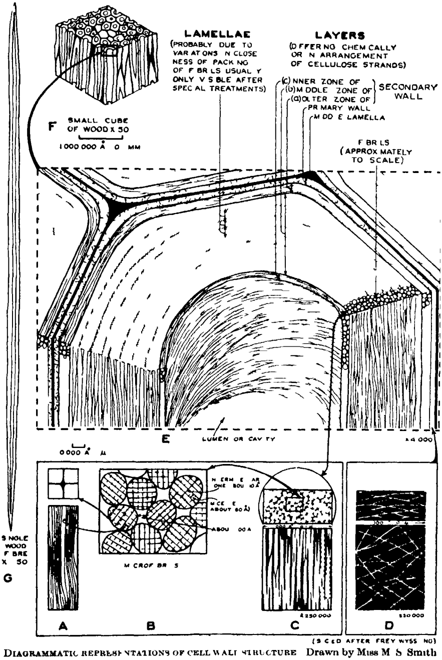
Plant fibres may be completely delignified without disintegration so that the cellulose apparently forms a continuous system throughout the cell wall It is also possible to remove the cellulose from the cell walls of some tissues leaving behind what is presumed to be a continuous skeleton of lignin In consequence the cell wall is regarded as having continuous and interpenetrating systems of cellulose and lignin The structure has been likened to reinforced concrete in which the iron strands represent the cellulose framework and the concrete the lignin and other substances From X ray diffraction patterns however the impression is gained that the cellulose chain molecules occur in discrete aggregates about 50 A in diameter and more than 1000 A in length This impression is given by both dry and water saturated material and it would therefore appear that water penetrates between the aggregates without disturbing their internal crystal structure In consequence they have been regarded as corresponding to micelles and they are so named albeit with a somewhat different meaning from that of Nageli The cellulose system is therefore visualized as continuous and yet able to give the impression of being composed of discrete micelles when examined by X rays

Fig *A* illustrates a feasible conception of a molecular arrangement fulfilling these conditions The cellulose chain molecules are represented as lines which are not completely parallel but show slight local variations in direction so that here and there lens shaped spaces occur between adjacent chains There are however many zones in which the chain molecules are parallel (indicated in Fig *A* by thicker lines) and since it is only such zones of regular arrangement that influence the X ray diffraction patterns the illusion of discrete aggregates is produced Actually the aggregates are linked by molecules which extend from one regular zone to another so as to maintain the continuity of the system In Fig *C* this condition is illustrated on a smaller scale the white zones indicate the distribution of the cellulose and the dotted lines the regions in which the chain molecules are parallel It may be observed from the dimensions given that the two illustrations (Figs *B* and *C*) do not completely correspond This lack of correspondence is doubtless explained by the fact that they were originally produced independently and in all probability the intermicellar spaces and the larger capillaries actually intergrade continuously in size

Adjacent glucose residues within a chain molecule of cellulose are united by primary valences but the nature of the attraction between laterally adjacent chain molecules has not yet been fully elucidated It is generally supposed however that the chain molecules are united laterally by van der Waals cohesion Frey Wyssling mentions in criticizing the hypothesis of discrete micelles that this force must also be invoked in seeking to explain the attraction between micelles It is clearly unsatisfactory to be compelled to resort to a single force to explain two distinct phenomena for example it is difficult to explain on such grounds why water only enters the intermicellar spaces and does not penetrate between the chain molecules within the micelles

The Intermicellar System

It is believed that the intermicellar system is normally occupied by lignin and related substances Whatever their composition these materials produce no effect on the X ray diffraction pattern so that they are apparently non crystalline Although they occupy a continuous system the intermicellar materials appear to have little or no influence on the tensile strength of the cell wall they bestow on the cellulose system however an increased rigidity and incidentally increase the resistance to compression Information regarding the intermicellar system has been obtained by impregnating cell walls with solutions of silver or gold salts, and precipitating crystals of the metals in the intermicellar spaces so as to make an impression on the X ray diffraction pattern In this way it has been



Diagrammatic representations of cell wall structure Drawn by Miss M S Smith

A Cellulose chain molecules showing here and there zones of regular and parallel arrangement (the micelles indicated by X rays)

B Group of microfibrils showing approximate relative sizes of micelles and spaces revealed by study of material impregnated with silver

C Cellulosic and non cellulosic systems in the secondary wall Cellulose white non cellulosic materials black transverse section above longitudinal section below Large circle indicates approximate size of fibril at same magnification (Note that the dimensions given by the author of Figs B and C do not correspond exactly but they serve to indicate the approximate sizes The linking arrows have been inserted by the present writer)

D Cellulosic and non cellulosic systems in the primary wall Cellulose white non cellulosic materials black transverse section above longitudinal sections below

E Small piece of wood showing the relative sizes and dispositions of the cell wall constituents as revealed by microscopic examination

F Small cube of wood fibres magnified 150 times

G Single wood fibre magnified 150 times

estimated that in their widest parts the spaces sometimes reach a width of 100 A that is about twice the diameter of the micelles Combining the data obtained from various X ray investigations the picture in Fig *B* has been suggested as representative of the condition in a typical cell wall It may be observed that the intermicellar spaces vary considerably in size and that the micelles themselves are aggregated into microfibrils separated by spaces rather larger than the usual intermicellar spaces In his studies of wood water relationships Barkas[8] reached the conclusion that there is a continuous gradation in size of the space system ranging from the botanical capillaries down to the colloidal structures and it would therefore appear probable that the intermicellar spaces and the spaces between the microfibrils are continuously graded in size

An interesting sidelight on the nature of the intermicellar system is afforded by the change in the refractive index of water entering the system Although the refractive index parallel to the chain molecule axis of dry cellulose by sodium light is 1 596 and that of water is 1 333 the refractive index of cellulose when swollen by 25 per cent of its volume of water is not noticeably less than that of dry cellulose whereas an index of about 1 536 might be expected if the water and cellulose were merely mixed Moreover the volume contraction and the evolution of heat which accompany the swelling of wood by water indicate some form of combination between the water and the wood cell wall Frey Wyssling suggests that the original function of the intermicellar spaces is bound up with the growth of the cell wall and that in the early stages of formation the protoplasm may occupy these spaces

MICROSCOPIC STRUCTURE

The phases of cell wall structure described above are invisible because the units involved are much smaller than the wave length of light There is a gap in our knowledge between the microfibril and the smallest particles distinguishable microscopically because no form of direct or indirect observation is yet available We must now therefore turn to the visible structure built on the micellar framework

Kerr and Bailey[9] have reviewed the nomenclature of the cell wall marshalling the evidence that in typical cells the wall has three distinct regions (Fig *E*)

(1) The *middle lamella* or intercellular substance is formed from the cell plate at cell division and is shared by adjacent cells it is very thin completely isotropic and composed largely if not entirely of polyuronides

(2) The *primary wall* is developed from the cambial wall it is anisotropic and is composed of cellulose with large proportions of hemicelluloses pectic substances and lignin It is laid down during the period in which extension growth takes place and this is reflected in the structure of the cellulose framework Fig *D* is an attempt to portray the relative proportions and arrangements of the cellulose framework and the intermicellar system of the primary wall on a scale comparable with Fig *C* which represents the condition in the secondary wall It may be observed that the cellulose strands are much more slender in the primary wall and Frey Wyssling suggests a more irregular arrangement as a consequence of growth by intussusception the intermicellar zones occupy a larger proportion of the whole in keeping with the fact that the primary wall is much more heavily lignified than the secondary wall It will readily be appreciated that if the tensile strength of wood depends on that of the cellulose strands it is likely to be limited by the zones in which these strands are least strongly developed and it is not surprising that in green wood tension failures normally occur in the region of the middle lamella and primary wall[10]

(3) The *secondary wall* is composed of cellulose or of varying mixtures of cellulose hemicelluloses lignin pentosans etc This wall is presumably produced mainly for mechanical reasons it is incapable of extension growth and during growth is added to by apposition Three distinct zones are frequently to be seen an outer zone (*a*) which is distinguishable in transverse sections from the middle zone (*b*) on account of a difference in refractive index It has already been mentioned that cellulose is anisotropic and the difference in refractive index between these two zones is due to the fact that in the outer zone the cellulose strands are arranged in a flat spiral (Fig *E*) whereas in the middle zone they are as a rule approximately parallel to the cell axis For this reason the outer and inner zones are readily distinguished when examined between crossed nicols The outer and middle zones are usually identical or similar in composition but there may be variations in the substances occupying the intermicellar spaces In some cells an inner zone (*c*) is present differing from the middle zone (*b*) in composition and in that the cellulose units pursue a flat spiral (Fig *E*)

Within this general scheme much variation is possible in different tissues and in the cells of different species In some cells no secondary wall is found while in others it is very strongly developed and shows within itself elaborate zonations Bailey and Kerr[11] illustrate fibres in the secondary walls of which the inclination of the cellulose units alternates in several successive layers, reminiscent of the alternations in grain direction in plywood The same authors illustrate other fibres in which the secondary walls show several zones caused by variations in the intensity of lignification these zones may be concentric radial or radio concentric, and Bailey and Kerr have shown the arrangement to be influenced by geotropic or phototropic stimuli operating on the growing tree

Zonations of the types described due either to variations in chemical composition or to variations in the arrangement of the cellulose units affecting the optical anisotropy of the cell wall are known as layers A much finer type of concentric zonation termed lamellation occurs in the walls of many plant fibres Although it may accompany layering lamellation is of a different nature and is not revealed microchemically or by polarized light A single layer may include several lamellæ Lamellæ may be observed in the thick walled fibres of certain species when thin transverse sections mounted in liquids of suitable refractive index are examined at very high magnifications they may be revealed also in the fibres of many other species when transverse sections are considerably swollen in dilute cuprammonia From calculations based on their dimensions in swollen material it has been estimated that in the natural state the lamellæ of the cotton hair are 0·4 μ (= 4000 A) or less in thickness In swollen sections each lamella is seen to comprise two concentric zones differing in brightness and it is purely on account of these variations in optical density that the lamellæ are visible It has been established that in the cotton hair the lamellæ are caused by diurnal fluctuations in light and temperature during the growing period[13] and although the methods used in studying the lamellations of cotton hairs cannot be applied to cells in other parts of the plant it has been suggested that lamellation in xylem fibres is of a similar nature[3]

By means of controlled chemical and mechanical treatment[5,14] the cellulose wall may be dissected into tenuous threads known as fibrils these are of indeterminate length and their diameter has been variously reported as between less than 1000 A to about 5000 A By further dissection the fibrils may be broken into smaller bodies described as dermatosomes fusiform bodies etc the diameter of which is reported to be 5000 A or less and the length of which is from about 1000 A to 1500 A The descriptions of various investigators show discrepancies which are no doubt due to the observation of different tissues of different species, to variations in the technique of dissection and perhaps to variations in the degree of swelling at the time of measurement All that can be said is that by dissection the wall can be broken into fibrils and these into smaller units Bearing in mind that dissection is only accomplished as the result of severe chemical treatment some reserve is necessary in attempting to construct from these units a picture of the cell wall in its original state Nevertheless the rough correspondence between fibril diameter and the dimensions of the lamellæ suggests that the separations are not entirely fortuitous Bailey and Kerr[1] actually attribute the lamellæ to variations in the closeness of packing of the fibrils or in the number of fibrils per unit area of cross section Some authors have suggested that the dermatosomes and the fibrils are coated with a non cellulosic material after the fashion of mortar in a masonry wall If this be the case we are again thrown back on the properties of the mortar as the ultimate source of the tensile strength whereas it has already been stated that there is much evidence for believing the cellulose to be mainly responsible In this connexion it may be mentioned that Farr and Eckerson[8] have described what they believe to be the laying down by the protoplasm of minute particles of cellulose coated with some pectic material which acts as a cement in the cell wall Weighty objections to this view are summarized by Anderson and Kerr[2]

From microscopic evidence then we are able to say that the plant cell wall is ordinarily composed of concentric layers differing in the relative proportions of cellulose and other constituents The layers appear to be built up of fibrils long slender threads of cellulose the direction of which is often parallel to the main axis but is subject to variation in different layers The closeness of packing of the fibrils is subject to periodic fluctuation as a result of which the cell walls frequently include a large number of extremely narrow lamellæ The fibrils may be dissected chemically into small fusiform bodies or dermatosomes It is inferred from the behaviour of suitably treated material that both the cellulose and the non cellulosic constituents of the cell wall form continuous systems which are finely interpenetrating and it is apparent that the cellulose system is mainly responsible for the tensile strength whereas the non cellulosic constituents have a stiffening effect which results in increased resistance to compression From X ray evidence it is concluded that the fibrils are themselves composed of microfibrils which in turn consist of aggregates of micelles The micelles are aggregates of cellulose chain molecules Each chain molecule includes a large number of glucose residues but it is not yet known whether the chains are of uniform length or even of uniform constitution In all probability neither micelles microfibrils nor fibrils are discrete units, and their apparent independence is illusory and is due to peculiarities in arrangement that affect certain types of observation It seems probable that the spaces between the cellulose units such as might contain water, non cellulosic wall constituents or protoplasm at certain stages in the life of the cell are of a continuously graded size and may be regarded as the successive ramifications of a single system

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Obituary Notices

Dr C C Carpenter

THE technical press has paid tribute in full measure to the memory of Charles Carpenter to his many outstanding achievements in the gas industry to his ability to manage and to organize to his intense consideration for his fellow workers as displayed in his zealous furtherance of co partnership (see also NATURE Oct 8 p 636) There remains the need to express something of the man himself a difficult task with anyone but doubly so with one of his complex personality

Dr Carpenter was a far greater man than his contemporaries realize His shyness the habit of working alone which had developed almost to an inability to work with others the reluctance to take part in those co operative efforts which are so fashionable to day, have collectively resulted in limiting the number of those to whom he was personally known during the later years of his life Possibly to many of us now active in contemporary spheres he has been a memory of past deeds rather than the present embodiment of an activity both mental and physical which his colleagues and intimates knew he had preserved until stricken by illness

My friendship with him dates twenty five years back when he was already distinguished and his habits formed He had consented to become president of the Society of Chemical Industry at a critical time when the status of that industry in England had been brought low by neglect Some of us were making a great effort to reform the Society, which we regarded as a potential instrument for progress, and to change its complacent attitude of parochial conservatism to one of vigorous action Carpenter proved an ideal chairman at many difficult meetings and won the confidence of all by his firm and sympathetic handling of delicate situations When it was realized that the troubles of the chemical industry could best be overcome by the formation of an entirely new Association of British Chemical Manufacturers, Dr Carpenter was the obvious and universal choice for its first chairman In th capacity he displayed his best qualities in the handlin of the initial difficulties including the reconciliatio of conflicting interests and so laid a firm and sur foundation for its future success

This achievement in sooth a considerable one might have tempted Dr Carpenter to continu collective industrial leadership at a time whe leaders of his calibre were so much in demand, an he had many requests to do so, but the work wa foreign to his real nature and he preferred to immers himself wholly in the problems of his gas companie to their great advantage

Carpenter s qualities in his daily work have be emphasized by others His attention to detail th desire to find a reason for everything the refusal t put up with anything but the best his pertinacity to pursue a matter to the end, his remarkable powe of continuous work and numerous other attribute combined to make him the personality he was durin the long working day The high standard he set fo himself made him expect the same of others an caused him perhaps to be lacking in sympathy towards lesser mortals This made him unduly severe when displeased and over generous whe giving reward Hazlitt somewhere defines genius as the power of producing excellence, from this point of view, Carpenter certainly was a genius

It was given to a few intimates to know Charl Carpenter on his artistic side Evenings after dinne in his large comfortable room in Chelsea dwell in my memory Spartan himself, he provided good chee for his guests, and the range of conversation displaye a human personality remote from the austere chair man presiding in his board room The boon of artistic enjoyment makes itself manifest in many ways To some it comes through the gradations of the bitten line, others find revelation in broader ton masses put on with a palate knife, more of us like my late father find intense happiness in colour A clas apart find supreme joy in the melodies of music, an to these belonged Carpenter He derived great pleasure from his gramophones ingeniously arranged to play both sides of a record consecutively without a break the opera and concerts were his one relaxation and the only accepted reasons for his going out in the evening His library was peculiar in more than one respect He took great pride in the workmanship and binding of his books and regretted the decline in that craft His tastes would be called old fashioned literature of the French sentimentalists and George Moore were among his favourites He detested anything shoddy or imperfect

This attitude is reflected in Dr Carpenter's annual addresses as chairman, which instead of the usual platitudes contained studied discourses on matters of moment to the policy of the company in which the meaning of every word had been weighed an immense amount of time and trouble went to the preparation of these

How shall we reconcile the dual characters the shy sentimental music loving artist with an intense sense of perfection and a hatred of shams the reasoning intrepid engineer seeking to put into his creative work the artistic expression which he could not by his own hand achieve with pen or piano the great leader setting so high a standard for himself that he felt he could not trust to others to execute his plans and so becoming lonely, unable to depute in the way that modern industry demands carrying most of his burdens himself and in later years almost unwilling to be helped

Each one of us is the integration of our many component parts, and who shall judge if the result is short of the ideal Charles Carpenter was a great engineer a cornerstone of the gas industry to which he devoted his life the best of masters to his thousands of work people, to whom more than anything else he brought fair dealing and security and a complex and lovable personality to his intimates We shall think of him at his best and remember how in life he did

Strive and hold cheap the strain,
Learn, nor account the pang,
Dare, never grudge the throe'

E F A

Prof W H Merrett

Prof W H Merrett formerly assistant professor of metallurgy at the Royal School of Mines who retired from his post rather more than a year ago, died after a short illness on October 29 last He was sixty six years of age A fortnight before his retirement he had a severe stroke from which he never really recovered It was followed by another, after an interval of little more than a year, which proved fatal

Merrett received his school education at St Olave's School, London, during which time he gained a number of valuable prizes for science, and obtained a Royal Exhibition of the Board of Education In 1891 he entered the Royal School of Mines, and after spending three years there was awarded a first class in the associateship of the School in metallurgy This was during the tenure of the late Sir William Roberts Austen of the professorship of metallurgy In addition to holding this post Sir William was chemist and assayer of the Mint and it was there that he carried out his researches on metals and alloys Thither Merrett proceeded after graduation and acted as an assistant in the prosecution of these researches during the next seven years It was a particularly interesting period in the development of that branch of metallurgy which is to day known as metallography These were the early days of the subject and the foundations were still being laid Roberts Austen was himself one of the pioneers he was a member of the Alloys Research Committee of the Institution of Mechanical Engineers and published five reports of experimental work in all It is with the work for the fifth report that Merrett was particularly associated acting as an assistant to Roberts Austen and Stansfield

The method of investigating the thermal inversions of metals and alloys at that time by taking cooling and heating curves was due to the late M Osmond using the thermo electric pyrometer introduced by the late H le Chatelier In this method the co ordinates were time and temperature and while it was quite satisfactory in the upper ranges of temperature it was not so suitable for the lower ranges where the rate of cooling becomes very slow Roberts Austen and Stansfield accordingly devised the differential method in which a neutral body was also present (Strictly speaking it is not a differential but a difference method since no differential co efficient is involved) In this method temperature and difference of temperature were the co ordinates, and accordingly the rate of cooling did not matter Moreover, accidental fluctuations in the rate of cooling of the furnace were cancelled out This method could be made very sensitive and by its means accurate thermal curves of iron and carbon steels were obtained In the Fifth Alloys Report is published a curve of a sample of electro deposited iron which had cooled from 1150° to 100° C It represented the most skilled piece of experimental work in this field at that time In addition this research contains a number of photomicrographs of steel structures of great clearness Merrett developed a skilful technique in both these branches of metallography, which contributed very much to the value of the report in question He was the first to apply the electric arc light as a method of illumination in the metallographic microscope The Sixth Report to the Alloys Research Committee had been begun during Roberts Austen's lifetime but owing to his illness and death it was completed by the late Prof Gowland with the assistance of Merrett This deals with the heat treatment of steel

Roberts Austen was also a member of a War Office and Admiralty Committee on Explosives and Ordnance In this capacity he carried out a number of investigations most of which were of a strictly confidential nature These comprised (*a*) the nature of erosion in gun tubes (*b*) the effects of various additions of nickel, chromium, tungsten and manganese on the mechanical properties of gun steels, and (c) the effects of heat treatment on gun steels Merrett carried out all the experimental work on which these reports were based He conducted an investigation, also under Roberts Austen, for the Board of Trade on the St Neots railway disaster This examination was published *in extenso* as a Blue Book in 1900, and the accident traced to a broken rail He found evidence of a 'martensitic structure, which is associated with great brittleness on its surface A temperature of at least 800° C is required to produce this Merrett was at least partly if not wholly responsible for a new lyddite shell exploder, for which a secret patent was taken out by the late Lord Haldane He was also largely concerned with the development of ammonium nitrate for use as an ingredient of explosives which led to the introduction of amatol

In 1901, Merrett was appointed instructor in the Metallurgy Department of the Royal School of Mines, and spent the remainder of his professional life there until his retirement He rose to the position of assistant professor He was an admirable teacher, clear and inspiring This side of his work appealed to him very much He was always anxious that his students should conduct themselves with credit in their examinations, and this led him sometimes to take a kindlier view of their performances than the results warranted As early as the age of sixteen years he showed his taste for military work and joined the 3rd Middlesex Artillery in 1888 He was transferred as a sapper ten years later to the newly formed Corps of London Electrical Engineers He rose to the rank of major and was mobilized for active service on July 29, 1914 During the Great War he was in charge of various coast defences and anti aircraft units Afterwards his scientific knowledge was made available to the Ordnance College as instructor in metallurgy, chemistry and explosives In 1926 he retired from military service on reaching the age limit and was awarded the Territorial Decoration and Long Service Medal

Merrett was a member of many scientific societies, a governor of the School of Metalliferous Mining at Camborne and a member of council of the Institution of Mining and Metallurgy The writer was a colleague of his at the Royal School of Mines for twenty three years He possessed qualities which made him one of the most delightful of fellow workers Some of these such as punctuality and reliability, could probably be traced to some extent to his military training Others, such as his perfect courtesy, generosity and good temper, were natural to him It is impossible to think that he had an enemy His many friends mourn the loss of one of the kindest and most unselfish of men H C H C

We regret to announce the following deaths

Mr J F Bailey director of the Botanic Gardens, Brisbane, from 1905 until 1917, and director of the Botanic Garden, Adelaide from 1917 until 1932

Prof E M East, professor of genetics in Harvard University aged fifty nine years

Admiral Sir Herbert Purey Cust, K B E , C B formerly hydrographer to the Navy, on November 11 aged eighty one years

News and Views

The Royal Society

His Majesty the King has been graciously pleased to approve the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year to Dr F W Aston, F R S in recognition of his discovery of the isotopes of non radioactive elements and to Prof R A Fisher, F R S , in recognition of his important contributions to the theory and practice of statistical methods The Council of the Royal Society at its recent meeting recommended the following for election as officers and council at the anniversary meeting on November 30 ***President***, Sir William Bragg ***Treasurer*** Sir Henry Lyons , ***Secretaries***, Prof A V Hill and Prof A C G Egerton , ***Foreign Secretary***, Sir Albert Seward , ***Other members of the Council***, Prof F C Bartlett, Prof F E Fritsch, Prof M Greenwood, Mr H L Guy, Sir Thomas Holland, Dr A D Imms, Prof C K Ingold, Prof G B Jeffery, Prof J Mellanby, Prof J Proudman, Dr F L Pyman, Prof O W Richardson, Prof W W C Topley, Prof D M S Watson, Prof R Whiddington, Prof R Whytlaw Gray

Prof Enrico Fermi

The Nobel Prize for Physics for 1938 has been awarded to Prof E Fermi, professor of theoretical physics in the University of Rome, and his work in connexion with artificial radioactivity induced by neutrons is specially mentioned in the award Bombardment of the nucleus with neutrons is peculiarly effective in producing nuclear reactions because the neutron does not experience the strong electrostatic forces which oppose the approach of a proton or α particle Fermi in 1934 showed that most nuclei, even the heaviest which are most resistant to charged particles, are disrupted by neutrons with the formation of new radioactive nuclei In the same year, he discovered that the effectiveness of neutron bombardment is greatly increased in the presence of masses of water or paraffin, and concluded that the neutrons are slowed down by collisions with hydrogen nuclei in these substances, and that the slow neutrons have a high probability of entering and disrupting nuclei Prof Fermi has, however, made other outstanding contributions to atomic physics In 1926 he applied Pauli's exclusion principle to deduce a new kind of statistics for electrons (Fermi Dirac statistics) He applied this to the assemblage of electrons in an atom (Thomson Fermi atom model) and it has become the basis of the modern theory of electrons in metals In 1934 he devised a theory of β decay, starting from the view that a β particle is emitted when a neutron in the nucleus turns into a proton The distribution of energies in a continuous spectrum requires that a neutral particle (neutrino) be emitted with the β ray This theory has formed the starting point for many more recent discussions Fermi has also published work on spectroscopy on quantum electrodynamics and, with Rossi, on the *deflection of cosmic rays in the earth's magnetic field*

Dr W D Lang, FRS

DR WILLIAM DICKSON LANG who retires from the keepership of geology in the British Museum (Natural History) at the end of the year, has made notable contributions both to palæontology and to geology While occupied with curatorial duties he has studied especially polyzoans and corals, and in classifying them he has always sought for underlying principles Like palæontologists studying other groups, he soon recognized parallel lineages in the evolution of these fossils as he traced them through geological time, and he found corresponding grades in the same order in each parallel lineage, showing that there was a definite common trend, as he termed it Natural selection, therefore, did not work on indefinite individual variations but on trends which were orthogenetic or in a certain fixed direction Dr Lang contributed several valuable papers on this subject to the *Proceedings of the Geologists Association*, and he summarized his results in discussions at the centenary meeting of the British Association in 1931

DEALING with animals which retained the complete skeleton of a lifetime in each individual Dr Lang could also study the growth stages, and he was convinced of the truth of the doctrine of recapitulation (the immature stages of an organism repeating more or less exactly the adult stages of its ancestors) He described it as "a guiding principle for palæontologists Dr Lang also recognized that the calcareous skeleton of the polyzoans, when once started in a lineage, often proceeds to superfluity and eventually leads to extinction He treated this subject in a memoir in the *Philosophical Transactions* in 1919, and in two valuable volumes of the British Museum Catalogue of Cretaceous Polyzoa, 1921–22 Dr Lang spent many vacations in studying the succession of zones in the Lias of the Dorset coast In 1924 he contributed to the *Proceedings of the Geologists' Association* a remarkably detailed map of those formations, and during more recent years he and other specialists have made a detailed examination of the fossils he collected His interests have always been varied, and during the Great War he investigated insects which spread disease, eventually preparing an exhaustive 'Handbook of British Mosquitoes', which was published by the Trustees of the British Museum in 1920

Prof A V Hill, OBE, FRS

THE Guthrie Lecturer of the *Physical Society* this year was Prof A V Hill Foulerton research professor and secretary of the Royal Society who chose as the title of his lecture delivered on November 11 The Transformations of Energy and the Mechanical Work of Muscles Prof Hill is a Cambridge man, where under Langley he devoted two years to research on the heat produced by living tissues Here Hill found a congenial and stimulating environment for those working in the laboratory at the time included such well known figures as Anderson, Barcroft Fletcher Hardy Hopkins and Keith Lucas Prof Hill's success may be said to be due to his appreciation of the basic essentials of a problem, to his knowledge of the methods by which such problems may be solved to his ability to design the apparatus required by such methods, and lastly to his skill in constructing the necessary apparatus himself A first rate athlete he was specially interested in the physiology of athletics It was he who showed that energy is developed in muscle at two different times during a single contraction Two pieces of apparatus have entered largely into these studies, namely, extremely delicate thermopiles and galvanometers which have a short period and great sensitivity While the study of energy of contraction of muscle has been Hill's main line of research a number of branch lines have interested him from time to time mostly on biophysical subjects, for example the measurement of small differences of osmotic pressure and the heat produced in nerves during the passage of impulses During the Great War, Hill was director of research on anti aircraft defence In 1920 he became professor of physiology in Manchester, and in 1923 professor of physiology at University College, London Prof Hill has been honoured by several foreign universities and learned societies and in 1922 he received the Nobel Prize for Medicine

Energy Transformations in Muscles

IN his Guthrie Lecture on the subject Prof A V Hill pointed out that the study of the heat given out by muscles in relation to the work done by them is one of the classics of physiology Until recently, however the matter appeared much more complicated than it really is owing to technical difficulties These have been overcome by the use of a very rapid recording system and an insulated thermopile only 0 002 inch thick Some very simple relationships have now emerged An active muscle liberates energy in three forms in maintaining a contraction as heat, in shortening as heat in shortening against load, as work its behaviour in any circumstances is deduced from the resultant of these three *Rate* of total energy liberation of a muscle is determined by the load upon it, increasing as the load decreases This allows a simple equation to be deduced for the relation between speed and load The constants of the equation are the same whether they are obtained by thermal or by mechanical measurements The fact that a muscle does less external work when shortening at a higher speed has led to the hypothesis that muscle is endowed with 'viscosity', attributed to a lag in the rearrangement of its molecules, as the external form of the contractile elements changes. This viscosity hypothesis is, however, altogether unnecessary; for the decrease of force and work with increased speed can be deduced from the manner in which the energy liberation is regulated. Some applications were also described. The maximum power developed by a muscle is with a load about three tenths of the maximum load it can bear. The highest efficiency (work/total energy) is with a load of about 0·45 of the maximum. These are near enough for maximum power and maximum efficiency to occur very nearly at about 37 per cent of the maximum load. These results obtained with frog's muscle almost certainly apply, though possibly with different constants, to man; and it would be very important to find out and to determine the constants of human muscle. The technique required would be a very different one.

Anthropoid Evolution in South Africa

DR. ROBERT BROOM continues to provide sensational news from South Africa for anthropologist and palæontologist. In another column of this issue (see p. 897) he reports further finds of relics of South African fossil anthropoids which, if anything, surpass in interest the remarkable discoveries he has already recorded recently in these columns. From the site on which was found the Kromdraai skull, he has now recovered three bones or parts of bones, the right humerus, the ulna and one of the toe phalanges of *Paranthropus* which, as his nomenclature indicates, he places, on the evidence of the skull, very near the line of man. The new evidence fully bears out his conclusion, for as he states, these bones, which on the balance of probabilities must be associated with the skull, are "nearly human". Further, and this is the most interesting feature of the discovery, they, and more especially the toe bone, must be interpreted as pointing to *Paranthropus* having walked erect. In other words, the upper limbs of this type were already freed from the duties of locomotion to undertake those functions which were to play a predominant part in forwarding the development of the specific characters of the brain of *Homo sapiens*.

THIS eminently reasonable interpretation of the Kromdraai finds removes the element of surprise from the further discoveries from Sterkfontein, which Dr. Broom records; but it adds to their significance in mutual corroboration as between the two series of discoveries. At Sterkfontein, on the site on which he had previously discovered *Plesianthropus transvaalensis*, an advance towards the human on Prof. Raymond Dart's *Australopithecus*, or ape-man from Taungs, Dr. Broom has also found the distal end of a femur and part of the brain cast of, it is argued, a mature male. Not only would the fragment of femur suggest that this type of fossil anthropoid also had attained bipedal status, but in addition the brain cast, when reconstructed, would place the capacity of the brain of *Plesianthropus* next in the scale of measurement, so far as at present known, to the recently discovered specimen of *Pithecanthropus* from Java. *Pithecanthropus*, no longer in danger of being classed as a gibbon, is definitely above the human border line. The new evidence from Kromdraai and Sterkfontein, taken in conjunction with the evidence of the symphyses, which Dr. Broom further records, would indeed seem to afford warrant for the view that we have been given a glimpse of the evolutionary process at a moment when what has been regarded hitherto as man's prerogative—the permanent assumption of the erect posture—had not long taken place. The difficulty in the way of regarding the South African fossil series as forming part of the human evolutionary process, though of course significant by analogy, on the ground of its relatively late date, to which Sir Arthur Keith has directed attention, is reduced though not eliminated, by Dr. Broom's evidence for a revised dating.

Scientific Associations of the Lubbock Estate

THE public acquisition of the High Elms estate in Kent as part of London's 'green belt', is an event of note in the history of science; for this was the home of the Lubbock family from 1808. In that year, Sir John William Lubbock acquired the nucleus of the property, some 270 acres; by later accretions the estate reached its present extent of nearly a thousand acres. A second Sir John William Lubbock was the first to bring scientific fame into the annals of the family: his observations of tidal and lunar phenomena and in physical astronomy ranked him high, and he was elected fellow of the Royal Society when barely twenty-seven years old. He worked also on the mathematical doctrine of probability and applied it practically to the subject of life assurance. He became the first vice-chancellor of the University of London. He built the present mansion of High Elms, extended the property, and greatly beautified it by planting many of the splendid trees which grace it now. He was followed by a still more famous son, Sir John Lubbock, afterwards Lord Avebury, who, born in 1834, spent nearly all his life there, and succeeded to the property in 1865. It is well known that on the scientific side his extraordinary career was influenced, not only by his father, but also, profoundly, by Charles Darwin.

IN fact, the assurance of the preservation of High Elms rounds off, as it were, a unique scientific memorial. For Down House is less than two miles from High Elms, and Down House, as is well known, is preserved as a memorial to Darwin by the gift of Sir Buckston Browne to the British Association. It is on record that Sir John William Lubbock hailed as a great event the news that Charles Darwin was coming to live at Down House in 1842, and it was not long before intimacy was established between the two houses. Between Darwin, in his thirties, and John Lubbock, not yet in his teens, a close friendship grew and endured until Darwin's death in 1882, when Lubbock paid final tribute to his scientific master by drawing up the memorial which petitioned the Dean of Westminster that Darwin should be buried in the Abbey. It is good to know that not only the homes of these two renowned men but also some at least of the countryside which they knew and loved, are safe from future change though suburban London lies so near.

Jubilee of the Pasteur Institute, Paris

NOVEMBER 14, 1938, marked the fiftieth anniversary of the inauguration of the Pasteur Institute of Paris as the result of international subscription, but the actual celebrations have, owing to the recent crisis, been postponed until December 27, the anniversary of the birth of Pasteur. The spacious building in the Rue Dutot, recently renamed Rue du Dr. Roux, took the place of the small laboratory in the Rue d'Ulm where so much of Pasteur's valuable work had been carried out. Although his labours were interrupted by ill health during the rest of his life, he received the assistance of a number of collaborators and pupils, notably Roux, Yersin, Metchnikoff, Chamberland and Calmette. The institute at once became an important centre for bacteriological research, the results of which were published in the *Annales de l'Institut Pasteur*, founded in 1887, in which epoch-making papers appeared on rabies, anthrax, diphtheria toxin and antitoxin, and experimental syphilis, among many other important subjects.

IN 1903 the *Annales* were supplemented by the *Bulletin de l'Institut Pasteur*, which contained, as the title indicated, reviews and summaries of work on bacteriology, medicine, general biology, physiology and biological chemistry *in relation to microbiology*. The close association of the Institute with clinical medicine was shown by the subsequent establishment of the Pasteur hospital for infectious diseases on the opposite side of the street. Pasteur died on September 28, 1895, and after a public funeral was laid to rest in a magnificent tomb in a crypt of the Institute. Since his death three eminent men have been in charge of the Institute, namely, Émile Duclaux (1895–1904), Émile Roux (1904–1933) and Louis Martin, the present director. Metchnikoff, Chamberland and Calmette were for some time sub-directors. Numerous Pasteur institutes modelled on that of Paris have been built in different parts of the world, such as those at Saigon (1889), Tunis (1893), Lille (1895), Algiers (1910) and Athens (1920).

Violent Earthquake of November 10

IT is reported from the Air Ministry that an earthquake of great violence was recorded on November 10 at Kew Observatory at 20 h. 30 m. 7 s. G.M.T., a second movement following about half an hour later. The displacements of the ground at Kew were about one tenth of an inch, and the epicentre of the shock was 5,100 miles away. This earthquake has been reported from observatories throughout the world. From New York it appeared to be at a distance of 3,400 miles and from Pasadena, where the needles nearly went off the paper of the recording seismographs, it appeared to be 2,550 miles. From the Dominion Observatory, Wellington, New Zealand, the epicentre appeared to be distant 6,000 miles, and from the Villa Ortoza Observatory in the Argentine more than 6,000 miles. At Mr. J. J. Shaw's Observatory at West Bromwich it was reported to have had the largest amplitudes recorded in thirty years and to have been of greater violence than the Quetta earthquake of 1935 or the Tokyo earthquake of 1923. The shock was felt by people in Alaska, though no damage was done, and it is reported in the *Yorkshire Post* to have been felt in Leeds. A small seismic sea wave was apparent on some of the Hawaiian Islands. All this evidence seems to point to a submarine epicentre in the North Pacific Ocean near the Aleutian Islands and to the south-west of Alaska. This area is known to be one of the unstable regions of the earth, about fifty large and many more small earthquakes being recorded from the vicinity between 1913 and 1930.

Earthquake near Vienna

AN earthquake with an epicentre near Vienna occurred about 4h. G.C.T. on November 8, doing some damage to property but causing no casualties. An earthquake in this region is most unusual and the last one of any importance was in 1927 on October 8 at 19h. 48m. 55s. G.C.T., with epicentre lat. 48° 04′ N., long. 16° 35′ E. It was discussed very thoroughly by Dr. V. Conrad of Vienna, who confirmed from the records the existence of the P^* and S^* waves. He considered that the depth of focus was near 30 km. and that the thickness of the Granitic layer in this region was of the order of 40 km. Further, Conrad found a pulse which he thought was caused at the A. Mohorovičić discontinuity 60 km. deep under the earth's surface. It will be interesting to see whether or not these findings are confirmed by the present shock.

Inventors and Inventions

SIR JAMES SWINBURNE, in his presidential address delivered on October 25 to the Institute of Plastics, discussed the subject of invention. In his opinion, inventions are usually the work of men less than forty years of age and often are discovered by those without scientific training. He attributed this apparent anomaly to the likelihood of the technical man allowing his thoughts to be constrained in narrow grooves. The specialization of the modern world works against the interests of the home inventor. The day of the lone inventor has passed and progress is now usually the result of co-ordinated efforts of large research departments. Some of the greatest inventions have been, as a far-seeing judge once put it, what any fool might have done but had not. Differentiating between the independent or outside inventor and the inside or technical man, Sir James believes that the latter is the former's chief enemy. When the independent worker approaches a commercial concern with an invention he meets with opposition from the technical representative of the company, who is inspired by the human instinct of self-preservation, for the device submitted is something which the staff man feels that he himself ought to have thought of. A further distinction was drawn between the qualities necessary for an executive and those for a technical man Sir James epigrammatically stated that the object of patent law is to help industry by encouraging progress, by checking progress at each step , *in other words, if there were no patent law and* invention continued at its present rate, industry would progress faster , on the other hand if there were no rewards for invention, the incentive to invent would almost disappear In his opinion, the cost of patents is too high, and the legal expense entailed in fighting an infringement favours the large company The appeal system gives rise to anomalies Thus, the first judge may decide against a patentee, the appeal judges may agree with him, and finally three out of five in the Lords of Appeal might uphold the patentee s claim We then have the curious position of three judges overruling six

History of Iron Founding in England

At the annual general meeting of the Newcomen Society on November 9, Mr W A Young was elected president for the ensuing year The membership of the Society now stands at 870 After the conclusion of the business the first part of a paper by Mr Rhys Jenkins was read entitled "Iron founding in England 1490–1890 Though there are objects of cast iron to be seen in museums, probably made 1 500–2,000 years ago, iron founding in Europe as a regular trade is of comparatively modern origin In Great Britain iron founding followed the substitution of the primitive hearth, the bloomery, by the high furnace, known as the blast furnace Sussex was the cradle of English iron founding and there is a reference dated 1490 to a payment on behalf of the Archbishop of Canterbury to "ye Ierne founders of Buxstede' The industry was based mainly on the production of war material, though there was a certain amount of production of chimney backs, fire dogs and grave slabs, and also of gear for the forges King Henry VIII came to the throne in 1509 and he at once set about the provision of armament He brought over foreign workmen to cast bronze guns, and a year or two prior to his death the first cast iron guns were made The credit for initiating this departure belongs to William Levet, the parson of Buxted In the early days of Elizabeth, an export trade in cast iron guns commenced Guns were sent to the Low Countries, France and Germany, and in 1582 Portugal took no fewer than 132 pieces In 1601 it was stated the total output was about 800 tons per annum The earliest account of any real value of the methods of casting guns is given by Sirurey de Saint Remy in his "Memoires d'Artillerie" published in Paris in 1693

Structure and Strength

The seventh Andrew Laing Lecture, delivered by Sir William Bragg before the North East Coast Institution of Engineers and Shipbuilders at Newcastle on November 8, dealt with the molecular basis of the strength of materials Taking carbon compounds first, he showed how the regular arrangement of the carbon atoms in the diamond as determined by modern X-ray analysis accounts for its hardness, how long chains of such atoms with side atoms of hydrogen lead to paraffins, the tendency of which to set themselves parallel to each other like *corn stalks in a field leads to their slipperiness*, and how chains modified by oxygen atoms at one end lead to oils with lubricating powers Another arrangement of carbon atoms in a plane leads to graphite sheets, which again can slide over each other and also possess lubricating powers More complicated chain structures give celluloses of many kinds as found in plants, and a combination of benzene rings with oxygen gives plastics like bakelite The atoms of metals and alloys are in general packed together like spheres, and the properties of the product depend mainly on the sizes of the atoms constituting it and the number of electrons they can put into the common stock

The Science Museum Recent Acquisitions

The inventor s working model of the first calculating machine capable of multiplying sums of money in sterling currency (£ *s d* and fractions of a penny) has been presented to the Science Museum The present machine, invented by Mr E C McClure in 1934, requires only one turn of the handle for each digit in the multiplier, so that to multiply any sum of money by a number less than a thousand it is necessary to make only three turns of the handle The principles embodied in the machine are being used in a new sterling multiplying punch which is being manufactured by Messrs Powers Samas Accounting Machines Ltd , who have given the model to the Science Museum A collection of trade cards issued by English instrument makers to advertise their products, presented by Mr Thomas H Court, has recently been placed on exhibition , they are mostly of the eighteenth century and are of considerable historical interest and importance The Museum has acquired a large scale working model of the escapement employed about 1880 in the original Waterbury watches, which were among the first really cheap watches to be made The group of hearing aids illustrates developments since 1930 ; of special interest are the widely contrasting valve amplifying sets of 1932 and 1938

Radio Valve Data

Each year the *Wireless World* performs a very useful function in providing comprehensive details of all the thermionic valves available in Great Britain. The issue of November 10 contains a Valve Data Supplement listing more than 1,000 different valves in twenty pages of tables All types of valves are dealt with, whether these be used as rectifiers, frequency changers or amplifiers , and while some of those described may be becoming obsolete, it is necessary to include them as they are used for replacement purposes in existing radio sets or amplifiers In general, the valves are listed in order of filament or heater voltage, and the variation in this voltage is one of the reasons for the large number of valves it is necessary to describe Valves for battery operation have filaments for 2-volt working, while

4-volt types are used for A.C. mains operation; the 6·3- and 13-volt types are intended either for universal use on A.C. or D.C. mains, or for use with 6- and 12-volt motor-car batteries respectively. Fortunately, the number of valve bases is not yet equal to the number of valves, but fourteen different bases are listed, of which seven types are in common use in Great Britain, and the text explains that these seven may be connected up in 144 different ways. It is much to be regretted that those responsible for the design and manufacture of valves have not seen their way to bring about some measure of standardization; but in the chaos that exists, the valve data supplement referred to above should prove a useful guide.

Co-ordination of Medical Services

A DEPUTATION from the central emergency committee of the British Medical Association, including representatives of the Royal Colleges, was received on November 8 by Sir Thomas Inskip, the Minister for Co-ordination of Defence, who was accompanied by officers of the Government departments concerned. The deputation urged the establishment of machinery for the co-ordination of all medical services for the civilian population under a single body, and the co-ordination of civilian medical organizations under that of the Service Departments. It was also proposed that the machinery should be closely associated with the central emergency committee as being representative of all branches of the profession.

A New Chemical Periodical

A NEW periodical entitled *Chemical Products and the Chemical News*, which is being published monthly by Science Services, Ltd., 35 Great James Street, Bedford Row, London, W.C.2, is designed to emphasize the indivisibility of the chemical industry. It will accordingly deal with matters of interest to the chemical, drug, pharmaceutical and cosmetic industries, and particularly the new uses to which chemical products and related materials are being put and their future place in industry and in the framework of the modern world. In this policy, *Chemical Products* claims to be in the lineage of the *Chemical News* of Sir William Crookes. The first number (October) includes an article by Dr. F. R. Weidlein, director of the Mellon Institute, on industrial progress, in which developments in the fields of synthetic resins, lubricants and fuels, carbon black, plant stimulants, etc., in which that Institute has been concerned, are reviewed. In other articles A. L. Bacharach reviews the influence of laboratory on manufacturing technique, and C. W. D. Stafford describes the preparation and uses of liver extracts. Dr. W. Langer deals with the formulation of cosmetics, and Dr. C. I. B. Voge with that of mouth washes. An interesting account of the House of Roche is also included, together with the brief views of such eminent chemists as Prof. J. F. Thorpe, Dr. Joseph Needham and Dr. E. F. Armstrong on the nature, scope and policy of a chemical journal.

Colonial Service: Recent Appointments

THE following appointments have recently been made: F. J. Harper, agricultural officer, Nigeria; G. A. Jones, director of agriculture, Jamaica; F. H. Fitch, geologist, Malaya; I. G. Chamberlain, veterinary officer, Kenya; D. Slavin, veterinary research officer, Kenya; J. F. C. Swan, veterinary officer, Northern Rhodesia; D. M. Hanschell, assistant botanist, British West Indies Central Sugar Cane Breeding Station, Barbados; W. A. Hughes, inspector of plants and produce, Gold Coast; J. Sheard, sleeping sickness control officer, Nigeria; O. T. Faulkner (director of agriculture, Malaya), principal, Imperial College of Tropical Agriculture, Trinidad (seconded); J. D. Gillespie (agricultural superintendent, British Guiana), agricultural officer, Sierra Leone; B. J. Hartley (district agricultural officer, Tanganyika Territory), agricultural officer, Aden; J. F. Ward (agricultural officer, Nigeria), agricultural officer, British Honduras; A. Cawley (engineering geologist), inspector of mines, Tanganyika Territory.

Announcements

SIR WILLIAM BRAGG, president of the Royal Society, is to deliver an address on "The Advance of Science" at the Ely Diocesan Conference to be held at Cambridge on November 21.

DR. H. SPENCER JONES, Astronomer Royal, will deliver the fourteenth annual Norman Lockyer Lecture under the auspices of the British Association at the Goldsmiths' Hall, London, E.C.2, on Tuesday, December 6, at 4 p.m. The subject of the lecture will be "The Atmospheres of the Planets".

DR. HANS HOLFELDER, professor of general clinical roentgenology at Frankfort-on-Main, has been awarded the Albers-Schönberg Medal by the German Röntgen Society.

A SERIES of open meetings on "National Defence" has been arranged by the Scientists' Group of the Left Book Club, the meetings are being held at the University Labour Club, 101 Great Russell Street, London, W.C.1, on Mondays at 8.15. Among the topics and speakers are: aerial warfare, by F. W. Meredith; food supplies in war time, by F. Le Gros Clark; the medical services, by Dr. D. Stark Murray; and national defence and the scientific worker, by Prof. J. D. Bernal. Particulars can be obtained from the secretary of the Group, 175A Highbury New Park, London, N.5.

ACCORDING to a special health commission, Poland, which ought to have 25,000 medical practitioners, has only 12,000, there being about 3·7 per 10,000 inhabitants. 61 per cent are settled in 28 towns which contain only 13·5 per cent of the total population. In order to provide medical attention in rural districts a law is being prepared to compel every medical practitioner to practise in the country for his first two years.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 919.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Palæolithic Industry from the Cromer District

INVESTIGATIONS by us during the last four years, supported by grants from the Percy Sladen Memorial Fund, have shown that a hitherto unrecognized flint industry occurs in the coast section at Corton, near Lowestoft, and in the neighbourhood of Cromer.

From the geological point of view these particular implements occur in the marine sands at Corton which were classified by Searles Wood as 'Middle Glacial', and in the shelly sand and gravel in the Cromer coast section which was correlated by Clement Reid with these Corton Beds. They have not so far been found in the underlying glacial deposits at either locality, but the same flint industry is also found in certain unfossiliferous gravels which are exposed in inland sections near Cromer, and further work is needed to prove the relationship of these gravels to the marine sands.

We have made a collection of Mollusca from the shelly sand near Cromer, especially at West Runton Gap, and a comparison of these shells with those of the Corton Beds is satisfactory so far as it goes in showing that the West Runton fauna is more like that of the Corton Beds than that of any other known deposit. The shells show certain differences from those found in such older deposits as the Norwich and Weybourne Crags, and we are accordingly in agreement with the contentions of Searles Wood and Clement Reid that they are indigenous to the deposits in which they are found and not derived. The geological side of the work has also shown that there is no real discrepancy between the stratigraphical successions at Corton and Cromer respectively. Whereas the marine sands at Corton are intermediate between the 'Lower Glacial' deposits (of Searles Wood) and the Chalky Kimmeridgic Boulder Clay (of F. W. Harmer), those at Cromer are younger than the North Sea Drift (North Sea Glaciation of Solomon), and it has now been proved that marly boulder clay like that seen inland at Weybourne and elsewhere overlies the marine sands on the Cromer coast (near West Runton). At a pit a small distance inland at East Runton the implementiferous gravel rests on North Sea Drift and is covered in places by marly boulder clay.

It should be pointed out that as the marine horizon, together with its contained implements, underlies the Chalky Kimmeridgic Boulder Clay, it must be considerably older than and probably represents the interglacial period preceding, that in which the well-known Middle to Late Acheulean, and Clactonian III deposits of Hoxne, High Lodge, Whitlingham, and Derby Road, Ipswich, were laid down.

The flake industry found at Corton, and in the Cromer area, may perhaps be described as representing, in a primitive form, the later well-made Clactonian III implements of the High Lodge brick-earth. The Cortonian implements comprise side-scrapers (an outstanding form with the bulb of percussion at the side), hollow scrapers (very rare), square-ended scrapers and some small examples of the ordinary round-ended variety. Points are by no means common. The flakes exhibit flat striking platforms and have been in many cases modified by secondary flaking into knives and other forms. The great majority of the specimens exhibit a certain amount of gloss but are otherwise not patinated. The flint is black, usually with a thin cortex. The artefacts exhibit very little sign of rolling by water action, and scratches on the flaked surfaces are very seldom present.

It is possible that the industry represented may be of early Acheulean date, but with the exception of one specimen of a partly finished hand-axe the forms of the implements do not, in the present state of our knowledge, support this supposition. A detailed paper on this research will be published in due course.

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J. REID MOIR.
D. F. W. BADEN POWELL.

Estimation of Uronic Anhydride Residues in Polysaccharides

IN the course of work on the constitution of certain wood starches and other polysaccharides containing uronic acid residues, we have found it necessary to investigate more closely the accuracy of the analytical methods used in the estimation of the uronic acid content. The usual procedure consists in heating the substance with aqueous hydrochloric acid and measuring the amount of carbon dioxide liberated.

Preliminary experiments revealed that potato starch gave an appreciable amount of carbon dioxide, and further investigation showed that the explanation of this lies in the fact that glucose and maltose give carbon dioxide under these conditions, the yield (c. 0·5 per cent) being similar to that observed with starch. It will be seen from the accompanying table that a similar yield of carbon dioxide is given by several types of starch and by cellulose, and the conclusion is reached that none of these polysaccharides contains any uronic acid residue. Fructose and fructose polysaccharides (for example, inulin) also give carbon dioxide when heated with hydrochloric acid, and, as might now be expected, so does sucrose. Rhamnose gave rather higher values, but a typical methylated sugar (2 : 3 : 6-trimethyl glucose) gave a smaller yield of carbon dioxide, presumably owing to the greater stability of the methyl ether groups, and mannitol, which cannot give rise to a reducing sugar, gave no carbon dioxide. In the case of glucose, fructose and sucrose, similar behaviour has recently been observed by H Colin and Mlle S Lemoyne[1]

PERCENTAGE OF CARBON DIOXIDE EVOLVED FROM CARBOHYDRATES

Substance	CO_2	Substance	CO_2
Potato Starch	0 30	Galactose	0 46
Rice Starch	0 45	Fructose	0
Wheat Starch	0 40	Inulin	0 60
Horse Chestnut Starch	0 50	Sucrose	0 52
Cellulose	0 17	Xylose	0 40
Glucose	0 40	Arabinose	0 4
Maltose	0 40	Rhamnose	0 90
2 3 6 Trimethyl glucose	0 20	Mannitol	0 00
Mannose	0 55		

It will be apparent that these results are of special importance in the investigation of polysaccharides In connexion with starches, no structural significance can be attached to reported carbon dioxide yields of the order 0 3 0 5 per cent, whilst for certain other polysaccharides, yields of carbon dioxide up to 1 per cent may be equally unreliable as an index of the presence of uronic anhydride These observations do not, however, affect the claim previously advanced by one of us[2] that certain wood starch preparations contain uronic anhydride, except in so far as the numerical value of the results is concerned The present experiments were carried out in an atmosphere of nitrogen in an improved form evolved by one of us (W G C), of the apparatus described by Dickson *et al*[3] With this consistent blanks were obtained corresponding to less than 0 2 per cent carbon dioxide under the conditions of the above analyses A scrubber containing aniline was used to absorb furfural liberated from pentose residues Otherwise furfural may be carried over to the barium hydroxide solution, with vitiation of the results

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[1] Colin H and Lemoyne S *Bull Soc Chim biol* **20** 344 (1938)

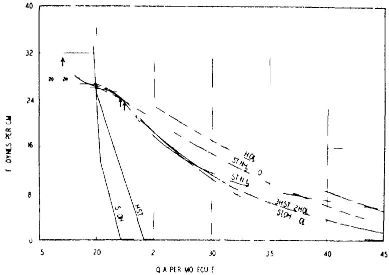
[2] Campbell W G *Biochem J* **29** 1068 (1935)

[3] Dickson A D Otterson, H and Link K P *J Amer Chem Soc* **52** 775 (1930)

Effect of Space Isomerism on the Squeezing out of an Unsaturated Compound from a Mixed Monolayer on an Aqueous Sub-solution

As the pressure is increased on a mixed film produced by a 1 1 mixture of oleic acid (HOL) with stearyl alcohol (STOH) or amine, or stearic acid (HST), the unsaturated oleic acid begins to separate out at about 24 dynes per cm, at which pressure minute particles of the oleic acid become visible in the dark field microscope used for observation Practically all the oleic acid is squeezed out if the area is sufficiently reduced, and the pressure area relations become those found for a pure film of stearic acid or stearyl alcohol on the same sub solution (Fig 1)

While Schulman has indicated that this is probably due to a lessening of the attraction between the hydrocarbon chains by the presence of the double bond, earlier work by Harkins indicates that the double bond does not lessen this type of attraction It seemed to us that the phenomenon has its origin rather in the space relations The carboxyl or hydroxyl groups of all these compounds have about the same attractive energy toward the water of the subphase That it is the oleic acid which is squeezed out is apparently due to the fact that the bending of the chain by the double bond causes the molecule in its rotation about an axis perpendicular to the surface of the water, and in its vibrations and flagellations to sweep out a larger area than the saturated molecules This increased area causes it to be less firmly bound in the film



OLEIC ACID HOL STEARYL ALCOHOL STOH
STEARIC ACID HST STEARYL AMINE STNH$_2$

It is usually supposed that oleic is a *cis*, and elaidic acid is the corresponding *trans* form If this be true, it seems apparent that elaidic acid would sweep out a smaller molecular area and would be, therefore, much more tightly bound in the mixture This proved to be the fact, since while the ultramicroscope shows that some elaidic acid may be squeezed out the process is by no means complete as in the case of oleic acid In fact, the amount which separates is very small, since the form of the pressure area curves is not appreciably influenced thereby

The above relations were found on an acid sub solution, but a change to a basic subphase (pH 9 5), while it altered the form of the curves, gave similar relations, and this was also true when calcium ions were present

At pH 3 the presence of elaidic acid greatly condenses the expanded film of stearyl amine ($STNH_2$), while above a pressure of 8 dynes per cm oleic acid expands it even above the areas of the expanded amine By itself, however, elaidic acid as well as oleic, gives an expanded film At the lower pressures, oleic acid gives much the higher molecular areas when pure, but the smaller compressibility of the film of elaidic acid causes it to have higher areas at the higher pressures, that is, above about 15·5 dynes per cm. In the work represented by Fig. 1, the *p*H was 3, and the temperature close to 25°

Note added October 20 In a paper which appeared after our letter was sent to NATURE, Marsden and Rideal (*J Chem. Soc*, 1938, 1193) also explain differences in behaviour between *cis*- and *trans*-unsaturated compounds as due to differences in the form of the molecules Their theory of the effect is the more static, and ours the more kinetic

A comparison of the experimental results is of interest, since their most convincing evidence is given by two single-component films in which the area is much greater per molecule for the *cis*- than for the *trans*-compound Thus a 22-carbon atom molecule is long enough to give a sufficiently large van der Waals energy between *trans*-chains of brassidic acid to produce a condensed film, while with the corresponding *cis*-chain of erucic acid, the bend in the molecules prevents such a close approach so the film is expanded In the case of the 18 carbon atom chains used by us, the shortening of the chain reduces the van der Waals energy sufficiently to prevent the formation of a condensed film by the *trans*-compound, so the difference between the *cis*- and *trans*-compounds, while marked, is not so great

In contrast with this, the differences between *cis*- and *trans*-compounds given by their mixtures are very small, while some of those investigated by us exhibit extremely great effects. Thus in the mixtures on basic sub-solutions of stearyl amine with elaidic acid (*trans*) or oleic acid (*cis*), the isomeric forms not only give extremely great deviations from the mean behaviour, but also the *cis*-compound expands the area above that of either component, while the *trans*-compound condenses it below that of either component

Thus the two researches, when considered together, present remarkably strong evidence for the general point of view expressed by Marsden and Rideal and by us, that it is the bend in the hydrocarbon chain at the double bond of *cis*-compounds which causes them to be less firmly bound to the other molecules of the film than is the case with *trans*-compounds, in which the bend is much less pronounced

For the exhibition of these differences, space models should be used These make it obvious that the effects are highly dependent upon the position of the double bond in the chain

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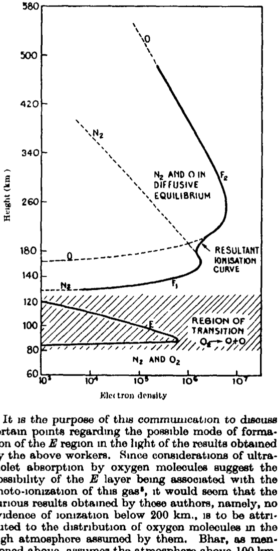
Aug 14

Origin of the *E* Layer of the Ionosphere

CHAPMAN's hypothesis regarding the different origins of the *F* and *E* regions of the ionosphere, first put forward in his Bakerian Lecture[1] of 1931, is well-known. The *F* layer he attributed to the action of the ultra-violet rays of the sun and the *E* layer to the action of neutral solar corpuscles. The reason for his assuming two different agencies was that he was unable to obtain any evidence of ionization maximum below 200 km. by applying Pannekoek's theory[2] of upper atmosphere ionization based on Woltjer's extension of Saha's theory of thermal ionization. The question of the possible mode of formation of ionization maxima in the upper atmosphere has recently been re-examined by Bhar[3] with the help of Pannekoek's method on the recent view that the atmosphere above 100 km has a high temperature and that it consists mainly of molecular nitrogen and atomic oxygen Bhar found that the only maxima of ionization are at levels 350 km (due to atomic oxygen) and 270 km. (due to molecular nitrogen) These he identified with the F_2 and F_1 regions He had not been able to obtain any evidence from his theoretical calculations about the presence of ionization at the level of the *E* region (100 km). Hulburt[4] has also come to a similar conclusion in a recent paper



It is the purpose of this communication to discuss certain points regarding the possible mode of formation of the *E* region in the light of the results obtained by the above workers. Since considerations of ultra-violet absorption by oxygen molecules suggest the possibility of the *E* layer being associated with the photo-ionization of this gas[5], it would seem that the curious results obtained by those authors, namely, no evidence of ionization below 200 km., is to be attributed to the distribution of oxygen molecules in the high atmosphere assumed by them. Bhar, as mentioned above, assumes the atmosphere above 100 km to be devoid of oxygen molecules—all of them having been converted to atomic oxygen by photo-electric dissociation. He therefore does not consider at all the ionization of molecular oxygen. Hulburt, though he assumes the presence of molecular oxygen (and molecular nitrogen) above 100 km., gets the result as stated above.

In view of the fact that recent investigations, both spectroscopic and theoretical, appear to show that the atmosphere above 100 km is very poor in molecular oxygen, Bhar's assumption seems to be correct. It may be shown[6] that the dissociation of O_2 to O is practically complete at about the 130 km level and that the region in which the transition of the atmospheric composition (from N_2 and O_2 to N_2 and O) occurs is a fairly sharp one. It is therefore evident that in investigating the upper atmospheric ionization the photo ionization of molecular oxygen in the transition region below 130 km should be taken into account, particularly because the ionization potential of O_2 (16.5 ev) being much different from those of O and N_2, this gas will produce its own level of maximum ionization. J N Bhar working in my laboratory has recently carried out the calculation of the photo ionization of O_2 after Pannekoek's theory in the region of transition of O_2 to O. The result obtained by him and the assumptions on which his calculations are based are given below.

The region of transition ($O_2 \rightarrow O + O$) is taken to lie between 80 km and 130 km. The density of molecular oxygen at the 80 km level is known to a fair degree of approximation from radio and other meteorological considerations. This is taken[7] as 1.6×10^{14} molecules/c c at 130 km the density is assumed to be 10^4 molecules/c c. Results of Bhar's calculations are depicted in the accompanying graph. For completeness the ionization distributions for the F_1 and F_2 regions as obtained by him from revised calculations are also given. It is to be noted that the maximum of ionization in the transition layer occurs at the level of the *E* region and that the ionized layer is extremely thin, which is in conformity with recent experimental evidence. The definite assertion can thus be made that the region around 100 km in which rapid transition of O_2 to O occurs is also as a consequence the region of maximum ionization of O_2, and that the ionized layer formed near this level is to be identified with the *E* layer.

For carrying out the above calculations a knowledge of the absorption coefficient of the gases under consideration is necessary. For atomic oxygen the value deduced recently by Saha and Rai[8] from wave mechanical considerations has been used. For molecular oxygen and nitrogen Bhar, in common with all previous workers, has utilized the well known Kramers formula for X ray absorption with certain modifications. The use of this formula for neutral atoms and particularly for neutral molecules is open to serious objection[4,5]. Crude as this procedure is, the importance of the analysis still remains for, if at any future date accurate experimental or theoretical values of the absorption coefficients and their variations with frequency be available, these need only be substituted in the working formula to get a more accurate result.

The origin of the *E* layer as explained above is due to strong absorption resulting in photo ionization of molecular oxygen commencing at λ 744 A. There is however, absorption due to nitrogen molecules and to oxygen atoms in this range of wave lengths. The effect of this absorption will be to reduce the intensity of the wave lengths necessary for the photo ionization of molecular oxygen. This fact has been taken into account by taking the intensity of the radiation in this range as one thousandth of what it would have been in the absence of the superincumbent gases.

A fuller and more detailed account of the investigation will shortly appear in the *Indian Journal of Physics*.

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[1] Chapman *Proc Roy Soc* A **132** 3 3 (1931)
[2] Pannekoek *Proc Amsterdam Acad* **29** 1165 (1926)
[3] Bhar Paper N 8 Mathematics and Physics Section Indian Science Congress (January 1 38)
[4] Hulburt *Phys Rev* **53** 3 (1938)
[5] Saha *Proc Roy Soc* A **160** 15 (193)
[6] Majumdar *Ind J Phys* **21** 7 (1938)
[7] Ghosh M Sc Thesis (1938) Calcutta University see also Martyn and Pulley *Proc Roy Soc* A **154** 4 (1936)
[8] Saha and Rai *Proc Nat Inst Sci Ind* **4** 319 (1938)
[9] Page NATURE **141** 1137 (1938)

Effect of Temperature on the Intensity of X-Ray Reflection

WE have studied with a fibre camera used in conjunction and simultaneously with a flat plate powder camera the effect of temperature on the intensity of reflection of X rays from copper. The effect has been examined over a range of temperature extending from room temperature to about 570° C.

According to Debye's theory as modified by Waller in order to account for the decrease of X ray reflection from a cubic crystal as the temperature is raised the *intensities* of the interference maxima should be multiplied by a temperature factor exp $(-2M)$,

where $M = \dfrac{6h^2}{mk\Theta}\left(\dfrac{\varphi(x)}{x} + \dfrac{1}{4}\right)\dfrac{\sin^2\theta}{\lambda^2}$ *m* is the mass of the atom concerned, Θ is its characteristic temperature $x = \Theta/T$ where *T* is the absolute temperature and $\varphi(x)$ is a certain function of *x* which Debye evaluates.

Observations made on the intensities of reflection from rock salt and sylvine by James and his collaborators show that the results obtained with those materials agree fairly closely with Waller's modification for temperatures ranging from 85° A to 400° A but that for higher temperatures up to about 900° A there is a definite departure from the Debye Waller formula, the intensity falling off more rapidly with rise of temperature than is allowed for by the formula.

The present results obtained with copper which possesses face centred cubic structure show that *throughout* the range of temperature from 290° A to 840° A the decline of intensity with increase of temperature is greater than that predicted by the Debye Waller formula. The experimental results agree closely with the calculated results if the temperature factor is assumed to be exp $(-3M)$ instead of exp $(-2M)$.

A full account of the investigation will shortly be published.

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Oct 22

A Lower Limit to Energy Evolution in Stellar Matter

IT is well recognized that the energy generation in stellar interiors is due to nuclear reactions in which protons play a dominant part. This circumstance fixes, as is shown here for stellar material of given density and chemical constitution, a lower limit to the rate of energy generation—the limiting value increasing very rapidly as the density of the material and the proportion of hydrogen in it increases. In the present note we shall only consider the reaction leading to the formation of deuteron by proton combination ($H + H = D + \varepsilon^{+}$), though the results discussed here can easily be extended to other nuclear transformations brought about by protons. The probability of this astrophysically important reaction has been recently calculated by Bethe and Critchfield[1], who conclude that for stars lighter than the sun this process is the main source of energy.

The existence of the lower limit mentioned above for the rate of energy generation follows at once when we note that the probability of the nuclear reaction is a function of the velocity of the protons, and as the protons obey Fermi-Dirac statistics, there exists for a given value of the proton concentration (number of protons per unit volume) a *minimum* energy distribution—the distribution corresponding to a *completely* degenerate gas. Therefore the limiting value of the energy generation for a given proton concentration n is obtained by averaging the probability of reaction for a velocity distribution corresponding to that of a *completely degenerate proton gas*; that is, the limiting value gives the energy generation when, for a fixed n, the temperature $T \rightarrow 0$.

If ε_0 denotes the minimum rate of energy generation per *gram* of the material, then, following Bethe and Critchfield with necessary alterations to take account of the new velocity distribution law, we finally obtain

$$\varepsilon_0 = 2\cdot4 \times 10^3 \rho c_H^2 e$$

where ρ is the density of the material, c_H the proportion of hydrogen by weight and z is given by

$$z = 4\pi^2 \binom{\pi}{3}^{1/3} \frac{m_H e^2}{h^2 n^{1/3}} = 4\cdot2 \times 10^3 \frac{1}{(\rho c_H)^{1/3}}$$

where m_H is the mass of the hydrogen atom, e the electron charge and h is Planck's constant.

In the following table the values of ε_0 are given for different densities for the case of $c_H = 1$ (all hydrogen) and $c_H = 0\cdot3$ (30 per cent hydrogen).

MINIMUM ENERGY EVOLUTION FOR DIFFERENT DENSITIES AND HYDROGEN CONCENTRATION

Density (gm/cm.^{3})	10^4	10^6	10	5×10^7
ε_0 for $c_H = 1$ (erg/gm sec.)	$1\cdot4 \times 10^{[illegible]}$	0·26	82	$1\cdot3 \times 10^6$
ε_0 for $c_H = 0\cdot3$ (erg/gm sec.)	$1\cdot2 \times 10^{[illegible]}$	$1\cdot3 \times 10$	$4\cdot9 \times 10^{4}$	$4\cdot3 \times 10^{5}$

It will be seen that ε_0 varies extremely rapidly with ρ and c_H. In the case of degenerate proton gas, the rate of energy generation for a given ρ and c_H will not differ much from the value corresponding to *complete* degeneracy, but for non-degeneracy it will obviously be widely different.

The existence of a lower limit to the rate of stellar energy evolution is particularly significant in connexion with the white dwarf stars (and also nuclei of planetary nebulæ). These applications, however, will be discussed elsewhere.

D. S. KOTHARI

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University of Delhi.
Oct. 6.

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[1] Bethe and Critchfield, *Phys. Rev.*, **54**, 248 (1938).

Seismic Methods in Submarine Geology

PROF. MAURICE EWING has shown that it is possible to use the seismic method for investigating submarine geology, and has used the method to show that in the continental shelf off the coast of Virginia many thousands of feet of sediments overlie the Palæozoic or pre-Cambrian rocks.

The Royal Society recently appointed a Committee with Rear-Admiral J. D. Edgell, hydrographer of the Navy, as chairman, to organize similar measurements on the eastern side of the Atlantic. The Lords Commissioners of the Admiralty made H.M. surveying ship *Jason* available for the purpose, and she was anchored successively at five stations on a line extending 170 miles west-south-west from the Lizard, and at each station geophones were lowered to the sea bottom. The geophones were connected to recording apparatus in the ship, and records were made of the ground motion produced by the explosion of charges of up to 62 lb. of T.N.T. laid on the sea floor and fired from a motor boat.

Forty-six records, mostly of satisfactory quality, were obtained, and time-distance curves were constructed. The first station was four miles south of the Lizard; the velocity of elastic waves in the surface rocks was 11,000 ft./sec.; this is too fast for recent sediments, but too slow for the igneous rocks of the Lizard. This surface layer was found to be 1,000 ft. thick and to be underlain by rocks in which the explosion wave travels with a velocity of 23,000 ft./sec.: the latter are presumably the igneous rocks. The occurrence of the 11,000 ft./sec. layer on top of the igneous rock is of considerable interest, and there is reason to believe from the results of dredging that it represents an outlier of Trias and indicates that the Channel was formed along the line of a pre-existing basin.

The next two stations are sixty and eighty miles west-south-west of the Lizard, and they showed 550 ft. and 1,000 ft. of sediments with a transmission velocity of 6,000–7,000 ft./sec. At the two outer stations (115 and 170 miles west-south-west of the Lizard), only lower limits can be set to the thickness of the sediments, as bad weather prevented very long lines from being shot. At the outermost of these stations the records are of excellent quality and show that there is certainly no rock having high transmission velocity similar to that found at the other three stations within 4,000 ft. of the surface. The next station shows that there are not less than 2,000 ft. of sediments.

It has been established, therefore, that a substantial part of the continental shelf is composed of relatively unconsolidated rocks. Measurements of the velocities of elastic waves in the rocks of Cornwall and Devon are to be made in the near future.

This preliminary note is published with the permission of the Royal Society In a later more detailed account, it will be possible to make proper acknowledgments to those who have assisted in the measurements and in the preliminary work

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Sept 27

Oxygen Isotopic Exchange in Animal Respiration

Oxygen enriched with respect to ^{18}O has been used to solve the problem of how far oxygen expired by an animal in the form of carbon dioxide is identical with that inspired as molecular oxygen Using rats and an artificial atmosphere containing oxygen equivalent in isotopic composition to water of 300 p p m excess density it was found that the expired carbon dioxide which was dried and collected by refrigeration methods, contained oxygen isotopes in proportions corresponding to water with about 40 p p m excess density the error of measurement being 2 p p m As the quantity of oxygen absorbed by the animal during each preliminary sweep out was considerably greater than the total oxygen and carbon dioxide stored as oxy hæmoglobin or bicarbonate, it can be accepted that the experimental results refer to the steady state

The two possibilities usually considered with regard to the fate of respiratory oxygen are (1) it enters directly into carbon oxidation and is exhaled as carbon dioxide , (2) it enters into combination with the hydrogen of water the originally combined oxygen of which effects carbon oxidation and appears as carbon dioxide Our results show that mechanism (1) operates since (2) acting alone would lead to an almost complete absence of inspired oxygen from the expired carbon dioxide The fact that only a proportion of the inspired oxygen reappears may be due to oxygen exchange between water and carbon dioxide produced by mechanism (1) or it may be due to the incursion of mechanism (2)

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Induced Tetraploidy in *Melandrium album*

In the flowering plants the problem of polyploidy in relation to diœcism is an extraordinarily attractive one, since it should be possible in this way to get additional proof of the balance theory of sex determination

So far, experimentally produced polyploids have not been described in diœcious plants, but occasionally such forms have been found in Nature In *Rumex*[1,2], triploids, tetraploids and a hexaploid have been described , in *Vallisneria*[3] and *Empetrum*[4] tetraploids are known to occur These polyploids which are considered by the authors to be of autopolyploid origin, are in *Rumex* intersexual in *Empetrum* bisexual and in *Vallisneria* diœcious, as in the diploid form

In *Melandrium album*, diœcism is very clear cut The male sex is heterogamous, having 11 pairs of autosomes and one pair of XY chromosomes, the X chromosome being considerably larger than the Y and larger than any of the autosomes The female plants are homogamous having 11 pairs of autosomes and 2 X chromosomes[5,6]

Tetraploids have been induced in *Melandrium album* in the summer of this year by the method of Randolph[7] as well as by the colchicine method[8] The tetraploid plants differ little from the diploids in appearance and are very difficult to pick out Their leaves are somewhat thicker the hairiness more conspicuous and the flowers relatively large Only chromosome counts can tell us the true nature of the suspected plants, and so far ten plants (out of 1 700) have proved to be tetraploid

These tetraploids are interesting from several points of view First concerning the sex expression The tetraploid plants show a diœcism just as clear cut as that of the diploids the $XXXX$ plants are females, the $XXYY$ plants are males (six of the ten tetraploids were males four were females) Secondly concerning the meiosis in tetraploid males a preliminary investigation has shown that the most frequent conjugation type of the sex chromosomes is autosyndesis that is $X—X$ and $Y—Y$ chromosomes pair Less frequently the sex chromosomes conjugate $X—Y$ and $X—Y$ The first mode of conjugation will give rise to gametes containing two sets of autosomes $(2A)$ an X and a Y chromosome $(2A+X+Y)$ The second mode will produce gametes of three sorts $(2A+2X)$ $(2A+X+Y)$ and $(2A+2Y)$ in the theoretical ratio 1 4 1, as previously postulated by H J Muller[9] A considerable excess of gametes of the formula $(2A+X+Y)$ will result As the females by normal chromosome separation will produce egg cells of the type $(2A+2X)$ only, three types of plants should appear by breeding tetraploids with tetraploids, if all types of gametes are viable the plants being of the formulæ $(4A+4X)$ $(4A+2X+2Y)$ and $(4A+3X+Y)$ It may further be mentioned that it is possible to cross tetraploids with diploids, both in the direction tetraploid female × diploid male, and the opposite way This should give rise to three types of triploids containing the chromosome sets $(3A+3X)$ $(3A+2X+Y)$ and $(3A+X+2Y)$ Thus the polyploid *Melandrium* should furnish very promising material for the study of sex balance

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[1] Ono T and Shimotomai N *Bot Mag* **42** 269 (1928)
[2] Yamamoto Y *Jap J Gen* **11** 6 (1935)
[3] Jørgensen C A *J Gen* **18** 63 (19
[4] Hagerup O *Dansk bot Arkiv* **5** 1 (192)
[5] Blackburn K B Nature **112** 68 (1923)
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[7] Randolph L F *Proc Nat Acad Sci* **18** 222 (1932)
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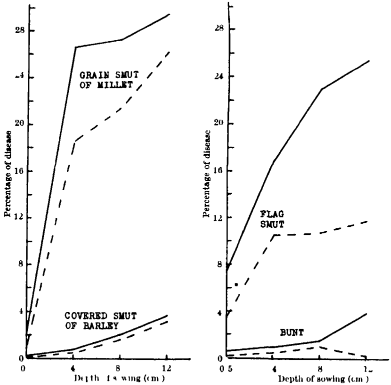
Control of Four Smut Diseases by Regulation of Planting Method under Irrigation

Anomalous amounts of disease in supposedly exactly repeated experiments of flag smut of wheat, and previously with covered smut of barley[1], were eventually traced to difference in planting method Under irrigation in Egypt, these cereals are either broadcast on moist land and ploughed in (*herati* method) or broadcast on dry land, harrowed in with a wooden baulk and irrigated (*afir* method)

Direct experiment proved two to three times more flag smut in *herati* plantings and similarly for covered smut of barley (six times), bunt of wheat (five times) and grain smut of millet Analysis indicates two factors operating, depth of sowing and soil moisture, shown in the accompanying graphs, where all differences are highly significant



Full lines, moist soil (*herati*)
Broken lines wet soil (*afir*)

Increase with depth has been recorded for flag smut[2], and again not only with covered smut but also with loose smut of barley[3], a flower infecting smut unlikely to be thus influenced , but perhaps this loose smut' was caused by the then unrecognized *Ustilago nigra*, a seedling infection

The cause of progressive increase may be the longer susceptible stage of deeper planted seedlings, while the strikingly small disease in the shallowest sowings may be due to coleoptiles growing more in air than damp soil The sudden effect in millet is perhaps related to the rapidly growing mesocotyl lifting the primary bud above the soil

The soil moisture factor is consistent and smaller, but increases with depth It is frequently mentioned in the literature (though few have worked with the very high soil moistures common under irrigation) and is usually ascribed to poor aeration The abnormally large effect in flag smut may be partly due to the peculiar germination needs of the spores[4] on the seed and in the soil, and hence partly dependent on the moisture history before sowing

While these results must generally remain only of scientific interest, they become immediately important in irrigation farming, where both operating factors are controllable The greatest inhibition of disease could be achieved if seed were broadcast on the surface of sodden soil, where fine particles allow soil moisture to reach the absolute maximum The results of two adjacent experiments with this new mud sowing' method are shown in the table below

Planting method	Cultural operations	Resultant depth of sowing	Soil condition	Per cent flag smut	
				Exp 1	Exp 2
Herati	Seed broadcast on moist soil and ploughed in	About 8 cm	Moist	8 1	8 6
Afir (usual)	Seed broadcast on dry soil harrowed in with a baulk and irrigated	4 cm	Wet		3 2
Afir (modified)	Seed broadcast on dry soil covered by raking and irrigated	2 5 cm	Wet	2 4	
Mud sowing (Method 1)	Moist soil ploughed and flooded seed broadcast on surface 1 hour later	Nil	Sodden	0 2	
Mud sowing (Method 2)	Dry soil flooded seed broadcast on surface 1 hour later	Nil	Sodden		0 08

Mud sowing seems worth thorough testing for agricultural value, apart from disease insurance It gives early tillering which may account for the improved size and maturity of grain obtained by Method 1 There is an indication of higher yield (although the elimination of 8 per cent of flag smut is unlikely to be the reason in Egypt) and seed rate might be reduced

Thus in irrigation countries special planting methods may present a practicable alternative to seed disinfection or immune varieties in preventing smut diseases

A full account of this and related subjects will be published as a *Scientific Bulletin* of the Egyptian Ministry of Agriculture

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Sept 17

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[1] Jones G Howard *Bull Min Agric Cairo* No 142 13 (1934)

[2] Miller, W B and Millikan C R *J Dept Agric Victoria* 33 365 (1934)

[3] Taylor J W , and Zehner M G *J Amer Soc Agron* 23 132 (1931)

[4] Noble R J *Phytopath* 13 127 (March 1923)

Bright Nebulosity in the 'Coalsack'

A PROGRAMME on the dark patch in the Milky Way, known as the 'Coalsack', taken when at the Boyden Station of the Harvard Observatory, Bloemfontein, included a number of red plates on that region. On one of these, a three-hour exposure taken with the Bruce telescope with an Eastman *I–C* Special plate and Ciné red filter, a small patch of bright nebulosity was observed within the region of the 'Coalsack'.

Dr Bok has confirmed for me the existence of this nebulosity on a long-exposure blue Bruce plate in the Harvard collection. There is no suspicion of nebulosity on two-hour exposure plates, but a six-hour exposure plate leaves no doubt of the reality of the nebula.

A detailed investigation will be published later.

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Mechanism of the Primary Photodissociation Processes of Organic Molecules

IN his comments on our communication[1] under this title, Prof. R. G W Norrish[2] has raised certain questions which we naturally would like to answer. But as this discussion would certainly require more space than NATURE can devote to these questions, we prefer to deal with the matter in the detailed paper which is now in course of completion.

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[1] NATURE **141**, 832 (1938)

[2] NATURE **141**, 1138 (1938)

Points from Foregoing Letters

PALÆOLITHIC implements belonging to a hitherto unrecognized type, apparently of early Acheulean date, have been found by J Reid Moir and D F. W Baden-Powell near Cromer, in the marine sands at Corton, classified as 'Middle Glacial'. The implements are of black flint, usually with a thin cortex and mostly exhibiting a certain amount of gloss. Scrapers (side-, hollow-, square-ended and round-ended) and flakes modified by secondary flaking into knives, are among the implements found.

The liberation of small amounts of carbon dioxide from cellulose and from certain starches by aqueous hydrochloric acid has been shown by W G Campbell, Prof. E. L Hirst, and G T. Young to be due to decomposition of their constituent hexoses, and not to the presence of uronic anhydride residues. The yield of carbon dioxide from a number of typical carbohydrates is reported. Mannitol, which contains no potential aldehydic group, gives no carbon dioxide. These results do not vitiate the claim by W G Campbell that certain wood starch preparations contain uronic anhydride residues.

Prof W D. Harkins and R. T. Florence find that on compressing surface films containing oleic acid and stearic acid (or some other straight chain saturated compounds) the oleic acid separates out in the form of ultramicroscopic droplets due, the authors consider, to the fact that the bending of the chain at the double bond causes the molecule to require a greater surface and is consequently less firmly bound. Elaidic acid shows the phenomenon to a lesser extent and these findings together with those recently reported by Rideal and Marsden indicate also that the bend at the double bond causes the *cis*-compounds to be less firmly bound to the other molecules in the film than is the case with *trans*-compounds.

Prof. S. K Mitra discusses some of the new work on the ionization of the upper atmosphere and suggests that the *E* layer (80–120 km high) is a region of transition from molecular to atomic oxygen, and its ionization is due to photo-ionization of molecular oxygen by absorption commencing at a wave-length of 744 A.

The effect of temperature on the intensity of reflection of X-rays from copper (which possesses a face-centred cubic structure) shows, according to Prof E A Owen and R W Williams, that throughout the range 290–840° Abs., the decline in intensity with increase in temperature is greater than that predicted by the Debye-Waller formula.

Dr D S Kothari calculates the minimum energy evolved at different hydrogen concentrations by the combination of two protons to form a deuteron, which reaction is considered by Bethe and Critchfield to be the main source of energy for stars lighter than the sun. The minimum energy is obtained by averaging the probability of reaction for a velocity distribution corresponding to that of a completely degenerate proton gas.

Records of elastic ground waves produced by the explosion of charges of T N T laid on the sea-floor and fired from a motor-boat indicate, according to Dr E C Bullard and T F Gaskell, that off the coast of the Lizard a surface layer 1,000 ft thick, in which the velocity of the elastic waves is 11,000 ft /sec., is underlain by rocks (probably igneous) in which the velocity is 23,000 ft /sec.

Experiments by Dr J N E Day and P Sheel, in which rats were allowed to inspire oxygen containing the heavier isotope of mass eighteen and the expired carbon dioxide afterwards analysed for the heavier isotope, indicate that the inspired oxygen mainly enters directly into carbon oxidation and is exhaled as carbon dioxide.

M Westergaard reports that tetraploids induced in *Melandrium album* by the method of Randolph and by colchicine treatment differ little from diploid plants in appearance. They show the same clear-cut diœcism. The most frequent conjugation type of the sex chromosomes in tetraploid males is autosyndesis.

G Howard Jones and Seif el Nasr have discovered that the amount of four cereal smut diseases in Egypt differs greatly according to the method of planting. They have analysed this effect into a large factor of depth of sowing and a smaller factor of soil moisture. They have thence developed a 'mud sowing' method of sowing seed on the surface of soaked soil, which is practicable under irrigation, and almost eliminates disease.

Research Items

Skeletal Remains from Kansas Mounds

HUMAN skeletal remains with crania of a distinctive type have been discovered in mounds near Kansas City excavated by Dr. Walso R. Wedel of the Smithsonian Institution, Washington. In a preliminary report issued by the Institution, the skulls are described as distinguished by a ridge in the centre of the frontal bone, which must in life have given the people the appearance of having obliquely arched foreheads. The mounds in which these remains were found were low, never more than five feet high, each of them enclosing a partly subterranean rectangular stone chamber. Some of the remains had been cremated. The people were American Indians but possibly of considerable antiquity. These houses of the dead at one time had been numerous but a large number had been destroyed or looted within the last seventy five years, so that few were found in good order. To date eight complete or reconstructable skulls have been obtained. It is thought possible that the mounds are to be associated in some way with the Mound Builders of the Ohio Valley, the so called Hopewellians. In the suburbs of Kansas City, artefacts have been discovered, which unquestionably belong to the general Mound Builder complex, and representing the most westerly extension of that culture known at present. Although the long headed Kansas skulls might be related to the Mound Builders, no artefacts assignable to that culture have been found in the tombs. It is possible that the stone burial chambers may represent an early manifestation of the Hopewellian culture, or a variation adopted in a treeless region. The practice of the Hopewellians was to place their dead in a log house and when it was filled to set it on fire and pile earth over the ruins, making a mound about fifteen feet high. Sometimes two of these houses were set close together and eventually formed one mound. Owing to this practice of cremation, it is difficult to obtain a view of the physical type from such material as escaped the flames. Hence the peculiar physical type of the Kansas remains does not bar them from association with the Hopewell people.

Relation of Rare Defects to Population Changes

THE effects of inbreeding and isolation in a population on the frequency of occurrence of recessive or dominant characters due to single or multiple genes, is discussed by Dr. Gunnar Dahlberg (*Proc. Roy. Soc. Edinb.*, **58**, Part 2, No. 15). His conclusions are based on the statistics of cousin and other consanguineous marriages in Germany, France and Italy. He points out that any group within which marriages chiefly take place, owing to geographical or social barriers, can be regarded as an isolate in which amphimixis is occurring. Any particular recessive mutational genic defect will be unequally distributed in the population of a country, and the best way to decrease it is by decreasing the number of consanguineous marriages. But even the abolition of cousin marriages would only decrease the frequency of the carriers of rare genes by 10–15 per cent. Increasing the size of isolates, through increasing communications or through population growth, diminishes the number of recessives. In Prussia, first cousin marriages decreased from 0.71 per cent in 1875 to 0.20 per cent in 1926, so that the frequency of inbreeding is one third what it was fifty years ago, while the number of marriages has nearly doubled. In Bavaria the changes are still more marked, while in France the total number of marriages has remained nearly constant, as well as the frequency of cousin marriages, which remains at about one per cent. Movement from country to town increases the size of town isolates, while increasing intercommunication increases the size of country isolates. Both these effects will diminish the frequency of rare recessive defects. In Prussia and Bavaria where the size of the isolates has more than doubled in fifty years, the rare recessives will have decreased by at least one half.

Relation between Ovaries and Uterus during Pregnancy

THE golden hamster, *Cricetus auratus*, is a comparatively new laboratory animal, having been introduced from Syria in 1932. It is now fairly widely distributed, for it is easily reared and managed under laboratory conditions. The length of pregnancy is only sixteen days, which is shorter than that of other laboratory rodents. M. Klein (*Proc. Roy. Soc.*, B, June 1938) has investigated in it the relation between the ovaries and uterus during pregnancy. Ovariectomy between the ninth and thirteenth days brings pregnancy to an end. Injection of progesterone and œstrone simultaneously into the ovariectomized hamsters maintained pregnancy in some instances up to parturition. The duration of the corpus luteum of pseudopregnancy is noticeably shorter than in true pregnancy. Complete removal of the uterus between the eighth and thirteenth day of pregnancy results in the rapid regression of the corpora lutea and the initiation of the ovarian cycle. The removal, by Cæsarean section, of the fœtuses only, leaving the placentæ inserted, does not shorten the duration of the corpora lutea or remove the inhibition of the ovarian cycle. No interpretation of the mechanism connecting the uterus to the ovary is suggested.

Experiments on Hæmostasis

A. GRASSI (*Policlinico* (*Sez. Chr.*), **45**, 72; 1938) records his experiments on rabbits in which application of powdered bone to wounds of the liver had a remarkable hæmostatic effect, the hæmorrhage ceasing in 10–20 seconds. It was important that the powdered bone should have come from the same animal as that in which the liver was wounded, as the hæmostatic action of bone taken from another animal was much less. Grassi regards the hæmostasis as due mainly to a chemico biological action of the powdered bone and only in a very small degree to its mechanical action.

Parasites of the Elephant

TAKING advantage of his own examination of the internal parasites of four Indian and of several African elephants, O. P. van der Westhuysen has compiled a monograph of the helminth parasites of the two species (*Onderstepoort J. Vet. Sci. Anim. Industry*, **10**, 49; 1938). The parasites show a fairly strict host specificity, no species having yet been found to occur in both African and Indian elephants, although both possess an extensive nematode fauna Amongst the Strongylidæ, the African elephant has 25 parasitic species, the Indian 12, the Anchylostomidæ are represented by 3 species in the African, 4 in the Indian, the Syngamidæ has only one species —in the Indian elephant In all, ten nematode genera are represented in this fauna and of these, four are confined to the Indian species *Equinubria*, *Decrusia*, *Bathomostomum* and *Choniangium* All the Strongylids are parasitic in the alimentary tract except the members of the genus *Grammocephalus*, the adults of which inhabit the bile ducts The author gives descriptions of the species, keys for specific identification and many illustrations of distinguishing characters

Botanical Research in Brazil

The University of São Paulo Brazil, proposes to publish the work of the different departments of the faculty of science separately, all correspondence to be addressed Caixa Postal 2926 São Paulo, Brazil The first botanical publication, *Botanica*, No 1 1937, contains several interesting papers by Prof Felix Rawitscher on experiments upon factors controlling leaf symmetry and by his scientific assistant, Dr Karl Arens, upon the photosynthetic process Dr Arens also has a description of the different modes of entry of the germ tubes of *Bremia lactucae* The germ tubes of the conidia enter nearly always by piercing the leaf cuticle just above the position of an anticlinal wall, the zoospores settle down near a stoma and the germ tubes penetrate through the stomatal aperture

Features in Fern Prothalli

P N Mehra is mainly concerned with the occurrence of apogamy in the prothalli of *Adiantum lunulatum* and *Pteris biaurita* in two papers recently published (*Proc Indian Acad* Sci, 8, B No 3), but considerable interest is also attached to the very fine photographs he gives of the typical spirally thickened tracheids in the prothallus of *Adiantum* He describes these as of regular occurrence and a specific character of this gametophyte and a study of their development and detailed structure would have great interest as they would appear to be typically protoxylem elements though occurring in gametophyte tissue In this connexion it may, of course, have significance that they occur in a prothallial cushion on the anterior face of which may afterwards arise a fern sporophyte as a vegetative bud None the less, these tracheids are said to be typical of the normal prothallus—apart from the apogamous formation of vegetative buds, and they are also said to have no direct continuity usually with the vascular strands of such buds when they arise It is possibly also suggestive, in connexion with their presence, that Mr Mehra sees a tendency in these prothalli to continue vegetative growth, even after the production of a sporophyte has commenced The prothalli of *Adiantum* raised from spores from ferns from Sikkim showed no trace of archegonia, while others from spores collected at Kulu grown under the same conditions produced normal archegonia The prothalli of *Pteris biaurita* developed neither archegonia nor the usual prothallial cushion All these prothalli produced apogamous embryos, even in the Kulu prothalli of *Adiantum* the archegonia played no part in embryo formation

Leaf-Spot of Bananas

A bulletin of the Department of Science and Agriculture, Jamaica (No 15, New Series, Govt Printing Office, 1938) describes the leaf spot disease of bananas caused by *Cercospora musæ* Three types of infection are known and the spots pass from yellow to brownish black, having finally a grey centre The disease has a seasonal recurrence, being most severe in the rainy season when temperatures are low It occurs most seriously on compact alluvial soils, on soils of white limestone origin, and on the badly eroded soils of ridges Spasmodic, succulent growth favours the parasite more than the steady riper growth associated with the older banana lands, These conditions of external environment have a strong influence upon the incidence of the fungus but control can also be effected by spraying with Bordeaux mixture

Horticultural Uses of Peat

Diminishing supplies of stable manure have made gardeners acutely aware of the need for maintaining sufficient organic matter in their soils A very convenient source of humus is peat and Mr W J C Lawrence briefly describes the various kinds in a short paper in the *Gardeners Chronicle* of September 24 Wet peat can hold as much as 95 per cent of water, and is therefore useful for increasing the water holding capacity of light soils Rhododendron peat' usually has considerable quantities of silt and sand, and may have weed seeds in addition Moss peat and sedge peat are of uniform texture, and are free from weeds Mixtures of peat and artificial fertilizers provide adequate substitutes for farmyard manure, and peat is also useful as a constituent of rooting composts for cuttings It often has, in addition, a *p*H of about 3 5, and this would help the growth of many garden crops which require an acid medium

Soils of Dutch East Indies

In an article entitled Climate and Soil in the Netherlands Indies (*Bull Colonial Institute of Amsterdam*, 1, No 4), Dr F C J Mohr directs attention to certain factors that affect the soil and so the productivity of the various Dutch islands of the Malay Archipelago Rainfall differs much in some islands it falls on almost every day in the year, in others there is a marked dry season of greater or shorter duration Heavy rainfall causes leaching and impoverishment of the soil Hence it is the areas with a dry season that are most fertile Middle and East Java are more productive than Sumatra, in the same way that elsewhere in the world the civilized peoples of the tropics have always been in dry or comparatively dry regions The higher the altitude the lower the temperature This decreases the power of rain to leach the soil and so results in greater fertility at high elevations than on lowlands, always provided that first, the high elevation does not mean a greatly increased rainfall and, secondly, steep gradients do not facilitate active soil erosion Furthermore, higher elevations on account of lower temperature have more humus in the soil this enhances their fertility The one factor of great importance in restoring the fertility of the soil is the action of volcanoes that scatter ashes These, when basic, help to restore the value of the soil, hence again the greater fertility of Java than Sumatra and the poor soils of Borneo and New Guinea

Earthquakes in the Neighbourhood of Lake Michigan

THIS is an area where earthquakes are rare Since 1804 there have only been seven of greater intensity than 5 on the Rossi Forrel scale namely 1804 Chicago (6) 1883 Kalamazoo (8) 1909 Freeport (8), 1912 Aurora (6), 1928 Mt Carroll (5) 1934 Rock Island (6), and 1938 Porter (6) This last one has been studied by A R Schmitt, S J , of Loyola University Chicago, Illinois (*Earthquake Notes and Abstracts* 10 Nos 1 and 2 19 21) The earthquake was recorded on February 12 1938 shortly after midnight, by seismographs at the University of Chicago and at Loyola University but not at the next further stations at Ann Arbor Cincinnati and St Louis The *S–P* interval on the Wiechert record at Loyola was 9 seconds, the beginning of the *P* phase being at 6 h 27 m 41 s G M T whilst the Milne–Shaw at the University of Chicago registered *P* at 6 h 27 m 39 s G M T Joliat s tables thus give the epicentral distance from Loyola as 60 km or 38 miles In the absence of other instrumental evidence the area was canvassed for human evidence, and this was greatly assisted by the *Chicago Tribune* This established the presence of a sound concurrent with the shock which many thought to be double like a heavy truck passing the house , and also established the epicentral point as being in the lowland approximately fifteen miles to the east of Porter Indiana

Earthquake Sounds

ALTHOUGH it is usual for a rumbling sound to accompany most earthquakes this aspect of the shocks has not received a great deal of attention Dr C Davison (*Bull Seis Soc Amer* , 28, No 3, July 1938) helps to make good this deficiency by publishing the results of his large collection of observations chiefly from the British Isles He draws thirteen conclusions, the chief of which are (1) that the sound is a low rumbling one , (2) as the distance from the origin increases the sound becomes smoother and more monotonous (3) the intensity of the sound increases to a maximum with the strength of the shock and then dies away with it , (4) in British earthquakes, the sound area bears to the disturbed area a ratio that increases from an average of 54 per cent for earthquakes of intensity 8 to one of equality for earthquakes of intensity 4 , (5) the duration of the sound is usually greater than that of the shock

Copper Content of Sea Water

SINCE a number of marine organisms need comparatively large quantities of copper for their metabolism, for example, in the form of the blood pigment hæmocyanin it is interesting to determine the concentration of copper in sea water from which these organisms must derive their supplies In the expedition of the *Meteor* in the North Atlantic earlier this year, the copper content of water in the sub tropical North Atlantic (Sargasso Sea) was determined by a photometric method The results have recently been published by K Kalle and H Wattenberg (*Naturwiss* , 26, 630 , 1938) The concentration of copper obtained at ten different stations varied from less than 3γ per litre to 12γ per litre At greater depths, values up to 30γ per litre were obtained , but it is possible that these results were spoilt by impurities arising from the dredges, and they therefore represent maximum values The concentrations of copper found are too small to lend support to the theory that the colour of sea water is affected by its copper content

Steroidal Hormones

IN a paper summarizing thirty nine previous communications, R E Marker (*J Amer Chem Soc* 60 1725 , 1938) discusses the origin and interrelationship of the steroidal hormones from a general point of view The isolation and synthesis of sex hormones and the isolation of steroids from the adrenal cortex have led to an increasing realization of the important part played by steroids in the animal It seems to be generally assumed that these various steroids arise from cholesterol, but the author brings together several lines of evidence which make this seem improbable, and it is suggested that sex hormones and the cortical substance may be derived from another precursor The steroidal hormones, including the C 18, C 19 and C 21 sex hormones and the cortical steroids may come from a common precursor, pregnadione 4 8 diol 17,21 trione 3 11,20, or its hydrate at C–9 The bile acids are also supposed not to originate from cholesterol Consideration of the interrelationships among the many steroids make it possible to propose a definite structure for the precursor of the steroidal hormones and it is shown how the various steroids isolated may arise from this precursor by orderly processes following definite rules and, with few exceptions having their counterpart in laboratory reactions The paper gives a useful review of some of the literature bearing on its subject

Variability of the Sun s Radiation

AN important contribution to the study of the variability of the sun s radiation has recently appeared (*Quart J Roy Meteor Soc* , July 1938) It is an abstract of a thesis by Miss M M Paranjpe Improved methods of measuring the radiation received from the sun at the earth s surface have been developed by Abbot at the Astrophysical Observatory of the Smithsonian Institute during the last thirty years and with their aid very careful determinations of the solar radiation have been made on a number of mountains Mountains were chosen to facilitate the difficult task of allowing for the selective absorption of different wave lengths by the atmosphere before determining the solar constant Errors of observation, and of computation of this absorption, result in apparent variations of the solar constant from day to day , but real variations, if large enough, would be revealed by positive correlation between simultaneous determinations at different places Abbot has maintained that such variations have been established, and Clayton has attributed many variations of the weather to them But the critical examination of the evidence for the existence of any variation of the solar constant large enough to be detected even by the most up to date methods, which occupies most of Miss Paranjpe s paper, appears to show that Abbot's supposed variations are illusory If that is the case, none of the work based on them is valid It does not follow, however, that still more refined methods of observation in the future may not lead to the detection of very small variations, such as are to be expected in view of the known changes of the sun's appearance

Television

THE twenty-fifth Thomas Hawksley Lecture was delivered to the Institution of Mechanical Engineers on November 4 by Sir Noel Ashbridge, chief engineer to the British Broadcasting Corporation, the subject chosen being television. He began by pointing out that the scientific suggestions on which modern television is based were made at intervals extending over a period of more than fifty years. In 1873, a telegraph operator named May, almost accidentally, made the discovery that the value of selenium resistances varied according to the amount of light falling on them. This was confirmed by Willoughby Smith and Prof. W. G. Adams. The importance of this discovery lies in the fact that it provided for the first time a means whereby an electric current could be generated, the value of which varied in sympathy with the intensity of a beam of light.

The elementary telegraphy of pictures at rest presented no great difficulty, but television essentially includes the transmission and reproduction of moving objects which introduces considerable complication. In the first place, the exploring of the subject, element by element, by a beam of light—usually called scanning—must be carried out rapidly, and the process repeated a sufficient number of times per second to give the illusion of uninterrupted movement when the picture is reproduced at the receiving end.

A very important step in the development of practical television took the form of a scientific forecast—one of the most remarkable ever made. In 1908, A. A. Campbell Swinton wrote a letter to NATURE describing a device which he considered a scientific possibility; this was the forerunner of the now famous 'Emitron' tube. It was not developed until twenty-five years later. This special form of electron tube constitutes the essential feature of the system now used for generating the picture currents at the London Television Station. In Great Britain it was developed by Electric and Musical Industries Limited. In the United States a tube based on the same principle has been produced by the Radio Corporation, and in other countries similar devices are being developed.

In Great Britain, between 1923 and 1928 J. L. Baird developed a complete system of television based on scanning with 30 lines and transmitting pictures at the rate of 12½ per second. He generally employed a mirror wheel—a development of the Nipkow disk principle—at the receiving end of his apparatus, in conjunction with selenium cells, the light beam being produced by an electric arc. Although an experimental service was operated by the B.B.C. for many months, it was never developed successfully on a service basis. It is now replaced by the 'high definition' system which operates at the London Television Station.

Many difficulties had to be overcome in establishing the high definition system. It is well known that it is necessary to use a wave length of about eight metres. There was also the difficulty of establishing a definition standard which was likely to remain for a reasonable number of years without becoming obsolete. Thus it came about that in 1934 the Postmaster General appointed a committee, under the chairmanship of Lord Selsdon, to study the whole problem. The Selsdon Committee made four recommendations: first, that high definition television was sufficiently advanced to justify the establishment of a public broadcast service, and that the B.B.C. appeared to be the most suitable body to do this, in view of the possibility of its merging with sound broadcasting; secondly, that the two systems developed in Great Britain, namely, Baird Television Ltd. and the Marconi E.M.I. Television Co. Ltd., should each be given a practical trial; thirdly, that the definition standard should not be lower than 240 lines per picture and the number of picture repetitions not less than 25 per second; and lastly, that an advisory committee should be established for a period of about five years.

Thus it came about that a station was built to serve an area within a radius of about twenty-five miles from the centre of London, and equipped with two complete and different systems which were to be tried out under conditions which would allow of a comparative test of their respective merits. After some months of experience the Committee decided to continue the service using one system only and one standard of definition. This was put into effect on February 5, 1937, when the 405 line 50 interlaced frame standard was adopted. There is little doubt that should it become necessary in the future to increase greatly the degree of definition and therefore the range of frequencies to be transmitted, it will be necessary to use shorter wave lengths. At the television station, the channels adopted were 6.67 metres for vision, and 7.23 metres for sound.

It has been frequently stated that propagation could not exist beyond the horizon. It is now known that the effective range is not limited to a visual path. Regular reception is known to be possible at fifty miles, while good pictures have been obtained at a distance of two hundred miles. In considering the site of the station, the main requirements were that it should be within a few miles of the centre of London in order to give a strong service in the more densely populated areas, and that it should be on high ground relative to the London district in the broader sense. Taking everything into consideration, it was decided that the Alexandra Palace in the north of London, would be the best site. There are two separate aerials, for vision and sound respectively, but both are carried on a single mast which is itself mounted on one of the brick towers forming part of the Alexandra Palace. The maximum height of the mast above ground level is about 300 feet—giving a total height of 600 feet above sea level. The aerials themselves are therefore higher than the top of any building within a ten mile radius of Charing Cross. This is important when considering the possibilities of propagation using wave lengths of this type. When viewed from a distance, the mast and aerial relays are somewhat reminiscent of a lighthouse.

Public broadcasts of the Coronation, Armistice Service, the Derby, etc., have been very successful, and great improvements have been introduced by the new 'Super Emitron', the output of which is about ten times that of the ordinary emitron As to the future, the Television Committee has announced that the present standards will remain in operation for at least three years Any improvements during this time will not render existing receivers obsolete

There is one aspect of television development which must be recorded with regret At present there seems no likelihood of international standardization with regard to definition and picture frequency standards In the following countries the standards at the moment are as follows although there is as yet no public service

	Lines per picture	Pictures per sec	Modulation
America	441	30	Negative
Germany	441	35	Positive
France	455	35	Positive

In the distant future, international television cables may become available In this case the absence of a common standard in European countries will be a serious matter

In spite of these early difficulties there is no doubt that this new development of entertainment in the home will, in the course of time reach the same degree of importance that sound broadcasting has done , in fact it may be readily anticipated that the two services will ultimately merge

Localization in the Central Nervous System*

BY electrical stimulation of the brain, David Ferrier established the main facts relating to the localization of the motor centres in the cerebral cortex These facts have been confirmed on man as well as on animals, and have been of great practical as well as theoretical importance But although they have been the basis for all attempts to analyse the cerebral organization, they reveal mainly its receiving and executive apparatus and show little of the intervening processes

With the development of methods for recording the activity of the brain in terms of the electrical effects produced the problems of cerebral localization can be approached from another aspect It has been found that the cerebral cortex is naturally in a state of constant activity which may take the form of a rhythmic series of potential waves (for example, Berger's α rhythm) or of more complex and irregular oscillations When the activity has been reduced by an anæsthetic, the arrival of an afferent message has a twofold effect It produces a direct local excitation in the region in which it arrives and a more widespread increase in the persistent activity of this and neighbouring regions The latter result may be considered a local or regional awakening for it resembles the generalized increase in electrical activity which occurs in the brain when a sleeper is roused In either case a mutual reinforcement by cortex and thalamus is an important factor in raising and maintaining the level of the spontaneous activity

In certain cases electrical stimulation of the brain has the same facilitating effect as an afferent message The spread of activity can then be followed by making simultaneous records of the potential changes at different distances from the stimulated point and it can be shown how a number of competing wave systems can come into being

Electrical records have not yet revealed any features peculiar to the cerebral neurones In other parts of the nervous system there are many examples of rhythmic activity favoured by the arrival of impulses and in the cortex as elsewhere there are probably all grades of spontaneity, ranging from neurone systems which cannot help discharging periodically to those which need a specific stimulus for each reaction Thus the activity in a given region of the cerebrum will depend on the interactions of each, rhythmic and non rhythmic systems In normal conditions inhibition as well as facilitation will help to determine the local patterns of activity but in records from the narcotized brain the excitatory factors are the more prominent

* Abstract of the Ferrier Lecture of the Royal Society delivered by Prof E D Adrian F R S on November 10

International Cancer Research*

ACCOUNTS of the Second International Congress of Scientific and Social Campaign against Cancer which was held in Brussels in September 1936 have appeared previously in this journal (NATURE 138 727, 1936 139, 255, 1937) The second volume of publications of the Congress has now been published and contains accounts of some two hundred communications which were submitted to the Congress The General Minutes of the Congress are to form volume 3

The papers are divided into two main groups the scientific, and the social campaigns against cancer, and these groups are again divided into sub groups Among the papers on the social campaign are some interesting statistics of cancer in Germany, Poland Rumania, South Africa and the Dutch Indies It is possible to refer to only a few of the papers in this review , emphasis will be laid on foreign scientific work, as British cancer research is often reviewed in these columns

The first sub group of communications on carcinogenic agents deals with the action of cancer producing compounds, the nature of cancer viruses and the part played by hormones in the origin of cancer Drs J Maisin and Y Pourbaix describe how the production of cancer on the skin of mice by the active carcinogenic agent of tar, 3 4 benzpyrene, is inhibited by treating the animals with minute amounts

* IInd International Congress of Scientific and Social Campaign against Cancer 2 Communications Pp xii + 628 (Bruxelles Marcel Hayez 1937)

of the oxidation products of ether As yet the result has not been obtained with any pure compound

Dr N Waterman, of Amsterdam, describes how carcinogenic agents inhibit the breakdown of cholesterol esters and possibly cause increased esterification of cholesterol in animals The results indicate that agents which have a localized carcinogenic action may have a widespread effect in the animal It is possible, but not certain that general effects of this type may be an essential part of the carcinogenic action Prof F Vlès and Dr A Ugo show that if mice are injected with the fluorescent carcinogenic agent 3 4 benzpyrene, the hair becomes fluorescent and the spectrum resembles that of the original hydrocarbon Drs J G Chalmers and P R Peacock show that the same compound is excreted as a fluorescent derivative in the bile It is also excreted in some form in the urine and thus animals excrete carcinogenic compounds by three routes in skin fat, bile and urine but in most cases the compound produces tumours only at the site of application and not along the paths of excretion

Dr Albert Fischer, of Copenhagen reports on some *interesting transplantation experiments* Tissue from salivary glands, liver ovaries and mammary glands of young mice was grafted at a different site in the same animal from which the tissue was taken After 10 14 days, the graft was inserted in a fresh place in the mouse, and this was repeated several times In some cases the regrafted tissue developed into malignant tumours showing that normal tissue may become malignant either by selection or by change in the character of the cells

Among a number of papers on the *nature of tumour viruses* is one by Dr A Claude, of New York showing that the virus of the Rous sarcoma No 1 is destroyed by incubation with crystalline trypsin Crystalline carboxypolypeptidase had no action on the virus These results indicate that the Rous sarcoma agent is a protein Other experimenters have found that the agent is not completely deposited on centrifuging at 15 000 R P M but is completely deposited at 50,000 R P M

Several communications deal with inherited predisposition and resistance to cancer The results of Dr Maud Slye of Chicago, on mice breeding indicate that types of cancer segregate as unit characters, and the incidence of malignancy at different sites can be explained by laws of heredity Dr N Dobrovolskaia Zavadskaia introduced radon tubes into the groins of female mice which normally had a high incidence of mammary carcinoma The total incidence of cancer was not changed by such treatment, but one third of the tumours in the radon treated mice were sarcomata instead of the usual mammary carcinomata

One section of the volume deals with cancer diagnosis Prof P Lamarque of Montpellier shows photographs of tissues made by microradiography These are taken by placing a thin section of tissue on specially fine grained photographic film and exposing the tissue and film to feebly penetrating X rays Those parts of the tissue which contain heavy elements absorb the X rays and a photograph showing the distribution of heavy metals in the tissue is obtained The results are similar to those obtained by microincineration which shows the distribution of ash in tissues Historadiography however has the advantage that the tissue is not treated so drastically as in incineration It appears to the writer that a modification of this technique to determine the distribution of introduced radioactive elements such as radioactive phosphorus in tissues has possibilities

The Second International Cancer Congress was well organized and the volume of Reports' was published at the opening of the congress The volume of communications contains many papers of value, it is unfortunate that they could not have been published immediately after the Congress F B

Iron and Steel Works Developments

IN his presidential address to the Institution of Mechanical Engineers on October 21 Mr David E Roberts reviewed the changes which have taken place during the last fifty years in the basic industry of iron and steel making with which his experience has been primarily concerned The twenty five years preceding the Great War, when the world s annual output of steel increased from seven million to nearly seventy million tons, were marked by great activity in the development of improved processes of manufacture, and this period he regards as the one during which the greatest strides were made in the engineering side of the industry

Sir Lowthian Bell, president of the Institution in 1884, established the ideal height for blast furnaces and, even to day, few exceed 90 feet In other respects, marked changes have been made Hearths, from 11 ft diameter, have been doubled in size while blowing pressure has increased from 5 to 25 pounds per square inch to ensure that the air will penetrate to the centre of the wider hearths For blowing, Watt's beam engines with air cylinders 10 12 ft in diameter are now replaced in Great Britain by turbines while, on the Continent, gas engines are largely used Raw materials are much more carefully selected and graded and the result is easier working of the furnace, with a saving of fuel and an increased output Blast furnace gas now cleaned most thoroughly is actually cleaner than the normal atmosphere It is used for driving gas engines or, when mixed with the richer coke oven gas for heating and smelting operations In the Ruhr area with its very numerous blast furnaces and coke ovens the whole of the works are connected to a huge pipe grid and every cubic foot of gas generated is effectively used—there is no waste such as is sometimes seen in Great Britain Steel manufacture has also developed greatly The Bessemer converter has returned to favour for the production of commercial steel—on the Continent it has been practically the only method of making common steel The open hearth process is the British mainstay and these furnaces have increased from 20 to 100 tons capacity while some tilting furnaces of 250 tons capacity are in use Much mechanical equipment is installed in the melting shop to increase the speed of operation and to ease the labour and exertion involved in handling vast masses of molten metal

In the rolling shops the simple type of reversing mill has given place to massive machines rapid in operation and provided with lifting tables and other manipulating devices The absence of noise is remarkable when it is realized that at each reversal some 150 tons of machinery is brought to rest and re started An example of the adaptation of new materials to attain improved results is the use of fabric bearings to carry the heavy rolls One of the most recent developments is the rolling of sheets by what is known as a strip mill—composed of a continuous series of roll stands in tandem arrangement Twenty of these huge mills are in operation in the United States and one is being installed in this country The early attempts to roll sheets in a continuous mill were frustrated by the difficulty of ensuring that successive pairs of rolls were of exactly corresponding contour and consequent troubles with ripples ensued The Ashland plant in 1922 demonstrated the correct principles and the American strip mills are now stated to have an annual capacity of 12 to 13 million tons The graduation of the thickness of the sheet throughout such a mill is vitally important and automatic recording devices have to be employed so that variations can be shown on a much magnified scale

Science News a Century Ago

Education in the Metropolis

The Statistical Society on November 19, 1838, held its first meeting of the session, the first communication being the third report of the Society's Committee appointed to inquire into the state of education in the Metropolis This report contained a description of the schools in the parishes of St George, St James and St Anne, Westminster The area of these districts was 1,310 acres and the population according to the census of 1831, 110,862 It was estimated that there were 21,502 children between the ages of five and fifteen years, and of these less than one third received instruction in a school There were four kinds of private schools—dance schools common day schools, middle and superior schools—besides charity and infant schools The Committee had found the teaching imperfect, the surroundings often cheerless and there was a notable absence of a good supply of literature Inquiries had been made at some five hundred houses and the members of the Committee had been met with courtesy

Blasting by Electricity

At a meeting of the London Electrical Society on November 20, 1838, a paper was read by Martyn Roberts entitled On the Use of Galvanism in Blasting Rocks' A report of the paper appeared in Sturgeon's *Annals of Electricity*, 3, p 423 The author described experiments, which had been attended with perfect success, made on granite rocks in the neighbourhood of Penzance, Cornwall His method was to bore a hole 2 ft deep in the granite and place 3 in of gun powder in it A wad of oakum was then driven in 9 in from the top of the hole, leaving 12 in of air between the wad and the powder The upper part of the hole was filled with sand, a convenience being allowed for placing a thin iron wire in connexion with the powder, which wire became red hot, and consequently exploded the charge, when connected with the voltaic battery

Interior of the Earth

On November 22 1838, W Hopkins read a paper to the Royal Society entitled "On the State of the Interior of the Earth The object of the paper was to inquire into the modes in which the 'refrigeration' of the earth may have taken place, on the hypothesis that its entire mass was originally in a fluid state, a hypothesis which was at first founded on astronomical considerations and was corroborated by the discoveries of modern geology exhibiting the apparent injection from below of large masses of unstratified rocks through the fissures of sedimentary strata In the course of his discussion, Hopkins said that the internal mass of the earth may consist of matter still in a state of fusion, or the earth may consist of an external shell and a solid central nucleus with an intermediate stratum of matter in a state of fusion or the earth may be solid from surface to centre

The author of this paper William Hopkins, was born on February 2 1793, and died on October 13 1866 He began life as a farmer but at the age of twenty nine years entered Peterhouse Cambridge, and graduated as seventh Wrangler five years later Settling at Cambridge as a tutor he had among his pupils Stokes Kelvin Tait, Clerk Maxwell and Todhunter It was through Sedgwick that he acquired a taste for geology In 1850 he was awarded the Wollaston Medal for his application of mathematical physics to geology, and in the following year he served as president of the Geological Society In 1853 he was president of the British Association After his death the Cambridge Philosophical Society founded a *prize in his honour*

University Events

Cambridge—A L Percival, of Jesus College, and H G Rhoden, of St John's College, have been appointed University demonstrators in engineering and A M Barrett of Pembroke College, has been appointed University demonstrator in pathology

J R F Jeffreys, of Downing College, has been elected to an Isaac Newton studentship

The degree of Sc D has been conferred on F Yates, of St John's College

T P Hughes Rhondda research student, 1935–37, of Gonville and Caius College, has been elected into an unofficial Drosier fellowship for research in chemistry

The following new appointments have been made in connexion with the Cambridge Philosophical Society *Vice President* Prof F J M Stratton *New Members of the Council*, Dr E C Bullard, Dr L J Maskell and Dr F C Phillips

Sheffield—The following appointments have recently been made Dr G K T Conn, assistant lecturer in physics, W J Lytle, honorary lecturer in surgical pathology, Dr H E Harding, honorary lecturer in medical pathology, J Hughes, honorary demonstrator in anatomy, F G West Oram, at present junior research assistant, as assistant lecturer in glass technology

Societies and Academies

Paris

Academy of Sciences (*C R* 207, 649–692, Oct 17 1838)

E JOUGUET Relationships between the problem of secular stability and that of critical speeds

A CHEVALIER New African coffee trees as a principal source of coffees for French consumption These indigenous coffees thrive in a relatively poor soil at altitudes of 0–600 m in the regions of dense equatorial forests found in the French tropical colonies

P A DANGEARD Mode of multiplication of flagella at each division in *Oxyrrhis marina* The flagella of this peridinian divide longitudinally at each division

L ROY Total action exerted due to magnetization in a system of isotropic bodies

R SALEM A general test for uniform convergence of Fourier series

L BERGERON The problem of the fall of a mass on an elastic rectilinear prism

L ESCANDE Sluice gates experiments at the Valentine [hydro electric] works [on the Garonne]

R FORRER Production of several magnetic products, starting from FeOOH Non magnetic FeOOH, when heated at different rates, yields four products, magnetically distinct, but all corresponding in composition to Fe_2O_3

P AUGER and R MAZE Study of cosmic ray showers at an altitude of 2,800 m [at the Pic du Midi] Observations were made with Geiger counters by the co incidence method

M PRETTRE Existence of two mechanisms for slow homogeneous oxidation of mixtures of hydrogen and carbon monoxide

R TRUFFAULT Condensation of halogen derivatives of benzene with unsaturated hydrocarbons and with their halogen derivatives under the influence of concentrated sulphuric acid as catalyst

J ROUCH Observations of the terrestrial electric field at sea

M PAGET and R BERGER Researches on human allantoinuria

Y RAOUL and P MEUNIER *Trans* $\Delta^{5,6}$ dehydro desoxo androsterone This compound has about 1/250 of the androgenic activity of testosterone and no œstrogenic activity

J COURTOIS Synthesizing action of renal phosphatase

M POLONOVSKI and P DESGREZ Reducing properties of a tautomeric form of geneserine, an example of a chain reaction

C LEVADITI, R FASQUELLE, R BÉQUIGNON and L REINIÉ Influence of selectors on the encephalogenic potential of Jenner vaccine

F BURNET Positive inoculation of human leprosy into the golden hamster, *Cricetus auratus*

Calcutta

National Institute of Sciences of India, September 26–27, 1938

PUBLIC LECTURES

S S BHATNAGAR How chemistry can help Indian industries

J C GHOSH Poisonous chemicals in modern warfare anti gas defence measures

M N SAHA Geography of space

SYMPOSIUM ON RECENT WORK ON THE SYNTHESIS OF NATURALLY OCCURRING SUBSTANCES

J N RAY Some recent developments in the study of the constitution of natural products

P C MITTER History of researches in organic chemistry in India (1896–1923)

P C GUHA and collaborators Synthetic investigations on bicyclic terpenes

D CHAKRAVARTI Synthesis of coumarins and chromones

R C SHAH and collaborators New synthetical methods in coumarin chemistry

K S NARANG J N RAY and B S ROY The constitution of rottlerin

K VENKATARAMAN Synthetical experiments in the flavone and isoflavone groups

R D DESAI and S ZAFARUDDIN AHMED The colouring matter of the yellow flowers of *Thevetia Nerifolia* (Apocynaceæ)

R C SHAH C R MEHTA and T S WHEELER Attempted synthesis of oroxylin *A* and the synthesis of wogonin

T S WHEELER and collaborators Synthesis of some naturally occurring flavones from chalkones

Washington, D C

National Academy of Sciences (*Proc*, 24 365–405, Sept 15, 1938)

S CHEVAIS B EPHRUSSI and A G STEINBERG Facet number and the v^+ hormone in the bar eye of *Drosophila melanogaster* Eye disks from Bar larvæ fed with extract of *Calliphora* larvæ, which increases number of facets in the eye were implanted into vermilion hosts Resulting eye pigmentation was the same as that of eyes from larvæ on standard diet

B P KAUFMANN and RUTH C BATE An X ray induced intercalary duplication in *Drosophila* involving union of sister chromatids

S WRIGHT Distribution of gene frequencies in populations of polyploids A theoretical discussion

L R MAXWELL Mechanism of delayed killing of maize seeds with X radiation Dry seeds are irradiated with 50 000–100 000 r, germination occurs but the seedling dies after reaching a height of 1–2 cm (delayed killing) Statistical results of irradiating various zones of the seeds indicate that there is no single sensitive volume for a multicellular body

H JENNY and R OVERSTREET Contact effects between plant roots and soil colloids Contact exchange involves a mutual transfer of ions, hence for every cation gained by the root (contact intake) an equivalent number of ions leaves the root surface and goes to the clay (contact depletion) Data for potassium in the latter process are discussed In certain clay suspensions, roots containing radioactive potassium showed a net intake but also parted with radioactive potassium to the clay Intake of ions is not a uni directional process, outgo is especially pronounced for roots in contact with colloidal systems

S LEFSCHETZ Locally connected sets and retracts

E KASNER and J DE CICCO Conformal geometry of horn angles of second order

C R DOERING and ALICE L FORBES A skeleton life table A short method of computation based on 13 census groups or the 7 so called biological groups gives a life table claimed to be of sufficient accuracy for health officers

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, November 21

Royal Geographical Society at 5 30 —Miss F J Lindgren and A Croft Summer and Winter Life in Lapland (Film)

Thursday, November 24

Society of Chemical Industry and the Chemical Society (in the Leathersellers Hall St Helens Place London E C 3) at 5 —Dr H Levinstein Lecture to commemorate centenary of birth of Sir William Perkin *

Chadwick Public Lecture (at the Royal Institute of British Architects) at 5 30 —W W Wakefield M P Playing Fields and the National Fitness Movement (Malcolm Morris Memorial Lecture) *

Friday, November 25

Geophysical Discussion (at the Royal Astronomical Society) at 4 30 — The Electrical and Thermal Conductivities of the Earth to be opened by A T Price

Institution of Electrical Engineers at 6 —Discussion on Non Destructive Testing

Institution of Chemical Engineers (at the Institution of Civil Engineers) at 6 30 —Prof J C Philip Fog and Mist from the Physico Chemical Standpoint (Hinchley Memorial Lecture)

Royal Institution at 9 —Sir James Jeans F R S The Problem of the Astronomical Universe

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Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Principal of the Newton in Makerfield Technical Institute and Junior Technical School—The Secretary Newton in Makerfield Local Higher Education Sub Committee Town Hall Earlestown Lancashire (November 21)

Assistant Lecturer in Electrical Engineering in the Openshaw Technical School Manchester—Director of Education Education Offices Deansgate Manchester (November 26)

Lecturer (part time) **in Inorganic and Physical Chemistry** in the Woolwich Polytechnic London S E 18—The Secretary

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Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research Report of the Road Research Board with the Report of the Director of Road Research for the Year ended 31st March 1938 Pp viii+191+18 plates (London H M Stationery Office) 4*s* net [2710

London Shellac Research Bureau Technical Paper No 15 Shellac Esters—Esterification of Hydroxyl Groups of Lac with Acids By Dr R Bhattacharya and Dr B S Gidvani Pp 14 Free Technical Paper No 16 Fractionation of Lac By Dr R Bhattacharya and G D Heath Pp 15 Free (London London Shellac Research Bureau) [2710

Pioneer Health Centre Ltd Annual Report 1937 Pp 32+4 plates (London Pioneer Health Centre Ltd) [2710

Medical Research Council Eighteenth Annual Report of the Industrial Health Research Board to 30th June 1938 Pp iv+62 (London H M Stationery Office) 1*s* net [2810

ASLIB Book List Vol 3 No 4 June Pp 103 142 (London Association of Special Libraries and Information Bureaux) Free to Members to non Members 10*s* 6*d* per annum [111

Geological Survey and Museum A Guide to the Geological Column exhibited in the Museum of Practical Geology By Dr R L Sherlock Pp ii+6 (London H M Stationery Office) 2*d* net [111

Technical Publications of the International Tin Research and Development Council Series A No 78 A Study of the Mechanical Properties of Tin Rich Antimony Tin Alloys By Prof D Hanson and Dr W T Pell Walpole Pp 24 Free Series A, No 79 The Nickel and Chromium Plating of Tinplate By A W Hothersall and C J Leadbeater Pp 24+2 plates Free (London International Tin Research and Development Council) [111

Ministry of Agriculture and Fisheries Final Report of the Departmental Committee on the Ordnance Survey Pp iv+39+11 maps (London H M Stationery Office) 5*s* net [211

British Museum and British Museum (Natural History) Annual Report of the General Progress of the Museums for the Year 1937 Pp [illegible] (London H M Stationery Office) 4*d* net [211

Institution of Structural Engineers Report of the Committee on Air Raid Precautions Pp 48 (London Institution of Structural Engineers) 1*s* [311

Colonial Office Report and Proceedings of the Conference of Colonial Directors of Agriculture held at the Colonial Office, July 1938 (Colonial No 156) Pp 130 (London H M Stationery Office) [illegible] net [411

Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 10 No 1 June Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson Pp v+94 (London H M Stationery Office) 4*s* 6*d* net [411

Other Countries

Transactions of the Academy of Science of St Louis Vol 29, No 6 Some Problems of the Middle Mississippi River Region during Pleistocene Time By Percival Robertson Pp 165 240 (St Louis Mo Washington University) 1 dollar [2710

Tanganyika Territory Department of Lands and Mines Geological Division Short Paper No 18 The Geology of the North Iluiga Area By Dr A C Skerl and F Oates Pp 38+2 plates (Dar es Salaam Government Printer) 3*s* [2710

Australasian Antarctic Expedition 1911 14 Scientific Reports Series C Zoology and Botany Vol 2 Part 6 Crustacea Decapoda (in part) By Freda Bage Pp 13+1 plate 3*s* Vol 2 Part 7 Cirripedia By Freda Bage Pp 14+4 plates 3*s* 6*d* Vol 9 Part 5 Non Calcareous Sponges By Maurice Burton Pp 22 3*s* 6*d* (Sydney Government Printer) [2810

U S Department of the Interior Office of Education Bulletin 1938 No 2 The School Custodian By Dr James Frederick Rogers Pp vi+44 (*Washington D C Government Printing Office*) 10 cents [2810

Tanganyika Territory Department of Agriculture Pamphlet No 22 Fourth Annual Report of the Coffee Research and Experimental Station Lyamungu Moshi 1937 Pp 55 (Dar es Salaam Government Printer) 1*s* 6*d* [111

Journal of the Indian Institute of Science Vol 21A Part 22 Supersonic Velocity in Gases and Vapours Part 1 Aberrations of Supersonic Interferometers in Gases By S K Kulkarni Jatkar Pp 245 272 2 rupees Vol 21A Part 23 Reactions of Chromates at High Temperatures Part [illegible] Decomposition of Barium Chromate and of Mixtures of Barium Chromate with Barium Carbonate By V T Athavale and S K K Jatkar Pp 273 284 1 rupee (Bangalore Indian Institute of Science) [111

Sveriges Geologiska Undersökning Ser Ca No 28 Stripa odalfälts geologi Av Per Geijer Pp 43+3 plates (Stockholm P A Norstedt and Söner) 6 00 kr [111

New Zealand Department of Lands and Survey Annual Report on *Scenery Preservation for the Year ended 31st March* 1938 Pp 16 (Wellington Government Printer) 6*d* [111

New Zealand Twelfth Annual Report of the Department of Scientific and Industrial Research Pp 128 (Wellington Government Printer) 2*s* 3*d* [111

Meddelande från Lunds Astronomiska Observatorium Ser 2, *Nr* 94 Catalogue of Orbits for Visual Binaries By Bengt Ekenberg Pp 34 Ser 2 Nr 95 La densité d une nébuleuse obscure entourant le système solaire calculée d après les mouvements comètaires Par Axel Corlin Pp 14 Ser 2 Nr 96 (Historical Notes and Papers Nr 13) Notes as to Cosmological Ideas in Al Quran By Abdel Hamid Samaha Pp 6 Ser 2 Nr 97 Accidental and Systematic Errors of Modern Trigonometric Parallaxes By Erik Holmberg Pp 68 Ser 2 Nr 98 Positions of 110 Stars mainly Eclipsing Binaries and Reference Stars of Nebulae By Erik Holmberg Pp 16 Ser 2 Nr 99 The Orientation of the Orbit Planes of Visual Binary Stars By Folke Berglund Pp 12 Ser 2 Nr 102 (Historical Notes and Papers Nr 14) The Luni Solar Calendar By Lewis A R Wallace Pp 12 (Lund Astronomiska Observatorium) [111

Government of Iraq Ministry of Defence Meteorological Service Annual Report of the Director No 2 Year ending 31st March 1938 Pp 26 (Baghdad) Government Press) [211

Scripta Academica Hierosolymitana Simon Velikovsky Foundation Scientific Report 1 Polycyclic Aromatic Hydrocarbons By Ch Weizmann and E Bergmann Pp 42 (Tel Aviv Scripta Academica Hierosolymitana) [311

The Soaring Cycle Pp 58 (*Washington D C* The Soaring Flight Co) 5 dollars [411

Catalogues, etc

Chemische Novitäten Jahrgang 28 Heft 1 Juli Pp 72 (Leipzig Gustav Fock G m b H)

Catalogue of General Literature (Catalogue No 631) Pp 64 (London Francis Edwards Ltd)

Aeronautik und Meteorologie in Auswahl Bücher Zeitschriften, Abhandlungen (Antiquariatskatalog Nr 724) Pp 32 (Leipzig Gustav Fock G m b H)

Movable, Focussing Self sustaining Fittings Eighth edition Pp 22 (Hazel Grove nr Stockport John Dugdill and Co Ltd)

Musik Praktisch Historisch Theoretisch Teil 3 McDowell—Roussier (Antiquariats Katalog Nr 53) Pp 225–336 (Leipzig Karl Max Poppe)

Diffusion Pumps for the production of High Vacua (Dif 1) Pp 16 (London W Edwards and Co)

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Vol 142 SATURDAY NOVEMBER 26 1938 No 3604

Universities and Citizenship

THE report of the 1938 congress of the National Union of Students held at University College Nottingham which recently appeared under the title The Challenge to the University (London National Union of Students) is a worthy successor to the admirable report on graduate employment issued last year While disclaiming any attempt at an authoritative statement it gives a stimulating picture of the way in which the problems of a university are being faced by the students themselves and of the extent to which the suggestions and ideas of the report of the University Grants Committee have permeated the student body

The report has indeed gained rather than lost in force through recent events which have focused attention upon the importance of a definite national policy in regard to man power and the most effective means of utilizing professional and technical workers in the national service in time of emergency Every approach to the problem of national defence emphasizes the importance of leadership whether we are considering the organization and utilization of national resources in a time of emergency or the wider question of national reconstruction along lines which permit freedom for development and individual activity in time of peace while providing the basis and framework of a defence policy adequate to meet the demands of any sudden emergency

Leaving on one side some of the fundamental problems with which the issues of peace and war must always confront a university in its pursuit of learning and the disinterested search for truth the problem of national defence poses problems of great magnitude to the university Indeed no plan or policy of national defence can be regarded as adequate which does not have regard to the position and contribution of the universities while safeguarding their highest ideals and traditions If a university is to participate actively in the task of national defence or preparation for defence it cannot be on terms which violate its independence of thought or its loyalty to the aim of furthering human welfare and knowledge

Two fundamental principles are urged in the report namely that the university should provide the means whereby its students can fit themselves adequately for an effective position in the vocational strata of society and that it should assist its students to develop powers of thought and interest in the affairs and problems of the modern world so that ultimately they may play a full and leading part in the life of the national and international community These are indeed indispensable from the point of view of national efficiency

The real problems arise indeed not from divergence of aim or principle but from the question of methods Methods which may best serve national efficiency from the point of view of national defence at least on a short view are not necessarily the best to safeguard the ideals or independence of the university or its teachers or students One of the difficulties of the times is the necessity of confronting the totalitarian regimes with their menace to independent and creative thought and man's richest spiritual heritage with a discipline and organization no less resolute or capable of sacrifices because it safeguards the freedom of thought and love of justice which are the mainsprings of man's finest achievements Upon the solution of this problem the future of mankind largely depends and no policy for defence which ignores it can enlist the enthusiasm and support which will safeguard and enrich the truths which democracy represents The democracies have to meet the challenge by proving themselves able to add to their own noblest tradition and heritage

This factor in itself should strengthen for example the appeal which appears even more clearly in the report in an address of Dr F Lincoln Ralphs for lecturers selected for the ability to inspire and expound rather than for their capacity for research The consideration of man power in relation to national defence throws into new relief the question of limiting the numbers of those who receive a university education and the importance of ability being the sole criterion for entrance to a university Again the point of view of national defence strengthens the case so ably argued in the report for greater attention to the physical well-being of students and attempts to raise their general standard of physique whether by measures designed to prevent illness or under nourishment the extension of medical examination further provision for the treatment of illness whether by the extension of health insurance or in other ways or by increased provision for physical training and exercise

It can scarcely be denied that in many of these respects the democracies have lagged behind the totalitarian States and if the necessity for an effective policy for national defence stimulates action to improve the situation while still safeguarding the independence and integrity of the universities the recent crisis may not have been without its gains Even from the point of view of national defence the broadening of university training is desirable to stimulate the growth of the virile citizenship upon which the continuance of democracy depends Any measure which checks excessive specialization encourages a knowledge of public affairs the ability to think clearly and critically not merely in abstract fields but also in regard to the complex affairs of human society and the power of disinterested thought in itself is a step to the provision of the wise and intelligent leadership needed

The report provides welcome evidence that the responsibilities of citizenship are recognized by a growing section of students themselves no less than of the university authorities and the consensus of opinion revealed encourages the hope that in Great Britain at least the demands of a defence policy upon the universities will be met without encroaching on their inherent freedom of thought investigation or teaching It should not be forgotten however that many of the measures outlined in the report for improving the present position turn essentially on finance Increase in staff extension of maintenance grants provision of new buildings libraries etc may all be required and the report stresses the need for an increase in the Treasury grants to the universities

Under the present conditions it is unlikely that such an increase can be looked for except as part of a comprehensive and long range view of the national resources such as is involved in the formulation of a definite policy of national defence covering the resources of man power no less than of material resources and in which the contribution and place of the universities are fully considered Any such review can scarcely fail to lead to increased provision for the care of student health and for physical training and other means designed to assist the student to take a fuller part not only in the communal life of the university itself but also in that of the community at large

If however the bearing of such aspects of student life on national service is more obvious the more fundamental contribution of the university should not be overlooked It is only as a democracy can provide the leadership which is not content merely to rest in the past but can make positive contributions to the solution of the problems of to day bringing to bear upon them constructive and creative minds which in courage resourcefulness and self discipline are at least the equal of any to be found in the totalitarian regimes that it can hope to survive In the long run it is on the universities which safeguard freedom of thought and investigation of learning and impartial criticism that democracy must rely both for the supply of leaders and for the vision and inspiration which will enable it to meet the greater demands of the present day

The significance of this contribution has been emphasized by the recent unhappy events in Germany The horror and revulsion with which the world regards the further persecution and suffering inflicted upon those of Jewish origin have brought also the realization how fragile are the barriers between us and relapse into barbarism Only wise and independent leadership alive to human values and capable of impartial and constructive criticism can save a nation be it under totalitarian or democratic government, from the many dangers which attend mass hysteria and propaganda

Mathematical Biology

Mathematical Biophysics

Physicomathematical Foundations of Biology By Nicolas Rashevsky Pp xviii + 340 (Chicago University of Chicago Press London Cambridge University Press 1938) 18s net

SOME ten years ago, Dr Nicolas Rashevsky then a young mathematical physicist turned his mind to biological problems and ever since he has been writing papers on the borderland between physics and biology too hard and too speculative for some but which others have read with great interest and attention

Dr Rashevsky has a way of his own He is neither observer nor experimenter His business is to reflect on what other men have seen or discovered to interpret it anew and to use the help which mathematical methods give to guide his thoughts and help his reasoning The physicist deals with atoms of extreme complexity but only yesterday thermodynamics were well and truly laid on molecules as simple as billiard balls The histologist keeps adding to our knowledge of the complex structure of the cell but Dr Rashevsky would have us meditate over an imaginary cell simplified almost out of all knowledge A first approximation based on so simplified or idealized a cell must be far from the whole truth but it may be a first step on the way to comprehension

We may simplify our cell as we like even reduce it to a little structureless sphere but it must still be a seat of chemical activity and change What leads to cell division in such a cell is the first question Dr Rashevsky asks The ratio of volume to surface increases as the cell grows and the due balance between them is lost thereby this is true and obviously true but what does it mean ? In its constant metabolism things enter the cell suffer change within it and pass out again diffusion goes on both without and within , diffusion currents are set up diffusion gradients are established and forces act proportionally to the gradients of osmotic pressure The cell is a seat of energy and a centre of force for the old phrase which Goodsir used nearly a hundred years ago turns up again with its meaning a little altered and better defined

In the simple, homogeneous spherical cell the resultant forces will be nil In a slightly deformed sphere absorption or diffusion inwards will tend to set it right but the diffusion outwards of substances formed within will tend to distort it the more and in certain circumstances these latter forces actually tend to split the cell They have against them the force of surface tension a powerful opponent so long as the cell is small there must be some critical size where the forces leading to deformation get the upper hand and disruption or cell division ensues On such lines as these but with the argument illustrated mathematically in ways that are always lengthy and often hard Dr Rashevsky discusses cell division and arrives at certain tentative quantitative solutions which turn out to be of the order of magnitude of ordinary cells He goes on to discuss some of the many cells which like a red blood corpuscle a *Euglena* or a *Paramecium* are very far from spherical but are yet able to maintain themselves in quasi equilibrium or a steady state so long as their metabolism continues and a given distribution of forces is maintained But we must not suppose nor does Dr Rashevsky attempt to persuade us that the road is easy or our course assured It is a difficult business all along and in an interesting appendix (to which Dr Gale Young's work contributes) the main discussion is somewhat simplified and is certainly improved Formidable difficulties remain The case of the slightly deformed cell is not difficult to understand but the successive stages culminating in division are hard to follow Then comes the further difficulty that no two cells are quite alike they have their little differences in outward form and greater differences in internal content and these differences would greatly affect our calculations if we did not neglect them one and all Yet life goes on just the same in all of them and the mode and rate of cell division seem insignificantly changed

Beginning with the dividing cell the first half of the book keeps in view as a far off aim nothing short of a physico mathematical theory of organic form the latter half passes on to physiological questions concerning nervous irritability excitation inhibition conduction and reflex action An interesting chapter (xvii) reprints a five year old paper of the author's* in which he explained nervous excitability on lines analogous to A V Hill's well known two factor theory but somewhat vaguely based on Jacques Loeb's work on the effect of relative concentrations of antagonistic ions He looks on the nerve as likewise containing two antagonistic substances the relative concentration of which leads at a certain point to excitation When a current passes along the axon, ionized substances flow one way or other and according as the inhibiting and exciting substances go to or fro and go the same or opposite ways various significant possibilities occur some of them such as have received experimental confirmation at A V Hill s hands

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* Outline of a Physico Mathematical Theory of Excitation and Inhibition *Protoplasma* 20 42 56 (1933)

Dr Rashevsky starts afresh with the volley of impulses which Adrian finds set up in a nerve fibre with a vibrational frequency varying as the intensity of the stimulus When correlated with the same two factors in a diagrammatic system of neurones and synapses with a finite velocity in the one and a finite delay in the other many curious possibilities emerge A continual stimulus may lead to brief inhibition and lasting excitation or to just the converse a sudden stoppage of the inhibitory stimulus must in other circumstances lead to Sherrington s rebound phenomenon or something very like it and a certain particular distribution or pattern of peripheral stimuli will lead to a maximum or optimum stimulation at the centre But here and in all his other physiological chapters the weakness of the author s speculative method is more apparent than in his theories of the division of the cell. For a certain amount of pure speculation comes in handy and is even welcome in a case all but beyond the reach of experiment but nerve physiology is another story Sometimes the mere throwing of a phenomenon into mathematical form opens our eyes to something new as when Lotka and Volterra gave mathematical precision to vague instances of the struggle for existence But it oftener happens that mathematical symbolism leaves us just where we were before and merely expresses perfectly general relations where we had looked for something which should apply to and elucidate a specific case What Michel Petrovich called the *Mecanismes communs aux phénomènes disparates* illustrate over and over again the unimportance of mathematical analogy, and the need for something more than mathematical symbolism

We may admire Dr Rashevsky s learning and borrow ideas from his ingenuity but the physiologists will go on experimenting in their own old way Sir Charles Lyell said to the geologists Travel travel travel ! and the physiologists say to one another Experiment experiment experiment !

D ARCY W THOMPSON

The International Congress of Zoology

12e Congrès international de Zoologie tenu à Lisbonne du 15 au 21 Septembre 1935

Comptes Rendus Vol 1 Pp xix + 228 + 644 + 30 plates Vol 2 Pp 645 1514 + 41 plates Vol 3 Pp 1515 2424 + 28 plates (Lisboa Casa Portuguese 1936 1937) n p.

THE proceedings of the twelfth International Congress of Zoology which met at Lisbon in September 1935 have now been published in three handsome volumes which form part of the series Arquivos do Museu Bocage issued by the Zoological and Anthropological Section of the National Museum at Lisbon About two hundred papers communicated to the Congress are printed in full in the three volumes (each of nearly nine hundred pages) and they are illustrated by a hundred plates some of which are in colour in addition to many text figures The preparation and editing of this vast amount of material (in five languages) must have imposed a heavy burden on Prof A R Jorge the president and Prof F Frade the general secretary of the Congress and they are to be unreservedly congratulated on the result The printing and illustrations reach a very high standard and it is evident that neither trouble nor expense has been spared Those who had the good fortune to experience the lavish hospitality with which the Congress was entertained at Lisbon will be grateful to their Portuguese hosts for having provided such a worthy record of a memorable occasion

It is assuredly not to be laid to their charge if the general scientific interest of these volumes does not on the whole rise much above what one is accustomed to expect in the reports of international congresses There are some addresses especially among those delivered at the plenary sessions of the Congress handling major questions of biology which every zoologist will be glad to have upon his shelves Similarly in the more specialized proceedings of the various sections there are many papers which will appeal to a much wider audience than was able to hear them delivered at Lisbon Nevertheless it is evident that there are many who see in the proceedings of an international congress merely another vehicle for the publication of papers dealing with matters of detail and often of the most limited interest even to specialists One would have thought it self evident that descriptions of new species were entirely out of place in such a publication but there are several papers in these volumes that consist of little else Very little general discussion took place on the papers read and still less is here recorded in print

In the present state of world affairs any measures that facilitate intercourse and co operation between scientific men in different countries are deserving of the fullest support Among such measures the holding of periodical congresses is one of the most important and valuable, and those who undertake the heavy tasks of organizing and preparing for them deserve the gratitude of their colleagues It may seem ungracious to suggest adding to these tasks but there are certain reforms which if they could be carried out would add greatly to the interest and effectiveness of the meetings A group of the British delegates to Lisbon has already suggested to the permanent committee that future congresses might be made more profitable to those taking part if discussions could be arranged based upon papers which instead of being read at the meeting were printed and circulated to the members in advance This method has been adopted with success at certain international congresses of more limited scope and while there would be obvious difficulties in the case of so vast and diversified a field as that covered by zoology, it would be well worth while to try the experiment on a future occasion

One of the most successful attempts at international co operation organized by previous meetings of the Congress of Zoology has been the International Commission on Zoological Nomenclature If its decisions have not always received the unanimous assent of zoologists it has rendered an immense service by providing the only code of zoological rules that has any claim to international authority At Lisbon it was able to present a report recording considerable further advances towards a stable system of nomenclature One particularly hopeful step was the adoption of a long list of *nomina conservanda* in which changes that would have led to serious confusion are avoided by suspension of the rules in the individual cases Most unfortunately owing to causes that could not have been foreseen the Commission has been in a state of suspended animation since the Lisbon meeting It is to be hoped that it will be able to resume its beneficent labours before long W T C

Practical Genetics

(1) Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Aberhalden Lief 466 Abt 9 Methoden zur Erforschung der Leistungen des tierischen Organismus Teil 3 Heft 7 (Schluss) Methoden der Vererbungsforschung Methoden zur Zuchtung von Drosophila von G A Lebedeff Methoden der Erforschung der Vererbungsvorgange bei Pflanzen von F G Brieger Methoden und Ergebnisse bei der Zuchtung von Tetriginæ von Robert K Nabours Pp 115–1402 + xiii (Berlin und Wien Urban und Schwarzenberg 1937) 17 gold marks

(2) Practical Plant Breeding
By W J C Lawrence Pp 155 (London George Allen and Unwin Ltd , 1937) 5*s* 6*d* net

IN a recent issue of NATURE (138 972 1936) there appeared a letter directing attention to the neglect of genetics by British universities The letter was received with the apathy characteristic of British biology where genetics is concerned No one denied the need for genetics in universities but only one correspondent supported it Meanwhile we have come to rely on the U S S R and the United States to lead the world in genetical research Although plant breeding has now become one of the foremost activities in the agriculture of the British Empire and despite the stimulus provided by such institutions as those at Edinburgh and at Merton, many universities offer no more than half a dozen lectures on primitive Mendelism under the title Evolution and Heredity and practical teaching in genetics is confined to three or four departments The four works which come under review in this notice should remove one of the last excuses for shirking practical classes in genetics

(1) Dr Lebedeff in the compass of 67 pages sets out clearly all the information one is likely to need for culture work with *Drosophila* rates of development at different temperatures data on fertility, technique for dealing with stock preparation of media and construction of thermostats methods of counting eye facets cytological technique (contributed by Dr Stern) and X ray analyses

Dr Brieger s contribution on methods in plant genetics covers a wide field He presents data on the size of populations required for estimating segregation with precision and on the technique of hybridization and there follows a synopsis of statistical methods The synopsis contains a number of useful tables but does not provide either theoretical treatment of the formulæ or practical examples on applications of genetics There is a section on the various kinds of Mendelian segregation and upon methods of calculating linkage and three pages on useful methods for making cytological preparations

Dr Nabours contribution on the grouse locust contains more results than methods It is a useful summary of the work on the genetics and cytology of Tetriginæ (Orthoptera) and includes details of X ray work on *Apotettix* on parthenogenesis and the inheritance of colour patterns

(2) Mr Lawrence modestly describes Practical Plant Breeding as a guide book for the enterprising gardener This function it will most certainly perform but it can be recommended to a wider public Chapters iv and v contain within fifty pages an account of Mendelism and the cytological basis of inheritance excellently suited for elementary students The chapters on the technique of hybridization and on methods of plant improvement are as appropriate for the enterprising university teacher as for the enterprising gardener Mr Lawrence s style is easy and clear The book and the technique it describes should be introduced into the botany departments of all universities still at the six lectures on evolution and heredity stage ERIC ASHBY

Bessel Functions

Bessel Functions
Part 1 Functions of Orders Zero and Unity (British Association for the Advancement of Science Mathematical Tables Vol 6) Prepared by the Committee for the Calculation of Mathematical Tables Pp xx+288 (Cambridge At the University Press 1937) 40s net

THE worthy completion of a long and arduous task will always draw from the beholder the tribute of an almost personal gratification Our sympathy and interest are at once enlisted by the opening sentences of Prof E H Neville s preface to the latest volume of the British Association mathematical tables Volume 6 a table of Bessel functions of orders zero and unity It is with the satisfaction of keeping a long anticipated engagement that a Committee of the British Association issues its first volume of tables of Bessel functions Half a century ago the Committee decided that the tabulation of Bessel functions was the most useful undertaking that it could promote Our sympathy is deepened when we read that Prof Alfred Lodge who had been one of the original Committee of 1889 and to whom this handsome volume is dedicated in terms of grateful affection died on the very eve of its publication

The tables appear to the reviewer to be as much above praise as they are beyond criticism In the course of a most valuable and interesting account of the constructing and multiple checking of the tables (an account which includes a list of errors discovered in pre existing tables of Bessel functions) Dr L J Comrie a member of the Committee states that in the reading of proofs not a single compositor s error was found in some 280 pages containing just under a million figures He expresses the belief that the tables are completely free from error and no one has a better right to be believed in such a matter

The tables are principally of the functions (to use the most accepted notation) $J_0(x)$ $J\ (x)$ $Y_0(x)$ $Y_1(x)$ $I_0(x)$ $I_1(x)$ $K_0(x)$ $K_1(x)$ of the last two multiplied by e^x and e^{-x} respectively and short tables of e^x and e^{-x} themselves In addition there are tables of the first 150 zeros of $J_0(x)$ and $J_1(x)$ with the value of the other of the two functions for each zero and a similar table of the first 50 zeros of $Y_0(x)$ and $Y_1(x)$ The most extensive tables occupying some 170 pages are those of $J_0(x)$ and $J_1(x)$ to ten decimal places from $x = 0$ by steps of 0 001 to $x = 16$ then by steps of 0 01 to $x = 25$ Those for $Y_0(x)$ and $Y_1(x)$ are from $x = 0$ by steps of 0 01 to $x = 25$ those for $I_0(x)$ and $I_1(x)$ are to eight decimal places from $x = 0$ by steps of 0 001 to $x = 5$ those of $K_0(x)$ and $K\ (x)$ are to ten places from $x = 0$ by steps of 0 01 to $x = 5$ the products of these by exponential functions carry the range to $x = 10$ then by steps of 0 1 to $x = 20$ Interspersed are pages of formulæ and recurrence relations asymptotic series and tables of auxiliary functions All tables are supplied with second central differences and the last four pages provide Everett and Bessel interpolation coefficients with a short description of how to use them

It is pleasant to read of the generous co operation of Prof K Hayashi who allowed the Committee to use his own published tables and of Prof H T Davis who provided the Committee with a 15 decimal manuscript table of his own and renounced publication of this in favour of the Committee

Nothing remains but to congratulate the Committee Table making is an art in which beauty and utility are interfused and indivisible This book more than maintains the high standard set by its predecessors in the series It is gratifying to learn that a second volume of Bessel functions of other integral orders is in an advanced state of preparation ' A C A

Statistical Year-Book of the World Power Conference

No 2 Data on Resources and Annual Statistics for 1934 and 1935 Edited with an Introduction and Explanatory Text, by Frederick Brown Pp 132 (London World Power Conference, 1937) 20*s* net

THIS Year Book represents a further stage in the attempt of the World Power Conference to compile international statistics of power resources, development and utilization upon a comprehensive and comparable basis As in the first publication (1936), definitions of each power type together with uniform tables were supplied to national committees and other organizations for their returns Ambiguities and minor defects discovered in these definitions during preparation of the first Year Book were rectified before circulation, and a corresponding improvement is reflected in this second volume

Admittedly a certain amount of additional data extracted from published sources could have been added, had they been expressed in similar units to those adopted by the World Power Conference to make the work even more complete , but throughout the volume the editor has followed a policy of including only those data which conform closely to the definitions adopted as standard for this work The statistics presented, therefore, may be regarded as accurate from the point of view of comparison with each other, though they are in no sense claimed to be comparable with other published statistics

Statistics relating to production and distribution of manufactured gas and to production stocks imports exports and consumption of coke are included in this volume for the first time Indeed, with the exception of wind and sun power, which the compilers state are the principal omissions practically every type of solid, liquid and gaseous fuel, together with water power and electricity has been dealt with

Animal Life in Fresh Water

a Guide to British Fresh water Invertebrates By Dr Helen Mellanby Pp viii+296 (London Methuen and Co , Ltd , 1938) 8*s* 6*d* net

IN recent years, partly as a result of the establishment of the Freshwater Biological Association's station on Lake Windermere, there has been in Great Britain a welcome revival of interest in the freshwater fauna and flora The ease with which many types can be obtained almost everywhere and kept alive in small aquaria makes them very suitable material for the school teaching of biology, and Mrs Mellanby's book has been planned to provide a guide for school teachers and pupils For this purpose it is in many ways well adapted

A large number of common invertebrate types are described and figured in sufficient detail to enable the elementary student to identify his captures approximately, and some account is given of the more important features of their habits and life histories It is much to be regretted, however, that a little more care has not been taken with its compilation Misspellings such as "ciliæ", "flagellæ', lacustræ', '*Chironomous*", "*Notamma*' (for *Notommata*) '*Chælonotus* (for *Chætonotus*) and the like occur on almost every page and will cause needless trouble to the student The style is sometimes slipshod, as, for example where it is said that the Spongilla fly (*Sisyra*) is not very common but this may be due to its being small and inconspicuous A sedentary animal attached to the body of another animal is by no means an epiphyte , and the colour of grey or brown specimens of *Hydra* is not due to zoochlorellæ

W T C

Modern Physics

a Second Course in College Physics By Prof G E M Jauncey Second Edition Pp xviii+602 (London Chapman and Hall Ltd 1937) 22*s* net

THAT Prof Jauncey's book, now appearing in a second edition has been reprinted three times since its first publication in 1932 is sufficient testimony to its usefulness The date of the first edition gives a hint of the principal additions to be expected and to be found in this new edition Besides these additions, which have involved much re arrangement and re writing chapters on wave motion, the new quantum theory and physics of high pressure have been added

For the information of new readers it should be stated that Prof Jauncey's book contains a fair measure of classical and introductory work including chapters on alternating currents the electromagnetic theory of radiation, gas kinetic theory, geophysics, and astrophysics, to mention five out of the twenty six chapters which go to make up the book One chapter deals with Some Useful Mathematics , and this chapter in view of the demands on the space allotted to the volume could be curtailed with advantage , the quite elementary calculus considerations are surely unnecessary to the type of student likely to benefit by the study of the book which, considered as a whole, is an admirable elementary introduction to the study of the problems of modern physics But Prof Jauncey should not describe Maxwell who was a distinguished exponent of the art of writing light verse, as given to writing verses of the jingle type '.

A F

A Text Book of Physics

By Dr D B Deodhar Pp x +672 (Allahabad The Indian Press, Ltd 1937) 6 rupees

DR DEODHAR has produced a useful text book of physics for students of intermediate grade The book covers rather more than the usual ground , the topics are discussed clearly and in some instances, a little more fully than is commonly the case There is a good selection of examples, and a welcome feature of the book is the number of succinct descriptions of applications of physical principles to technical instruments

The book bears signs of hurried writing—Foucault appears consistently as Focault, and there is a remarkable diagram showing the ascent of mercury in an open tube Mass is quantity of matter, Newton's law of cooling is treated as an approximation valid only for small temperature excesses, and the effect of temperature on the velocity of sound is given in the form $v = v_0 (1 + \frac{1}{2}\alpha t)$ It is more correct, twice as clear, and half as long, to show in a couple of lines that the velocity is proportional to the square root of the absolute temperature

These minor errors will doubtless be corrected in a second edition A F

Tropical Aquariums, Plants and Fishes

By A Laurence Wells Pp 160 (London and New York Frederick Warne and Co, Ltd, 1937) 3s 6d net

THIS is a very useful little book written in a popular style by an expert in keeping and rearing small tropical fishes Mr Wells has already published valuable guides dealing with similar subjects aquariums and fish ponds, and garden ponds, fish and fountains The present book will be welcomed by many, for the cult of the tiny tropical fish is rapidly increasing, and a sound practical book, simply written, is exactly what is needed, and this is what is offered With its aid there should be no difficulty in setting up aquaria and rearing the fishes The aquarium itself, heating, feeding, the best plants to use and how to deal with ailments, all have their share of space but half the book is taken up with short descriptions of the various fishes themselves, their distribution, habits, the prices which they fetch and information for the treatment of each species The book is illustrated by numerous small sketches, nearly every fish being figured and also the various plants recommended for living in the aquarium

It might be pointed out that in describing the food certain terms are used which are rather unusual for example, algæ as a singular noun and *Daphnæ* and *Enchytræ* as plurals

The Alloys of Iron and Chromium

Vol 1 Low Chromium Alloys By A B Kinzel and Walter Crafts (Alloys of Iron Research Monograph Series) Pp xv+535 (New York and London McGraw Hill Book Co, Inc, 1937) 36s

THIS volume is the first part of a review and summary of published information and available unpublished data on the alloys of iron and chromium containing less than 10 per cent of chromium The second part, now in preparation, will deal with higher chromium alloys, including the heat- and corrosion resisting steels The constitution of the iron – chromium and the iron – carbon – chromium systems and the effect of chromium on the critical point is first dealt with, these chapters being followed by surveys of the manufacture, treatment and properties of chromium steels and cast irons In preparing this monograph it is stated that nine thousand papers and articles were assembled; and that of these 478 were selected for detailed study. The latter group is given as a bibliography, arranged chronologically, and will prove a very valuable feature of the book A great wealth of data has been assembled in this volume, both in the text and in a large number of excellent tables and diagrams

Metallography

By Dr Cecil H Desch Fourth edition Pp viii+402+17 plates London, New York and Toronto Longmans, Green and Co, Ltd, 1937) 21s net

FOR twenty eight years Dr Cecil Desch's 'Metallography' has served admirably as a standard text book for students of physical metallurgy, and had previously run through three editions The last of these, however, goes back to 1922, and therefore a new and revised edition was considered desirable This has involved the re writing of most of the book as well as the introduction of new topics, among the latter are the improved technique of thermal analysis and of microscopic examination, the changes occurring in solid alloys (including age hardening and the order-disorder transformation) and the processes of mechanical deformation A section dealing with developments on the X ray side has been contributed by G D Preston

With the passing of time since this book was first published, it has become still more hopeless a task to compress into one volume our knowledge of physical metallurgy, but as an introduction and as a guide to the literature it continues to fulfil its function very well

An Introduction to Abnormal Psychology

By V E Fisher Revised edition Pp xiii+533 (New York The Macmillan Co 1937) 12s 6d net

THIS book appears in a thoroughly revised form The lapse of only a few years necessitates much revision in an exposition of such a subject as abnormal psychology But the author has done more than amend the first edition He has added seven new chapters and omitted three of the old ones doubled the number of illustrative cases, and otherwise introduced a good deal of fresh material

The book is essentially a text book, giving full directions for further reading, and aiming at a thoroughly comprehensive view of the whole subject At the same time, it is interestingly written, and merits the attention of the general reader as well as that of the student of psychology

The Basis of Tissue Evolution and Pathogenesis

By Dr Albert A Gray Pp xix+92+7 plates (Glasgow Jackson, Son and Co, 1937) 7s 6d net

IN this book, which is the posthumous work of an eminent Glasgow otologist, the author maintains that all tissues ultimately arise as the result of repair following injury, and supports his contention by examples of the labyrinth in animals taken from his work on the subject He points out that the term 'injury' does not mean merely gross mechanical injury but also includes the damage inflicted by chemical agents, poisons and physical conditions, such as moisture, heat, cold, etc He does not, however, exclude the possibility of chance variations or mutations having also played a part in the process of evolution

A short sketch of Dr Gray's life and work is given in the foreword by his son

Aspects of High Polymeric Chemistry

By Prof. H. Mark

INTRODUCTION

WHEN the magnificent structure known as organic chemistry was built up in the second half of last century, it contained not only an enormous number of new substances with interesting and valuable properties, but also embodied a series of more or less general laws on the relations between the structure and the qualities of a molecule It was realized, for example, that the presence of certain atomic groups (OH, NH_2, HSO_3) had as a consequence solubility in water, that other combinations of atoms impressed on the molecule the property of a dyestuff, others again made it a narcotic, or an explosive, and so on These laws did not appear suddenly in clear and definite shape, but grew slowly with the development of chemical science They were nearly all formulated at first as preliminary rules, and their validity checked by the aid of the continually increasing experimental material Some of them did not successfully pass this test , they are forgotten to-day and many of them are no longer known , others have survived and represent our present knowledge of the possibilities of constructing a molecule with required properties They can be called the leading principles of preparative organic chemistry, and are of utmost value for all synthetic work in chemical industry

At present, another organic chemistry is in full development– the chemistry of the high molecular substances Although they are built up of the same atoms as the normal organic molecules, namely, carbon, hydrogen, oxygen and nitrogen, and only occasionally contain other elements such as sulphur, chlorine, etc , they are of incomparably higher molecular weight While the single molecule of a normal organic substance such as benzene, urea or naphthalene has (referred to $O = 16$) a molecular weight of the order of magnitude of a hundred, the high polymeric bodies such as proteins, cellulose, rubber, polystyrene, polyvinylchloride, etc , achieve molecular weights of many thousands. At first they were found only in living bodies as frame-building substances and as resins ; to-day we know quite a series of chemical reactions, which enable us to build them up synthetically, and they appear to be growing in importance both scientifically and technically Almost daily a new polymerization product is built up and studied. In the chemical industry, we have to face already a host of commercial names, as neoprene, duprene, buna, perspex, victron, distrene, trolitul, mipolam, igelite, etc

In this state of affairs, while we naturally wish to produce an increasing number of these new bodies, it is also desirable to formulate some general laws on the relations between structure and properties, unless we are to lose all control over this rapidly growing branch of chemical science. When we look back to the development of organic chemistry, we cannot expect that these laws will be at once before us in their full clearness, but they will emerge slowly from the fog, which covers the yet unknown and mysterious region of our science Hence we are justified in putting forward some preliminary rules on the relationships between structure and properties, even although we are not yet in a position to give them the form of quantitative laws It must always be remembered that we have to test these working hypotheses very carefully against the experimental material, and that we must give them up at once if they do not work satisfactorily

SOME IMPORTANT VARIABLES

Our actual experimental knowledge on polymerization reactions enables us to state some characteristic features for a high-molecular sample, on which the final properties of the material depend in a very important way

(*a*) The *chemical nature* of the monomeric material ; it may be either aliphatic or aromatic , it may be a hydrocarbon, an ester a chloride or a ketone , it may contain one or more double bonds Table 1 gives a survey of the most important materials as regards their chemical nature

TABLE 1

CHEMICAL CHARACTER OF COMMONLY USED MONOMERIC MATERIALS

Chemical class of the monomer	Chemical formula of the monomer	Some trade names of the polymers
Hydrocarbons	Ethylene, $CH_2 = CH_2$	
	Butylene, C_4H_8	Oppanol
	Butadiene, C_4H_6	Buna
	Acetylene, C_2H_2	
	Styrol, $C_6H_5CHCH_2$	Victron, Trolitul
	Isoprene, C_5H_8	Natural rubber
Esters	Vinylacetate, $C_4H_6O_2$	Vinylite
	Acrylic ester C_4H_6O	Plexigum
	Methacrylic ester, $C_5H_{10}O_2$	Perspex
Chlorides	Vinylchloride, C_2H_3Cl	Igelite
	Dichlorethylene $C_2H_2Cl_2$	
Ketones	Methylvinyl ketone, C_4H_6O	
Alcohols	Vinyl alcohol C_2H_4O	Vinarol

(*b*) The (average) *length of the main valence chains*, which form the background of every high polymeric substance. It depends essentially on the way in which the sample has been produced; whether the polymerization was carried out at low or high temperature, with or without a catalyst and so on. Table 2 provides some idea of the numbers involved.

TABLE 2

DATA ON APPROXIMATE AVERAGE CHAIN LENGTHS

Material	Degree of polymerization, i.e., number of monomers in the chain
Natural rubber	approx 500-1000
Masticated rubber	,, 50- 200
Low polymerized styrene	,, 50- 100
Medium ,, ,,	,, 200- 800
High ,, ,,	,, 2000 5000

(*c*) The *internal flexibility* of the main valence chains. According to the fundamental ideas of stereochemistry and statistics of molecular movement, a very long hydrocarbon chain has a certain amount of internal mobility due to the principle of free rotation around the single main valence bonds. This mobility can be reduced by substituents, double bonds, ring formation, etc. Table 3 gives some examples of this property.

TABLE 3

DATA ON THE FLEXIBILITY OF THE CHAINS

Material	Internal flexibility of the chains
Cellulose	Very low
Cellulose esters	Very low
Polystyrene	Fairly low
Polyvinyl chloride	Fairly low
Methacrylic ester	Rather low
Acrylic ester	Medium
Polyvinyl alcohol	Medium
Polyisoprene	High
Polybutadiene	Very high
Polybutylene	Very high

(*d*) Main valence *linkages between the chains*. In certain cases, especially when the monomeric molecule contains more than one double bond, it is possible to create cross linkages between the long chains. This strengthens greatly the whole structure of the resin, makes it resistant to heat, impact and abrasion, but, on the other hand, increases the density and decreases the flowing properties. This 'netting' of the chains may be quantitatively characterized by the 'netting index' (*Vernetzungszahl*), which indicates the number of cross linkages to a hundred chain linkages. A netting number of 3 would mean that in the sample we have on an average three bonds perpendicular to the chains to a hundred parallel to them. Table 4 gives an idea of the amount of netting in different materials. It must be pointed out that, in accordance to the preliminary state of the whole of our quantitative knowledge in this field, all figures have to be taken as very rough estimations, but nevertheless they form a useful basis for further and better work.

TABLE 4

DATA ON CROSS LINKAGES BETWEEN THE CHAINS

Substance	Amount of cross linkages (netting index)
Native cellulose	Nearly zero
Native rubber	Nearly zero
Polybutylene	Very low, ~ 3-5
Polystyrene	Very low, ~ 3-5
Polyvinyl chloride	Very low, ~ 3-5
Soft rubber	Medium, ~ 5-10
Polybutadiene	Medium, ~ 5 10
Hard rubber	High, ~ 10-20
Buna	High, ~ 10-20
Bakelite	Very high, ~ 50

CONNEXION BETWEEN STRUCTURE AND PROPERTIES

After having enumerated some of the important factors, which together characterize in some way the structure of a high polymeric material, we may try to sketch some connexions between these factors and some of the more interesting technical qualities. For the present short survey, we choose the following properties: heat, oil- and water-resistance, impact and abrasive strength, electrical resistance and reversible elasticity. There are others, which may be equally important, for example, the flowing properties, the surface hardness or the dielectric constant, but it would be inappropriate here to deal with them all. For the sake of simplicity, it must suffice to state the results which one can derive from our present experimental knowledge together in a short table, without discussing every one of them in detail (Table 5).

At the top of the table, the different properties are named, and in the columns the four variables above-mentioned, namely: (*a*) chemical nature of the monomeric molecule, (*b*) length of the chains, (*c*) flexibility of the chains, (*d*) netting number. Two crosses mean that this particular variable has *no effect* on the special property at all, one cross indicates that it has *little effect*, if there is any effect it is stated in words.

We see, for example, that the impact strength is decreased by a small netting number and increased by a large netting number, that the water resistance is lowered by the content of OH and OCH_3 groups and made bigger by the introduction of CH_2 groups or fatty radicals, but that it is not affected by the chain length at all.

It is easy to see how such a survey can be used. Let us assume we want a material with high heat-, water- and electrical-resistance and great impact strength. Then we shall take a hydrocarbon with long chains (whether they are flexible or not is immaterial) and strong netting. If we want a rubber-like material, we have to make use of very long and flexible chains without too much netting. If it is to be oil-resistant we shall try to avoid

CH$_3$ groups in it, and we find that, as regards the flexibility and the netting number, the two qualities of oil resistance and high reversible elasticity require opposite factors Then it will depend on whether oil resistance or high elasticity is more important, and the choice will fall on a netting number in favour of the more valuable quality In the case of artificial rubber, for tyres, for example, the range of reversible elasticity must not be very high (about 100 per cent) but abrasive strength and oil resistance are so important that one would prefer a considerable amount of netting, as is indeed the case in all synthetic materials used for this special purpose, as neoprene, buna, sowprene or thiokol

It is easily realized how many possibilities for building up substances of very interesting properties are already available in such a rough and unexact scheme as Table 5 represents Nevertheless, it must be pointed out very clearly that it is absolutely necessary to work out every single case very carefully, and to weigh against each other all the required properties and possible results

At the present time, it is not possible to write down mathematical expressions for the relations between structure and properties of high polymeric substances, but it is possible to derive some preliminary and imperfect rules, which will help us to find our way in this new and very promising field of modern chemistry.

TABLE 5

RELATIONSHIP BETWEEN STRUCTURE AND PROPERTIES OF HIGH MOLECULAR POLYMERS

Heat resistance		Oil resistance		Water resistance		Impact strength		Abrasive strength		Reversible elasticity	
decreased	increased	decreased	increased	decreased	increased	decreased	increased	decreased	increased	decreased	increased
(a) ×	×	by CH$_3$, OCH$_3$, and fatty groups	by OH groups and O bridges	by OH, NH$_2$, OCH$_3$, HSO$_3$, COOH groups	by CH$_3$, C$_2$H$_5$ and fatty groups	×	×	by CH$_3$ or fatty groups	by OH groups	×	×
by (b) short chains	by long chains	×	×	×	×	when chains are short	by long chains	by short chains	by long chains	by short chains	by long chains
(c) × ×	× ×	by very flexible chains	when chains are not too flexible	when chains are very flexible	by rigid chains	×	×	×	×	by rigid chains	very much by flexible chains
(d) low netting index	very much by high netting index	by low netting index	very much by high netting index	when netting index is very low	by high netting index	by low netting index	very much by high netting index	by low netting index	very much by high netting index	very much by high netting index	by low netting index

An African Survey*

THIS great survey of the problems of Africa south of the Sahara carried out by Lord Hailey originated in a suggestion made by General Smuts in his Rhodes Lecture at Oxford in 1929 when he pointed out that Africa was developing under the control of a number of European powers, that different, and often conflicting principles were being applied in the administrative, social, educational and legal fields, but that nowhere was there any survey of what was taking place in Africa as a whole His plea for a survey of the extent to which modern knowledge was being applied to African problems was met by the appointment of a committee consisting of Lord Lothian as chairman, Prof Henry Clay, Prof Reginald Coupland, Mr Lionel Curtis Sir Richard Gregory Prof Julian Huxley Mr Ivison Macadam Dr J H Oldham Sir John Orr and Sir Arthur Salter, with Miss Hilda Matheson as secretary The funds for the survey were chiefly provided by the Carnegie Trustees and later by the Rhodes Trust.

In 1933, Lord Hailey accepted an invitation to undertake the survey, but was unable to undertake personal work until 1935, though certain preliminary inquiries were set on foot in the meantime It was intended originally that the scope and form of the report—the conception of Lord Hailey—should be of a general character only, but as a result of a year's journey through Africa from the Cape to the Sahara, in which a distance of 22 000 miles was covered and information was sought and obtained from every possible source it became evident that the original conception must be much enlarged In the preparation of the report chapters dealing with special topics were prepared and the more important then circulated among the Colonial and other Governments concerned as well as among authorities working on these topics from whom additions and comments have been received

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* An African Survey a Study of Problems arising in Africa south of the Sahara By Lord Hailey Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs Pp xxviii+1838 (London New York and Toronto Oxford University Press 1938) 21s net

The Committee believes in the words of Lord Lothian that this volume will mark a new era in the history of the continent—because it will enable those who are responsible for policy to consider it in the light of the problems of Africa south of the Sahara as a whole

The method of approach is objective and factual In addition to discussing the state of our knowledge of the problems of the development of Africa it describes the physical and social background out of which they have arisen and analyses the factors which must determine their solution Hence the early chapters of the report after introductory matter deal with the physical background survey and mapping climate and vegetation climatology and meteorology as well as the African peoples their divisions and institutions and languages and the agencies for their study at the same time pointing out deficiencies in method and scope

While Africa has a larger proportion of tropical area than any other continent from the human aspect its most striking feature is the fact that with the exception of Australia it has the lowest density of population in relation to its area The first of these facts has a special significance in relation to the extension of European settlement in Africa the second seems to be connected in some measure with the existence of known deficiencies in the constitution of the soil and with the prevalence of diseases facilitated by the malnutrition associated with such deficiencies This fact gives special importance to the necessity for a scientific approach by the African Governments to the interrelated problems of agriculture animal husbandry and health

A great number of areas in Africa still await topographical survey sufficient for the mapping needed for the handling of social problems and the work of material development It is however first necessary to supply an adequate geodetic framework on which a successful topographical survey must rest for the arc of the 30th meridian begun at the Cape early in the century on the advice of Sir David Gill has not yet been completed

In dealing with the study of the African peoples for purposes of description the conventional classification of Bantu Hamitic and Negro is adopted There is no anthropological survey which would make possible a classification of tribes on the basis of physical characters For present purposes however it is felt that a study of racial origins is of less importance than that of the reaction of African cultures to the influence of European civilization and that the social anthropologist can fulfil a practical function by providing material which will enable the African Governments in directing their own policy to see that the process of adjustment to new conditions shall cause as little disturbance as possible to African society Anthropological study has a further relevance in so far as observations made on African social life may be able to throw light on the existence of a characteristic African mentality The view here taken is that African social conceptions do not necessarily indicate any intrinsic difference of character or mental capacity between them and other peoples Neither the examination of the brains of Africans as indicative of mental capacity nor intelligence tests have as yet furnished any conclusion which will assist in the determination of general administrative policy

The diversity of native languages taken as seven hundred in number constitutes a problem of special difficulty particularly when policy has determined that education shall be given in the vernacular It is necessary in such cases to determine whether the language chosen shall be a dominant vernacular or a lingua franca such as Swahili It is a question whether either the African Governments or commercial firms attach sufficient importance to the attainment of linguistic efficiency by their servants

Great differences exist as between estimates of the indigenous population of Africa Expert authority now limits itself to the view that the present total may lie between 138 100 000 and 163 300 000—in itself it is remarked commentary on the value to be attached to the present system of enumeration It is thought probable that the African population is either stationary or subject to a very slow increase The desirability of a more efficient system of enumeration is shown by the difficulty of checking many current assumptions on such matters as the extent of infantile mortality and the effect on the birth rate of African marriage customs A system of registration of births and deaths might be introduced in all areas where there are means of securing reasonable accuracy

Having dealt with natural conditions and the people the report then turns to their relations with and position under European authority

In the matter of policy the presence of a considerable European element in some of the British territories gives rise to consideration whether the prevailing policy of indirect rule is compatible with the ideal of self government by representative institutions and whether native institutions must not be materially modified if they are to be made to fit into any scheme involving an elected parliament The objective of South Africa and Southern Rhodesia—the preservation of the social and economic standards of European civilization—leads to the policy of segregation in which in the Union access is provided to a consultative body the Natives Representative Council and not the South African Parliament French policy does not envisage a future self government but development which will fit a colony to occupy in reality the position now assigned to it in principle as an integral part of France Emphasis is not on securing a growing measure of political rights but on progressive access to French culture and legal institutions The main source of legislation is the ministerial decree and executive devolution a concession to the influence of personality rather than to principle In the Belgian colonies the policy of material development is combined with a conscientious recognition of the need for safeguarding the conditions of labour promoting health organization and improving the means of subsistence

Careful consideration is given to the question of labour The normal economic incentive is now an influence of increasing strength Labour problems are due to shortage of the local supply rather than a disinclination to enter wage employment

In relation to the land the communal system of landlord holding prevails over the greater part of Africa and it would be premature to give legal recognition to individual titles but it may be necessary before long to undertake this process in economically advanced areas

In the use of the land at an earlier stage in the history of the agricultural departments attention was largely directed to finding means for increasing the production of export crops Of late years a variety of causes has tended to emphasize the need for improvement of native subsistence crops Native agriculture is for the most part based on the system of shifting cultivation a natural adjustment to the needs of African soils which require a considerable period for regeneration after cropping The settlement of population in fixed areas and pressure on the soil due to the expansion of economic crops have led to the use of the system in an abnormal manner with the result that the period of regeneration is unduly curtailed and the vegetal cover destroyed As regards animal husbandry the salient facts are that over a large part of Africa the tsetse fly makes it impossible to keep domestic cattle and in other large areas the semi religious value attached to cattle leads to overstocking which is liable to cause great destruction of pasture and to produce soil erosion

The first effort towards the improvement of native agriculture must be to indicate an alternative method for the regeneration of soil after cropping of which one of the most promising examined appears to be mixed farming Its success however will depend upon the efforts made to secure protection from the tsetse fly and to secure a more economic use of cattle by the natives elsewhere Although native methods of agriculture are rooted in custom past experience shows that new methods will be accepted if these can be demonstrated to be adapted to their circumstances Every effort should also be made to secure the co operation of the Africans themselves in the preservation of their woodlands It is clear that erosion a major problem in so far as it is caused by shifting cultivation and by overstocking has been accelerated by modern conditions under which populations are concentrated, more extensive areas of land are cultivated and the increase of stock is more rapid

Problems of health are obviously of much importance but there are no reliable statistics which would enable a comparison to be made between Africa and other territories in respect of the prevalence of disease The fact remains however that malnutrition is a characteristic feature of many parts of Africa there are low standards of hygiene in many rural areas and in most urban native locations and there is a marked prevalence of malaria sleeping sickness venereal disease and different forms of helminthic disorders The task of the health services in Africa extends beyond the application of modern scientific technique for the prevention and cure of disease they share in the responsibility for other social services for the improvement of African conditions of life Their part is the more important because they are concerned with some of the fundamental problems of Africa such as that of nutrition

Only of recent years has systematic thought been given to the form which native education should take in Africa At an earlier stage in the Union official opinion would have given to the African only the instruction suitable for those whose future lay in subordinate positions in European employment A change came with the recognition by the Governments that education must be extended progressively throughout the population As a result the educational system in the Union is now coming under revision Current policy seems to indicate the vernacular as the most suitable medium for popular education both in the Union and in the British Colonies, where an effort is being made to give school courses a content suitable to African environment But native education is still in its initial stages and the wider employment of Africans in the public services is delayed owing to the lack of candidates fit to receive special training for their work The most pressing need in regard to popular education in British territories appears to be better means of control and improved standards of teaching The future of advanced education must remain in some doubt until the Government arrives at some definite policy on the position which the native is to occupy in the administrative and technical departments particularly under a system of indirect rule In the French possessions education forms an essential feature in the policy of association A carefully devised system separates the *élite* from the mass giving the former a training which engages their sympathy with French culture and makes them efficient auxiliaries in the work of administration The chief characteristic of the Belgian system is its effort to improve the African s capacity for the work of developing the Congo

In discussing the internal and external aspects of economic development the report has much interesting material for consideration and makes the pregnant deduction from current tendencies that in the future the European may move away from general agriculture into commerce or various forms of non agricultural enterprise

On the other hand the future economic prosperity of some of these countries probably depends more upon the general development of native economic activity than on the results of European enterprise The African however cannot achieve his economic development without a material change in his present social customs

We see before us now the most formative period of African history Much that is done to day will have a decisive effect on the future of the African peoples The task of guiding the material and social development of Africa gives rise to problems which cannot be solved by the application of routine knowledge they require a special knowledge which can only be gained by an intensive study of the unusual conditions This study must be pursued in the field of the social as well as the physical sciences For this purpose assistance is required from the Imperial Government This should take the form of a grant to be administered either by a Committee of the Privy Council or by the Economic Advisory Council Further the difficulty which is now felt in readily securing information about Africa should be met by the establishment of an African Bureau covering social economic scientific and administrative problems which will constitute both a clearing house for information and a source of assistance to aid all those who are pursuing research or inquiry into African questions

Czechoslovakia's Contributions to Science A Survey and a Forecast

By Dr Gerald Druce

WHEN the Czechoslovak State regained its independence in 1918 the people looked forward to a period of fruitful constructive effort in industry education culture and science Despite a long period of subjugation the nation could look back upon a tradition in the field of science and learning The University of Prague the oldest in Central Europe was founded in 1348 and during the Middle Ages the natural sciences flourished in Bohemia as is shown by the number of herbals and contemporary mineralogical and alchemical works in the Czech language

With the defeat in 1620 of Frederick the elected king of Bohemia and son in law of the English monarch Bohemia not only lost its independence but also an end was put to all cultural and scientific activities for more than a century Practically all Czech publications had then to be printed in Poland Holland and certain German States The University was handed over to the Jesuits who combined it with their college which had existed since 1556 It was re named the Charles Ferdinand University German gradually displaced Latin as the language of instruction Science was scarcely taught and although Adam Zalužansky in 1604 had insisted that botany for example should be considered a separate subject what courses there were covered all the sciences Among the few distinguished professors was Jan Bohac (Bohadsch) but even his comprehensive Flora fauna et historia regni lapidei Bohemiae remained in manuscript When he died in 1768 the science chair remained vacant until 1775 when his pupil Zauschner (who re discovered the *Gagea Bohemica* described by Jan Cerny in the fifteenth century), gave some lectures on natural history His successor was J G Mikan, a medical man who lectured mainly on chemistry

A cultural revival first became possible towards the beginning of the nineteenth century, when certain noblemen with a feeling of local patriotism became patrons of science Thus, through the efforts of Count Ignatius Born the Bohemian Scientific Society was founded in 1775 This society interested itself primarily in the study of local flora fauna and minerals but later turned its attention also to mathematics, astronomy and physics Count Malabaila Canal a foreign resident in Prague laid out a garden for the cultivation of economic plants and founded an institute for lectures in botany to be delivered by distinguished Czech botanists These were given for more than thirty years, but ceased when Count Canal died in 1826

Science found its strongest supporter, however in Count Kaspar Sternberg the centenary of whose death falls this year He was himself a botanist and palæontologist and the author of many scientific works , but his greatest achievement was the founding of the Bohemian National Museum in 1818 To this he not only presented his own extensive collections but also he impoverished himself to purchase books, minerals and herbaria from others, especially Czech collectors whose expeditions abroad he sometimes financed He also liberally supported the scientific periodical *Krok*, which appeared between 1820 and 1840 under the editorship of J S Presl, who published in Czech much contemporary scientific work

The National Museum was important because it developed an interest in science, though after Sternberg s death it widened its scope to become the rallying point of all Czech culture Nevertheless, this was a period when Bohemia possessed a number of famous biologists such as the brothers Presl A J Corda and F M Opiz, all of whom made contributions to the advancement of botany, whilst A Frič and J E Purkyně became famous zoologists The University could not escape the effects of the national revival movement, and outstanding personalities like Purkyně lectured in Czech, despite official disapproval Eventually, in 1882, the University was divided into the Czech Charles University and the German (Ferdinand) University, which retained most of the buildings and possessions

Despite difficult circumstances, the Czech professors soon began to make valuable contributions to the natural sciences The first modern chemist was Stolba, who was followed by Brauner, but only after persistent pleas was the new Chemical Institute erected in 1903, largely on the strength of Brauner's international reputation from his work on the rare earths and atomic weights A few other institutes, for example, for physics and botany, were eventually built, but the more specialized branches of science had to wait until the establishment of the republic before they had more than improvised accommodation

A number of chemists, Stěrba Bohm, Heyrovsky, Tomicek and Krepelka have followed some field of chemistry initiated by Brauner In physics F Kolacek was a pioneer in electromagnetism and the physics of the ether and V Posejpal contributed to a number of topics, including the refractivity of gases at low pressure K V Zenger was famous for his work on solar meteorology, and mineralogy (especially local) was developed by F Slavik who has frequently collaborated with British authorities In biology Purkyn had been followed by Sachs Then came F L Celakovsky, who laid the foundations of plant physiology (in which he has been ably succeeded by B Němec) and upheld the view that floral members are modified leaves In systematic botany, K Domin has continued in the tradition of foreign expeditions, notably to Australia, India and the West Indies, whilst J Velenovsky's work on fungi is a classic in that field

Many notable advances have been made by Czechs other than those associated with the Charles University The researches of Stoklasa and of Votoček and their collaborators was, for example, done at the Polytechnic, and the other universities and institutes have also contributed to scientific knowledge

The German University after the division of 1882, concentrated mainly upon the study of German literature Nevertheless work of permanent scientific value has been carried out by Rothmund in physical chemistry, E F Freundlich in astronomy, Waldschmidt Leitz in microchemistry E G Pringsheim and V Czurda in plant physiology and M Stark in mineralogy The German University served the German speaking community of Czechoslovakia and also attracted students from abroad Now that the country has lost the territory from which its students came its *raison d'être* has largely disappeared It has been reported that the German University will continue with support from Germany, but this seems doubtful, since those professors with Nazi sympathies have left The others include some who cannot be regarded as Aryans Another proposal is that the University should move to Reichenberg (Liberec) or some other town in the ceded territory but this proposal, also, has its difficulties

Their liberation in 1918 did not blind the Czechs to their obligations towards the other nationalities within their frontiers, and adequate provision was made for them in elementary, secondary, and technical schools, whilst the Germans in Czechoslovakia were the only minority to possess a university of their own. Indeed, in some ways the minority was more fortunate than the Czechs, for at the German University there was one professor for every forty students, whereas at the Czech University the ratio is one to forty-eight.

Altogether, the republic possessed some twenty-eight institutions of university rank. Advanced science teaching and original work is carried on at the universities, the polytechnics and at various special schools, such as that for mining at Pribram, the Brno veterinary college, and at forestry schools and institutes for glass technology. All have hitherto enjoyed generous support from the State. Moreover, a number of industrial undertakings have fostered specialized research work. Among these must be included the Radium Institutes of Prague and Jáchymov, the research laboratories of the Chemical Union, and those of the sugar industry, the leather trade, the forestry commission, the agricultural society and even much of the horticulture at Blatna is work of a scientific character.

As has been said before (see NATURE, Oct. 8, p. 637) various scientific and cultural institutions at Jáchymov (St. Joachimsthal), Usti (Aussig), Liberec (Reichenberg) and Opava (Troppau), to mention some of the more important ones, go with lost territory. These may still be utilized for local needs, but they are lost to Czechoslovak culture and science. More serious than this loss will be the curtailment of revenue without any compensating reduction of State liabilities, and it is obvious that the mutilated republic cannot continue to support its scientific and other educational institutions on the same scale as hitherto. A forty per cent 'cut' is to be made in the budget of the ministries, and it is to be feared that research and science will feel the full force of this necessity. The outlook for university staffs and the research workers is anything but reassuring. Amalgamations and the closing of minor institutions seem inevitable, and indeed this has already commenced.

The outlook for Czech scientific societies and publications is also serious. With diminished scope and reduced resources, many societies and their journals will find it difficult to continue unless they are able to secure assistance from abroad. Meanwhile, throughout the anxious weeks of uncertainty and national disaster, the university staffs, school teachers and public officials have shown a remarkable courage, self-denial and discipline, although for them, each and all, the future holds no security. A nation that has survived previous cultural and national disasters, coupled with persecution, will not lightly give up the struggle for a better future. First efforts must be directed towards economic survival. When this is vouchsafed it will again be possible for men of science to continue in the traditions of their distinguished predecessors.

Obituary Notices

Miss Clotilde von Wyss

By the death on November 7 of Miss Clotilde von Wyss, the world of education has lost an outstanding teacher of natural history, distinguished by her philosophical outlook and by her sympathetic attitude towards living things.

Clotilde von Wyss was born in Switzerland in 1871, and received the earlier part of her education at a school in Zurich, but from 1884 until 1891, she was a pupil at the North London Collegiate School. She was trained as a teacher at the Maria Grey College, Brondesbury, and after her course there gained distinction in the Cambridge Teachers Certificate. From 1894 until 1897, she taught at St. George's High School, Edinburgh, and during that time she was an external student at the Heriot Watt College, coming under the influence of the distinguished naturalist, J. A. Thomson, then a lecturer in the University. Miss von Wyss valued this experience extremely highly and always spoke of the late Sir Arthur Thomson with the greatest affection and esteem. From 1897 until 1900 she taught biology at the North London Collegiate School, after which she was a lecturer at the Cambridge Training College for Secondary Teachers. In 1903, she joined the staff of the London Day Training College, and here for thirty-three years she was a successful and stimulating lecturer in natural history and hygiene and a highly valued colleague.

Miss von Wyss was a brilliant and inspiring teacher. She had a wide knowledge of natural history and an infectious enthusiasm for the educational principles which she upheld. She never lost sight of the interdependence of theory and practice, and after the free and friendly discussion of school problems that prevailed in her classes, her students went out to teach with a feeling of power and confidence. She had a delightful personality, a lightness of touch and a sense of humour which helped her in surmounting difficulties and affected even the most unpromising students. Teachers of many years standing still remember her with affection and gratitude, and one of them writes, even now her advice and criticism form the sheet anchor of my everyday teaching practice Her ideals and personality have influenced many generations of students and she herself once said My family must number some thousands ' These are to be found, not only among old students of the London Day Training College, latterly the Institute of Education (University of London) but also amongst the many London teachers who attended her evening classes organized by the London County Council

Miss von Wyss was not only a successful lecturer but like all true teachers she was also continually a learner Her observations and practical knowledge of wood ants (*Formica rufa*) were used in 1936 by the Gaumont British Film Corporation in constructing a film, which not only in the spoken commentary but also in the details of the ant life shown is both artistic and educational

Convinced as she was of the value in education of the study of Nature along sound lines, Miss von Wyss helped in 1903 to found the School Nature Study Union, which stands for the sympathetic and first hand study by the child of its natural environment, particularly of plants and animals From 1906 until 1936 she was editor of the quarterly journal brought out by the Union, and the diversity and usefulness of the articles that have appeared during that time may be realized from the list of leaflets published by the Union, about seventy of which are reprints from *School Nature Study* As a colleague on the executive committee of the Union, Miss von Wyss was invariably tactful and courteous her opinions were always appreciated because they showed careful thought and sound judgment and on many occasions it was her intervention which cut the Gordian knot of a seemingly hopeless tangle

Miss von Wyss has also played an important part in the wider sphere of influence which comes under the auspices of the B B C , and her gift of the power of presenting knowledge in a simple and interesting manner has enabled her to carry her message into schools untouched in any other way She spoke and wrote with ease and clarity, and her views are to be found in many articles in educational publications and notably in her books, Living Creatures , The Teaching of Nature Study and 'The Elements of Biology"

Miss von Wyss will long be remembered as an inspiring teacher, an able and courteous colleague and a great pioneer in the school teaching of elementary biology

R F S

Prof Leonard S Dudgeon, C M G , C B E

Prof Leonard S Dudgeon who died on October 22, aged sixty two years, was educated at University College School, London, and entered St Thomas's Hospital Medical School in 1894 After qualifying, he decided to devote himself to pathology, and was appointed clinical pathologist to St Thomas's Hospital in 1903 Here he gained an extensive knowledge of morbid histology under the late S G Shattock, with whom he collaborated in several investigations, and whom he succeeded as lecturer in pathology to the Medical School

During the Great War, Dudgeon served as temporary colonel A M S in the Near East, and was consulting pathologist to the Expeditionary Force in the Balkans being mentioned three times in dispatches At the conclusion of the War he returned to St Thomas's continued his pathological work and on the retirement of Sir Cuthbert Wallace in 1928 became dean of the St Thomas's Hospital Medical School and later chairman of the Hospitals Deans Committee and a senator of the University of London

Although he contributed a number of investigations, Dudgeon was first and foremost a practising pathologist and was never so happy as when applying his pathological knowledge in the elucidation of problems of diagnosis and treatment of obscure morbid conditions One of Dudgeon's earliest investigations published in 1906 in collaboration with P W G Sargent, was on the bacteriology of aseptic wounds which showed that microbes of the *Staphylococcus* group are of frequent occurrence in wounds that heal without suppuration This subject was expanded in the Horace Dobell Lecture delivered to the Royal College of Physicians in 1908 Two or three other papers upon the staphylococci were published jointly with workers in his laboratory dealing with the classification of members of this group of microbes by means of cultural agglutination and other tests Another subject upon which he published several papers was that of *Bacillus coli* infections of the urinary tract He showed that two types of *B coli* occurred in these conditions, one hæmolytic the other not and tested the value of vaccine and other treatment upon them He was also interested in infections of the intestinal tract derived doubtless from his experience in the Balkans and he made a considerable study of the bacterial flora of the human intestine under normal and abnormal conditions

Various studies upon problems of immunity were also carried out by Dudgeon With Shattock, he investigated the phenomena of phagocytosis in human blood serum when this was mixed with horse serum, and later on phagocytosis carried out with melanin particles in which they showed that phagocytic cells vary as well as the serum Dudgeon also investigated the presence of hæm agglutinins, hæm-opsonins and hæmolysins in the blood obtained from cases of infectious and non infectious diseases in man and he brought together his studies on immunity in the Croonian Lectures delivered to the Royal College of Physicians in 1912 Blackwater fever, pathological changes in the tissues in acute diphtheritic toxæmia, the action of bile and bile salts on animal red blood corpuscles, and the reactions of the tissues and cells of the rabbit to injection of *Staphylococcus aureus*, a pathogenic agent, as compared with inert particles such as indian ink and colloidal silver, were other subjects investigated by Dudgeon, either alone or jointly with others

R T H

News and Views

Cleveland Abbe (1838 1916)

On December 3 the centenary occurs of the birth of the eminent American meteorologist and astronomer Cleveland Abbe whose work at Cincinnati Observatory led to Congress passing the Act of 1870 authorizing the creation of a United States Government Weather Service and placing it under the Signal Branch of the War Department Abbe took a prominent part in the organization of the new bureau and for forty five years from 1871 until 1916 was professor of meteorology and senior scientific assistant to the Chief Signal Officer Abbe was born in New York on December 3, 1838, and graduated from the College of the City of New York in 1857 As a student he had studied Ferrel s work and this led him to a close examination of the meteorological papers then published On the outbreak of the Civil War he enlisted, but served only for a short time on account of his nearsightedness He then turned to astronomy and worked at the observatories at Cambridge Mass Pulkovo and Washington In 1868 he was appointed to the directorship of the Cincinnati Observatory in Ohio holding this position until 1873 The list of his writings on both astronomy and meteorology is a very long one and includes Studies in Storm and Weather Forecasting Mechanics of the Earth s Atmosphere and Physical Basis of Long Range Forecasting His influence on the progress of meteorology in America was outstanding and his work received recognition both at home and abroad He was made a fellow of the Royal Astronomical Society in 1876 and in 1912 the Royal Meteorological Society awarded him the Symons Medal He died at Chevy Chase Md on October 28, 1916

New International Standard for Vitamin B_1

It is announced that the first International Standard for Vitamin B_1 which consisted of an adsorbate of the antineuritic vitamin, made from rice polishings on fuller s earth, has now been replaced by a preparation of crystalline vitamin B_1 hydrochloride In recent years, progress in the study of the antineuritic vitamin has been rapid and this change in the form of the international standard has been made possible by the synthetic preparation of the vitamin in pure crystalline form Through the generosity of four manufacturers an adequate quantity of the new crystalline material was placed at the disposal of the National Institute for Medical Research Hampstead, to enable a new standard to be prepared consisting of the pure crystalline substance Extensive international investigations of the properties of this material and, in particular, the determination of its potency in terms of the original international standard by a variety of methods have now been completed, and the members of the International Conference on Vitamin Standardization have unanimously recommended that the sample be adopted as the Second International Standard for Vitamin B_1 and that the international unit be defined as the antineuritic activity of 3 micrograms of the international standard preparation This recommendation has been adopted by the Permanent Commission on Biological Standardisation of the Health Organisation of the League of Nations

As in the case of the other international vitamin standards the new standard for vitamin B_1 is held, on behalf of the Health Organisation of the League of Nations at the National Institute for Medical Research London, N W 3 and is distributed there from to national control centres established in other countries for local distribution to laboratories institutes and research workers, and to workers resident in countries in which the establishment of national control centres has not yet been completed With regard to the supply of the new standard for vitamin B_1 to those requiring it in the United Kingdom, samples have already been sent to the laboratories institutes and research workers who have hitherto received the standard adsorption product Others requiring the standard are asked to make application to the Department of Biological Standards, National Institute for Medical Research London, N W 3

National Association of Science Writers

The National Association of Science Writers of Washington, D C has been awarded the second annual Clement Cleveland Medal of the American Society for the Control of Cancer for outstanding work during the year in the campaign to control cancer" The medal was established last year by Mrs Robert G Mead in memory of her father Clement Cleveland The late Dr Cleveland was one of the pioneers in the medical profession on public education for cancer control and it was in his New York home that the American Society for the Control of Cancer was organized in 1913 The award of this medal to the National Association of Science Writers is a fitting recognition of the work of this group of American journalists in promoting accuracy as well as intelligibility in dealing with scientific topics in the Press The Association is a comparatively young body, and the fact that the award was made for work in connexion with a notoriously difficult subject, which is often the subject of exaggerated claims, enhances its value It is interesting to note that Mr J G Crowther, well known for his contributions on scientific topics to the Press in Great Britain, has been elected an associate member of the Association

Blind Landing System at Aerodromes

It is reported that 40 R A F aerodromes are now to be equipped with blind landing approach apparatus This will presumably be the Lorenz system, already in use at Croydon, Heston and Manchester civil aerodromes, and extensively on the Continent, particularly in Germany In principle it consists of a wireless beam along and down which the machine flies as it approaches the radiating station on or near to the aerodrome The waves are picked up by the aircraft s apparatus, and turned into signals arranged so that they give warning to the pilot of any deviation of his from the line of approach, both in regard to his angle to the earth and in a horizontal plane A further warning is given when it is necessary to flatten out preparatory to landing The adoption of such a system will facilitate the operation of bomber squadrons in bad weather conditions The presence of low cloud, mist or fog, is often an advantage to bombers when attacking in that it helps to screen them from fighter and ground defences It is obviously important that they should be independent of these conditions when operating from their home aerodromes The fact that these facilities may be available in emergencies for civil aircraft should encourage a more general adoption of the system in civil aviation, which will help to promote both safety and regularity in service in civil air transport

Early Races of the Far North in America

Dr Aleš Hrdlička, of the Smithsonian Institution, Washington, having completed his tenth summer season of archæological and ethnological investigation in high latitudes, has brought his exploration of the far north of the American continent to a close, and is now engaged in the examination of the skeletal remains of the Aleutian and pre Aleutian peoples, as well as of the specimens of the material culture of the latter, collected in the last three years Dr Hrdlička gave a summary of his results in his annual Smithsonian lecture, which was delivered in the auditorium of the New National Museum, Washington, on November 8 He then pointed out that when he entered upon this investigation ten years ago, it was supposed that only two peoples lived in this part of the globe, the Eskimo with the Aleut and the Indians Now six races are recognized There are two distinct types of Indians and two types of Eskimo, while it is established that the Aleut are distinct from the Eskimo The most interesting discovery made by Dr Hrdlička is, however, the sixth race, the pre Aleut people, whom he regards as close to the Shoshonean and the Californian Indian Some of them, though not all, practised mummification, and it may be that the Aleut followed them in this practice, as in a few places mummies of the two races have been found together The remains of the older people, the pre-Aleuts, show close affinities with the peoples who were discovered in the lowest levels of the old village site on Kodiak island, but whereas those peoples appear to have been exterminated in a great slaughter, the pre-Aleuts appear to have escaped this fate, although as a distinct people they have disappeared The evidence which has been gathered points to the pre Aleuts having reached these islands from Alaska, whither their ancestors had migrated at a very much earlier date from Asia Dr Hrdlička dates their coming to the Aleutians at approximately two thousand years ago

Recent Accessions to the British Museum

Among recent additions to the ethnographical collections of the British Museum (Bloomsbury) announced at the November meeting of the Trustees, were four loans by the King from the Royal collections Of these, one is a war drum carved from the trunk of a tree with human skull attached taken from the King of Ashanti at his defeat in 1826 and presented to George IV, and a Maori chief s staff of office, a combined spear and club which was presented to Queen Victoria by Maori chiefs in 1884 The National Art Collections Fund has purchased for the Museum a gold Persian wine bowl of the eleventh or twelfth century, having a Kufic inscription around the rim in praise of wine, and an ornamental design in which several realistic representations of ducks are a prominent feature Among other gifts are a collection of antiquities including small bowls dishes and scarabs of the Eighteenth Dynasty (c 1370 B C) from the excavations of the Egypt Exploration Society at Sesebi in the Sudan given by that Society, a small finely carved Egyptian lion of ivory probably dating from the First Dynasty about 3300 B C, given by Mr and Mrs Alec Rea, and a bronze head of a Pharaoh, probably Ptolemaic given by Lord Harlech, while Mr Reay Geddes has deposited on loan an Indian sculpture in stone of the eleventh or twelfth century which represents Agni the god of fire, surrounded by worshippers and goat headed attendants Mr Alvan T Marston with the consent of the Portland Cement Manufacturers Ltd has presented to the Trustees the Swanscombe skull and the bones and implements associated with it The skull and some of the implements have been allotted for exhibition at the British Museum (Natural History) while the remainder are to be exhibited in the archæological collections at Bloomsbury These implements have been pronounced to be Early Middle Acheulean, Breuil s Acheulean III

Portrayal of Weather in Art

The *Quarterly Journal of the Royal Meteorological Society* for October contains a valuable paper by Mr L C W Bonacina on "Turner's Portrayal of the Weather" Landscape features and weather are the warp and weft of scenery, and the proper understanding of Turner's work as portrayer of scenery has been greatly hindered by the fact that such artists are described as landscape painters, and further by the circumstance that the salability of their work depends largely upon giving the picture a local name Turner's pictures may be divided into two classes, those in which the *motif* is provided by the features of the landscape proper and those in which the *motif* is provided by the aspect of the weather, and the latter are probably the more important part of

Turner's contribution to nature study Mr Bonacina's detailed discussion of notable examples of Turner's pictures in the National Gallery the Tate Gallery, and the Victoria and Albert Museum deserves the careful consideration of students of both science and art The attention of these specialists and also of persons of general culture may properly be directed to the following sentence in which the outlook of the author is strikingly expressed the co ordination and unification of truth acquired on the one hand *through scientific research and on the other expressed* through artistic intuition as the intellectual needs of the age

Recent Work in Meteorology

The annual report of the Director of the Meteorological Office for the year ended March 31 1938 describes the work of a period during which attention has been focused on the ever growing needs of the rapidly expanding Royal Air Force and civil aviation Many new meteorological stations were opened during that period on service and civil aerodromes as trained staff became available The installation of direct teleprinter connexions between the meteorological stations in the country and the Air Ministry Meteorological Office headquarters was begun and arrangements for its extension to the constantly growing network of similar stations had to be considered Meteorological information for the trans Atlantic flights of July 1937 was supplied from stations set up at the Shannon Airport and at Botwood The first of these was worked on an agency basis by the Meteorological Office for the Government of Eire and the second was operated by the Canadian Meteorological Service on behalf of the Government of Newfoundland Conferences were held afterwards at Toronto and Dublin to review the meteorological organization and improve it

On the research side important work was done in collaboration with the National Physical Laboratory in developing apparatus for measuring upper air conditions by radio instruments carried on unmanned balloons, so as to obtain immediate information about wind, pressure and temperature up to greater heights than could be reached when observations were made in aeroplanes An additional advantage from the new methods is that the information can be obtained *in weather dangerous for flying* Climatic conditions in Africa during years when there were serious outbreaks of locust swarms were under investigation on behalf of the Committee on Locust Control

Electric Heating for Merchant Ships

The heating installation of a merchant ship is very different from that of a building on shore An ocean going merchant ship may sail into cold weather at any time of the year In the course of a week she may sail from tropical heat into almost arctic conditions, and in a voyage of a month's duration she may sail from winter in one hemisphere, through spring, summer and autumn, or vice versa, and come into winter conditions in the other hemisphere A paper on this subject was read to the Institution of Electrical Engineers on November 24 by H C Macewan A difficulty of arriving at a simple method of calculation like that used for computing the electric heating for a building arises from the fact that the regulations quoted in specifications are very vague Recently the British Board of Trade stated in its instructions to its surveyors in relation to masters and crew's spaces that a heating system will be considered satisfactory if it is capable of maintaining a temperature of 60° F when the temperature of the outside air is 30 F This although a useful help for making calculations is insufficient as the basis for a test to show the adequacy of the heating Mr Macewan has collected data for the calculation of quantities and gives a general review of the problem as it exists to day He points out that the capital cost of the electric heating of ships is usually less than that of other systems as it is cheaper to run electric cables than pipes In running cost also electric heating is cheap as it usually acts as a demand leveller and it is seldom necessary to run an extra generator

Broadcasting in India

In *Electrotechnics* the journal of the Electrical Engineering Society of the Indian Institute of Science Bangalore of April we learn that the Government of India is making progress with the construction of broadcasting stations In December 1937 the 5 kw medium wave transmitter at Lahore and the 10 kw short wave station at Delhi commenced operation The short wave station at Bombay—also of 10 kw started to radiate early in February and Lucknow early in April The 0 25 kw medium wave and the 10 kw short wave transmitters at Madras were put into regular service from the middle of June The Trichinopoly 5 kw medium wave station is expected to commence operation at an early date Several Provincial Governments have already distributed a small number of receivers for group listening in villages The broadcasting authorities of the Central Government have under way a programme for installing 120 receivers in as many villages in the Delhi Province At the present moment the broadcasting service touches but a fringe of the population and the programmes are of limited appeal The element of novelty and wonder is still the dominating factor in reception amongst all classes of listeners Listening for pure entertainment and enjoyment, oblivious to the mechanism, is as yet virtually non existent in India Until the present uncritical listening gives place to the habit of turning to radio for enjoyment, such questions as the acoustical requirements of studios and the special requirements demanded by Indian music and its technique can receive no adequate and satisfactory answer In this journal, Mr K Sreenivasan's thoughtful address on the design of studios for broadcasting is published

Oxford Science

The first number of a new shilling quarterly called *Oxford Science*, edited and published by the Junior Science Club, and printed at the Oxford University

Press, appeared this week. All new journals of this kind are necessarily precarious ventures but there are good hopes that this one will fulfil the need it has been produced to meet. It is taking the place of the *Transactions* of the Club which have been published now for more than fifty years. It will contain the more important lectures given from time to time to the Club, discuss problems connected with study and research in science and medicine at Oxford and review the work of the different scientific departments. The opening number contains the Robert Boyle lecture by Sir Edward Mellanby on methods of discovery in the fight against disease, an article by Prof. F. Paneth on atomic transmutation an account of recent investigations on the structure of proteins by D. Parker Riley and an article discussing and criticizing medical curricula by one of the medical tutors. Some of the articles are illustrated. There are also editorial and other notes and a few book reviews. Altogether this is a lively first number that should make a wide appeal to the student of science interested in other sciences besides his own and in the problems that their impact on the world and the university has produced.

Gardeners of Essex

THE presidential address of Dr. John Ramsbottom to the Essex Field Club provided an opportunity to present much historical gardening knowledge in a pleasant, intimate form ("Old Essex Gardeners and their Gardens", *Essex Naturalist*, **26**, 65–103, 1938). *Yucca* first flowered in England during the year 1604 in the garden of William Coy at Stubbers North Okington. This same garden also enjoys the distinction that it was the source whence the ivy-leaved toadflax, *Linaria cymbalaria*, first spread to become apparently native upon walls throughout England. It would be difficult to over-estimate the valuable work of another Essex gardener, Lord Petre, who stimulated the collection of many foreign plants which have become accepted beautifiers of British gardens. Richard Warner of Woodford introduced the genus *Gardenia* to English horticulture in 1754, and Dr. John Fothergill, 1712–80, had an influence similar to that of Lord Petre. He stimulated numerous useful projects, and himself cultivated many new and curious plants. No geographical limits were set by these Essex plant collectors, but they appear to have been especially responsible for the introduction of North American species to the gardens of Europe.

National Planning

THE Town Planning Institute has issued a report of the National Survey and National Planning Committee (price 1*s*.). The report stresses several matters of importance, and points out that in England and Wales (for Scotland is not included) about three quarters of the local authorities have applied the various Acts to about two thirds of the total land area. The process of planning, however, appears to be slow and essentially local in outlook. The Committee believes that national planning is required to supplement and reinforce local and regional planning. There is no national policy or guidance in the preservation of land for agriculture and for the reservation of national parks and other large open spaces. Further, in problems of transport, such as roadways and airports a national, rather than a regional outlook is necessary. The report contains a strong plea for a new department of Government which should take the form of a National Planning Commission. Its functions would be, first the completion of a national survey and secondly advice and guidance to other Government departments and local authorities. Thus it would be possible to formulate and execute a national policy in the utilization of land.

Earthquake in the East Indies

THE U.S. Coast and Geodetic Survey, Washington, D.C., has announced the occurrence of an earthquake on October 10d. 20h. 48m. G.C.T. with provisional epicentre lat. 1° N., long. 125 E. The epicentre was determined from instrumental data obtained at twelve United States seismological observatories. The epicentre is to the west of the Molucca Passage and the nearest town of any size is Menada in the north of Celebes. No damage has so far been reported from here. According to Dr. S. W. Visser and his colleagues of the seismological observatory at Batavia, small earthquakes are quite frequent near this spot. World-shaking earthquakes are somewhat infrequent, however, and the last ones were the swarm of *July 10–12, 1926* (epicentre lat. 1 N. long. 126° E.). It is possible that the earthquake on July 10, 1926 was multiple as the *P* residuals appear to show groupings which are confirmed by the *S* residuals.

Traffic in Women and Children

THE League of Nations Committee for the Suppression of Traffic in Women and Children recently proved by investigation that there is a connexion between licensed houses of prostitution and traffic in women. The League, therefore, sought information from many Governments and voluntary associations respecting the early lives of women who afterwards became prostitutes, and has issued an analysis of this information with comments, in a report recently issued ("Prostitutes: their Early Lives". Geneva, 1938. London: Allen and Unwin. 3*s*.). Some 60 per cent of the women were considered to be below normal in intelligence. Poverty and destitution, early seduction and the desire for an easy life seem to be the main causes responsible for women adopting this kind of life.

Monkeys as Botanical Collectors

THE *Kew Bulletin* No. 7, 1938, quotes from the annual report of the Director of Gardens, Straits Settlements, an account given by the acting director, Mr. E. J. H. Corner, of the use made of berok monkeys (*Macacus nemestrina*) to collect specimens from tall trees. Two young beroks are at present employed; they understand twelve words of Kelantanese and can thus be instructed to pick specific twigs and drop them to the ground. Mr. Corner states, "A berok upon the shoulder can be likened, in effect, to a falcon on the wrist", and its employment is recommended both to amateurs for its charm and cheapness and to keepers of Reserves where it is desirable to collect specimens repeatedly from the same trees without damage to them '

Science Masters' Association

The thirty ninth annual meeting of the Science Masters' Association will be held in the University of Cambridge on January 3 6, 1939 On January 3, Prof J Gray will deliver his presidential address on 'The Role of Science in Education" The following lectures have also been arranged Prof E V Appleton 'The Upper Atmosphere , G C L Bertram, "Animals of the Antarctic' , Prof R G W Norrish, Experiments in Photochemistry , Prof W L Bragg, X Ray Optics", Prof O T Jones, The Making of a Geological Map , Dr H B Cott, 'Visual Concealment in Nature and in War' , N E Odell, 'Everest, 1938 On January 6, a discussion will be held on 'Films in the Science Classroom' Further information can be obtained from Mr W Ashhurst, The Grammar School, Stretford, Lancs

The Night Sky in December

The night lasts for 16¼ hours in the latitude of London at the time of the winter solstice on December 22 The moon is full on December 7 and new on December 21 The moon s altitude when southing at Greenwich on December $8^d\ 0^h\ 27^m$ U T is 58½° No star brighter than mag 5½ is occulted during the month Conjunctions between the moon and planets occur as follows December $3^d\ 2^h$, Saturn $17^d\ 7^h$, Mars $18^d\ 16^h$, Venus $20^d\ 14^h$, Mercury $27^d\ 0^h$, Jupiter $30^d\ 11^h$, Saturn On December 5 there is a fairly close approach between the moon and Uranus actually resulting in an occultation of the latter as seen from parts of Asia and North America Jupiter and Saturn are both evening stars At about $18\frac{1}{4}^h$ on the following dates, the four inner satellites are grouped fairly closely to Jupiter, being easily seen in a pair of binoculars December 1^d (Satellite I occulted), 2^d, 10^d (Satellite IV occulted) ,17^d, 18^d, 19^d, 25^d to 28^d Mercury, Venus and Mars are all morning stars In mid December, Venus rises about 5^h , it is at its greatest brilliancy (mag −4 4) on December 26 The variable star, Algol, is well placed for observation during the month The approximate times of primary minima accessible to observation are on December 2^d 4 5^h, 5^d 1 3^h, 7^d 22 1^h, 10^d 19 0^h, 25^d 3 1^h, 27^d 23 9^h, 30^d 20 7^h On or about December 11 the Geminid meteors are at their maximum In the middle of the month at midnight, there is a fine array of bright stars on the southern meridian

Announcements

Prof Andrew Cowper Lawson, emeritus professor of geology and mineralogy at the University of California, has been awarded the Penrose Medal, highest honour of the Geological Society of America, "for eminent research in pure geology, and outstanding original contributions and achievements which mark a decided advance *in the science of geology*".

Prof James Kendall, professor of chemistry in the University of Edinburgh, will deliver the Christmas Lectures adapted to a juvenile auditory" at the Royal Institution on January 3, 5, 7 and 10 The subject of the lectures will be 'Young Chemists and Great Discoveries '

Mr K de B Codrington, keeper of the Indian Section of the Victoria and Albert Museum, has been appointed to give the Charles Phelps Taft Memorial Lecture at the University of Cincinnati in January Mr Codrington has been attached to University College, London for many years as honorary lecturer in Indian art and is chairman of the Indian Research Committee of the Royal Anthropological Institute He held the chair of archæology at the University of Cincinnati in 1925–26 His present invitation to the United States is an indication of the increasing interest there in India, and especially Indian art Mr Codrington intends to investigate the educational activities of various museums in the United States during his visit

The Nobel Peace Prize for 1938 has been awarded to the Nansen Office for Refugees in Geneva The Nansen Office ceases its activity at the end of this year, and its duties will be continued in London by the newly founded International Commission for Refugees The Prize will automatically be transferred to the new Commission in London, the director of which is Sir Herbert Emerson

The Geophysical Discussion at the Royal Astronomical Society on The Night Sky and Aurora , arranged for January 27, has been postponed to May 19 The discussion arranged for May 26 is cancelled On March 24, 1939, Dr L C Bullard will open a discussion on Recent Geophysical Investigations at Sea

Messrs Francis Edwards, Ltd , 33 Marylebone High Street, W 1, have issued a catalogue (No 630 1938) containing many rare examples of books relating to the sea, atlases, autograph letters, log books, etc The gems of the collection are, perhaps, a fine first edition of Sir William Alexander's "An Encouragement to Colonies ' (1624), 'Hakluytus Posthumus" of Purchas (1624–26), "The Principal Navigations" of Richard Hakluyt (1598–1600) and an atlas, the "Strassburg Ptolemy ' (1513) There is also a long series of works, with many rarities, dealing with the *Bounty* mutiny and Captain Cook s voyages Among scientific works listed we notice copies of the "Challenger Report", Sir J D. Hooker's "Botany of the Antarctic Voyage" of the ***Erebus* *and Terror***, the "Botany and Zoology of the Voyage of H M S 'Sulphur' ", Darwin's "Surveying Voyages of H M S 's 'Adventure' and 'Beagle ", and a complete set of the *Journal of the Polynesian Society*

In the short notice of J Halcro Johnson's "Reverse Notation" on p 775 of Nature of October 29, the reviewer, in quoting examples of the abundance of negative digits, inadvertently omitted the word 'minus' before log $6\ 3\bar{3}5$ According to the reverse notation, log $6\ 3\bar{3}5 = 1\ \overline{32}04$, but in converting subtraction into addition, minus log $6\ 3\bar{3}5 = \bar{1}\ 320\bar{4}$ is used

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 959

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Distribution of the Bridled Form of the Common Guillemot (*Uria aalge*)

THIS subject forms an excellent illustration of how character gradients in and between geographical races of animals submit to the treatment suggested by Huxley[1] In this instance, the cline— to make use of his term—is one in the proportions of polymorphs The bridled form of *Uria aalge*, a mutant, which apparently depends on a single gene difference and is distinguished by a white circle around the eye continuing backwards as a line towards the region of the nape, represents a larger percentage of the guillemot population in the north of its range than in the south It is clear that more details of this cline will reveal important facts such as the groups that are situated on it and the relationships between them During the past breeding season the British Trust for Ornithology has organized a co operative inquiry into the status of the bridled guillemot in the British Isles and, although it is hoped to continue this inquiry during the coming season to fill in the remaining gaps, enough is now known to encourage a preliminary publication

Observers were asked to visit as many breeding colonies as possible, to count at least two hundred birds from representative parts of the colony and to note the number of bridled birds in their total Fairly complete figures have been obtained except for colonies down the west coast of Scotland and Ireland, for which information is still badly needed Where two observers sent in counts for one colony, percentages were first worked out for each to find out what was the discrepancy Since this was in every such case insignificant, the counts were added together

The results for the British Isles are shown on the accompanying map, where the figures shown in circles denote the percentage of bridled birds in that particular colony

The following points illustrating the nature of the cline may be noted

(1) At all the English and Welsh colonies the percentage is very small

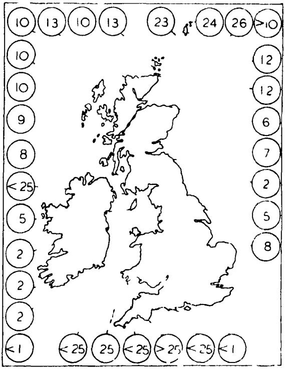
(2) At about lat 56° N the numbers commence to rise Along the east coast of Scotland there is a fairly steep and regular cline, while on the west coast there is marked discontinuity, though this may be due to incompleteness of figures

(3) Between Fair Isle and Shetland there is again marked discontinuity, the proportions rising from 10–13 per cent, which is characteristic of the whole north Scottish area, to 24 per cent

(4) In Ireland there may possibly be a gradually rising cline in a north westerly direction, but more figures are needed to confirm this

(5) In the region of rapid change off the Northumberland and Berwick coasts there is even a reversal of the cline at St Abb s Head and the Farnes showing that differences are more likely to establish themselves in such regions

As regards the rest of the guillemot s breeding range, the cline is continued northwards and southwards of the British Isles France has very occasional bridled birds Heligoland 1 per cent Gotland 1 per cent Faeroes 34 per cent Iceland more than 70 per cent, Magerö North Cape, more than 50 per cent, Bear Island more than 50 per cent and Novaya Zemlya (where only very few *Uria aalge* breed, most being *Uria lomvia*) less than 40 per cent



PERCENTAGES OF BRIDLED GUILLEMOTS AT COLONIES IN THE BRITISH ISLES

In North America, the situation in the east coast colonies has recently been studied by Johnson[2], who reports 15 7 per cent of the breeding population to be bridled Whether any similar cline from south to north is found there does not seem to be known

Another cline is also found in *Uria aalge* Birds from the southern part of the range are brownish on the back, while those from farther north show a considerably deeper colour, which is almost black. Subspecies have been named from back colour and other characters It may be significant that the change from *Uria aalge albionis* to *Uria a aalge* corresponds with the first zone of change in percentage of bridling but it does not seem safe to postulate a causal connexion between the cline in polymorph frequencies and that in melanin pigmentation on the present evidence

The genetic situation involved is of some interest From the non existence of intermediate forms it may be assumed that the control is unifactorial Whether it behaves as dominant or recessive is however, less clear, and only breeding experiments or ringing of wild populations could decide this

This method of describing sub species and forms makes a useful addition to the usual taxonomic procedure and gives important information as to the processes of species differentiation, the methods by which isolation arises in a widespread group and the speed with which genes may diffuse across such barriers

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[1] Huxley J S NATURE **142** 219 (1938)
[2] Johnson R A *Auk* **55** 6 61 (1938)

Tellurium Tetrafluoride

The formation of a white solid which accompanies the main product tellurium hexafluoride when fluorine is passed over tellurium has often been noticed but its composition has not been settled (Moissan[1], Prideaux[2]) Yost and Claussen[3] showed that the same or a similar substance is formed by heating the hexafluoride with tellurium in sealed glass tubes, but they were unable to identify the product, which they state is probably the difluoride, TeF_2

We have re investigated the reaction using sealed tubes of both glass and silica With the hexafluoride alone in the tubes, no reaction occurs and the density of the gas remains unchanged With tellurium present, a white solid is formed at a temperature of about 200° C The ratio of fluorine to tellurium in this solid is not constant but decreases with the time the tube is heated, until after heating for several days, the fluorine content becomes very small and the solid approximates in composition to TeO_2 At the same time the gas pressure in the tube rises and finally attains a value 1 5 times the initial pressure The gas, originally pure TeF_6, is converted completely into SiF_4, as shown by vapour density measurements The most probable explanation of these facts seems to be that the first product of the reaction is the formation of a new compound, tellurium tetrafluoride, which then reacts with the silica giving silicon fluoride and tellurous oxide

$$(1)\quad 2TeF_6 + Te = 3TeF_4$$

$$(2)\quad 3TeF_4 + 3SiO_2 = 3TeO_2 + 3SiF_4$$

Further investigation has confirmed the correctness of this interpretation We have found that the product of the first reaction can be isolated by using a tube composed of pure crystalline alumina This material, as supplied by the Thermal Syndicate, Ltd , is non-porous and is the only one we have found which is not attacked by this reaction

In these conditions, the tellurium hexafluoride is absorbed completely by the tellurium at about 200° C , forming a colourless solid which crystallizes in fine needles on the walls of the tube On exposure to ordinary air the solid hydrolyses very rapidly with evolution of hydrogen fluoride By dissolving this product rapidly in aqueous potash, we have been able to determine the ratio F Te in the substance Two independent experiments showed it to approximate closely to 4 1

Quite recently we have been able to prepare larger amounts of the white crystalline material free from excess of tellurium and to analyse it completely As a mean of two experiments, we find for its composition Te 62 5 per cent, F 38 7 per cent The formula TeF_4 contains Te 62 6 per cent, F 37 4 per cent The fluorine was estimated as lead chlorofluoride after precipitation of tellurium as dioxide—a method which we have found to give rather high results when used for the estimation of this element in compounds of tellurium and fluorine

The results can therefore be regarded as satisfactory, and there can be little doubt that the white solid we have obtained is a new fluoride of tellurium, TeF_4, which on account of its reactive behaviour with glass and silica and its instability in presence of traces of moisture has not been isolated previously

Further experiments on the properties and behaviour of this substance are in progress

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Nov 1

[1] Moissan *Ann Chim Phys* **24** (6) 239 (1891)
[2] Prideaux *J Chem S* **89** 320 (1906)
[3] Yost and Claussen *J Amer Chem Soc* **55** 88 (1933)

Fate of the Sulphate Radical in the Animal Body

Phosphorus enters as phosphate in the numerous compounds in which it is to be found in the animal body , in connexion with the investigations carried out in recent years concerning the fate of ingested phosphorus atoms in the organism, it seemed to be of interest to determine whether or not, in the course of the numerous metabolic processes in which phosphorus is involved, the phosphate radical exchanges its *oxygen* content with other oxygen atoms present in the body This question could be answered by injecting into an animal sodium phosphate which contained heavy oxygen (^{18}O) as an indicator and then determining if the phosphate recovered in the urine, for example, contained more than the normal amount of ^{18}O

As, however, it was recently found[1] that 'heavy oxygen phosphate' can be obtained by dissolving sodium phosphate in 'heavy oxygen water' and vice versa, it is apparent that the oxygen atoms present in phosphate radicals exchange their places freely in water and there can be scarcely any doubt that the probability is extremely small of a phosphate radical leaving the body coupled to the same oxygen atoms with which it entered Sulphate ions, on the other hand, have been found[2] to exchange oxygen atoms either not at all or at a very slow rate with neutral water, even at 100° C , and it seemed of interest, therefore, to investigate whether sulphate ions during their circulation in the body participate in chemical reactions which loosen the oxygen bonds sufficiently to make an oxygen exchange possible

In the experiments we wish to report here, sodium sulphate containing heavy oxygen was prepared from heavy oxygen water, kindly presented to us by Prof Urey[3], having a density 740 parts in a million greater than that of normal water The reaction used for the preparation of the 'heavy sulphate was that which takes place between SO_2Cl_2 and heavy oxygen water in the presence of traces of iodine as a catalyst 1 gm of the dry material, converted into 50 c c of solution, was injected into a rabbit, we are very grateful to Miss Lindberg, of Prof Krogh s laboratory, for making the injections The urine of the rabbit was then collected for 24 hours, its sulphate content recovered as barium sulphate the oxygen content of the latter converted into water, and the density of this determined The preparation of water from the oxygen of the sulphate was carried out in the following way The barium sulphate precipitate was dried at 400° C in a stream of nitrogen and then reduced with purified carbon at 900° C, the gases evolved were mixed with a great excess of hydrogen and stored over oil in a gasometer, and, finally, the gas mixture was led over a nickel catalyst at 310° C and the water formed collected The density determination was kindly carried out by Mr O Jacobsen, using Linderstrom Lang s floating drop method

Should the sulphate oxygen during its stay in the animal, enter into exchange reactions with other oxygen atoms present in very great excess in the body, the oxygen of the heavy radicals would be replaced by normal oxygen atoms and the water prepared from the sulphate recovered from the urine would show the density of normal water If, on the other hand the sulphate ions injected retain the oxygen atoms with which they start the water prepared from the urine sulphate should show an excess density of 370 parts per million if no secretion of normal sulphate took place The water prepared from the sulphate isolated from the urine after injecting heavy oxygen sulphate has shown a very appreciable density excess—240 parts per million When comparing this value with the one calculated on the assumption that no exchange of sulphate oxygen took place, we must consider the following fact Besides the heavy oxygen sulphate– 0 84 gm of sodium sulphate being secreted in all during the day following injection—the urine contains also sulphate, even when no injection is given, the amount of which we found to correspond to 0 23 gm per day The latter is normal sulphate and its presence reduces the density excess of the water prepared from the urine sulphate

From the high density found for the water prepared from urine sulphate, one must conclude that most of the individual sulphate ions injected into the rabbit are recovered in their original form, and from this it follows that at least the greatest part of the sulphate administered leaves the body unchanged, and also that none or only a small part of the ingested ions exchange as such with other sulphate ions present beforehand in the tissues

A H W Aten, jun
G Hevesy

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[1] Blumenthal and Herbert *Trans Faraday Soc* **33** 849 (1937)

[2] Datta S C, Day J N E and Ingold C K *J Chem Soc* 1968 (1937)

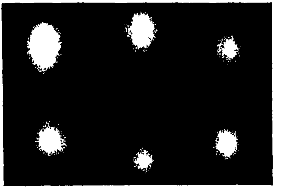
[3] Huffmann and Urey *Ind Eng Chem* **29** 531 (1937)

[4] Manian, Urey, and Bleakney *J Amer Chem Soc*, **56** 2601 (1934)

Distribution of Phosphorus in the Leg Bones of Chickens

In rickets, as is generally known, the total phosphorus content of the bones is diminished We have started now to investigate the distribution of phosphorus in the leg bones of normal and rachitic chickens with a radioactive phosphorus isotope as an indicator

The active phosphorus used was prepared by Dr F A Heyn, of the Philips Lamp Works at Eindhoven, with a Philips neutron generator[1] A fixed quantity of the active phosphorus was injected intraperitoneally as an aqueous solution of sodium phosphate of *p*H 7 2 The chickens were decapitated 22 hours after the injection and quickly sectioned The leg bones were then dissected and cleaned One of the leg bones of each bird then was divided into three parts, namely, the proximal epiphysis the distal epiphysis and the diaphysis The two epiphysial parts of the bone were then carbonized together in an oven at 200° C, the same was done with the diaphysis Preparations for the determination of the radioactivity were made in the manner described previously[2] In addition a part of the residue of carbonization was used for the estimation of the total phosphorus according to Fiske Subbarow



As was to be expected the provisional figures from eight chickens showed that the phosphorus content of the dried matter in the epiphysial part and in the diaphysial part is larger in normal than in rachitic chickens Furthermore it was observed that both in normal and in rachitic chickens the phosphorus content from the diaphysial part of the bone seems to be larger than that from the epiphysial part of the same bone

With regard to the distribution of the active phosphorus administered, it was observed that, both in the normal and in the rachitic chickens decapitated 22 hours after the injection of the labelled phosphorus, the quantity of the active phosphorus in 1 mgm of bone phosphorus was larger in the epiphysis than in the diaphysis Furthermore, it was observed that both the epiphysis and the diaphysis from the rachitic birds, decapitated 22 hours after the injection of the labelled phosphorus, contained a much larger quantity of the active phosphorus in 1 mgm bone phosphorus than the normal chickens

The second leg bone of each chicken was not carbonized, but after being cleaned was placed on a double coated X ray film It remained on this film for some days, according to the quantity of radioactive phosphorus injected The film was then developed, a clear picture of the whole bone was visible, as is shown by the accompanying photographs It is convincingly shown in these that the epiphysis contains a larger quantity of the active phosphorus than the diaphysis does Hence the results of measurements of the radioactivity of the several parts of the bone are fully in accordance with the photographs obtained

Thus it appears from the radioactivity measurements and also from the radiographs that phosphorus metabolism is more intense in the bone of the rachitic chicken than in the bone of the normal chicken and also phosphorus metabolism is more intense in the epiphysial part than in the diaphysial part of the same bone

We are now trying to investigate whether it is possible to estimate photographically the quantity of the active phosphorus present in the several parts of a bone

Finally, we wish to express our thanks to the Philips Lamp Works for furnishing the radioactive phosphorus used in these experiments, and to Mr J C de Back for his assistance in these investigations

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[1] Brouwers A Heyn F A and Kuntke A *Physica* 4 153 (1937).

[2] Nature 139 1068 (1937) *Proc Roy Acad Amsterdam* 40 547 (1937)

Enzymic Deamination of Aspartic Acid

From the cell free solution of *B fluorescens liquefaciens*, which has a powerful aspartase effect[1], we have isolated aspartase by adding acetic acid up to *p*H 4 6 at 0° C The precipitate thereby formed (precipitation begins at *p*H 4 8) gives, when rapidly filtered and dissolved in *M*/15 phosphate buffer (*p*H 7), a solution which possesses considerable aspartase and also asparaginase effect This solution has no fumarase effect even in experiments of long duration

Despite the absence of fumarase, the enzyme solution obtained forms malic acid from fumaric acid in the presence of ammonia The reaction occurs also in the presence of toluene When a longer time is allowed, the reaction goes so far that only aspartic acid, malic acid and ammonia can be found in the solution, fumaric acid is not detectable If we start with *l* aspartic acid there are formed fumaric acid, malic acid and ammonia Fumaric acid is not converted into malic acid by our enzyme solution, if ammonia is absent

The results led to the conclusion that the purified fumarase free enzyme solution contains two different enzymes One (I) is the actual aspartase and catalyses the reaction

$$HO_2C\ CH_2\ CH(NH_2)\ CO_2H \rightleftharpoons HO_2C\ CH = CH\ CO_2H + NH_3,$$

the other (II) catalyses the following reaction :

$$HO_2C\ CH_2\ CH(NH_2)\ CO_2H + H_2O \rightarrow HO_2C\ CH_2\ CH(OH)\ CO_2H + NH_3$$

Thus the hydrolytic deamination of an amino acid would be established for the first time The latter reaction is not reversible The conversion of fumaric acid into malic acid in the presence of ammonia proceeds through aspartic acid Consequently, enzymes I and II are required for the reaction Enzyme II acts more slowly than Enzyme I, therefore at first chiefly fumaric acid and ammonia are formed from aspartic acid

We report the above results because Gale[2] has recently published investigations on the separation from the raw aspartase in *B coli* juice two different enzymes deaminating *l* aspartic acid One of his enzymes, however, does not act in the presence of toluene, and both of them contain fumarase, thus preventing elucidation of the mechanism

In addition, we have also noted that the aspartase effect of the enzyme solution is approximately proportional to the enzyme concentration Systematic exceptions to this rule are noted in that small quantities of enzyme act more favourably during a long reaction time than do large quantities during a short reaction time The equilibrium constant for deamination obtained with a fumarase free preparation was K_{3}, 100

With the enzyme solution or with the suspension of *B fluorescens liquefaciens* we were unable to accomplish the amino acid synthesis from oxalacetic acid and ammonia, or from succinic acid and ammonia

A detailed account of this work will be published elsewhere

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[1] Virtanen and Tarnanen *Biochem Z* 250 193 (1932)

[2] Gale *Biochem J* 32 1583 (1938)

Oxygen Exchange during Esterification

In a recent paper[1] on the exchange of oxygen between water and acetic acid, we pointed out that the mechanism of the exchange of the carboxyl oxygen atoms of the acid with the oxygen of the water, H–OH, was probably identical with the mechanism of esterification of an acid by an alcohol, *R*–OH, and ventured to predict that when esterification of an acid occurs in the presence of about equal quantities of alcohol and water an exchange will be observed between the oxygen of the water and that of the acid running parallel to the simultaneous rate of esterification We mentioned that we were carrying out experiments to test this view

Meanwhile, Urey and Roberts[2] have esterified benzoic acid with methanol containing excess of the heavy oxygen isotope in order to determine which linkages are broken during esterification They found it necessary to apply to their results a correction for the exchange between benzoic acid and the water formed during the esterification They therefore measured also the rate of exchange between benzoic acid and heavy oxygen water under the same conditions as those pertaining during esterification

Urey and Roberts find that 0 1505 moles of the acid were esterified, while simultaneously 0 0726 moles of the acid exchanged *both* its oxygen with those of the water Taking into account the relative concentration (or better, the activities) of the water and methanol in the reaction mixture, this result indicates that the velocity constant of the exchange reaction is about five times as great as that of the esterification This difference corresponds to a difference of only 1,000 calories in the activation energies, and we therefore consider that the above result supports our prediction

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Trans Far Soc 34 1219 (1938)
[2] J Amer Chem Soc 60 2303 (1938)

Crystal Analysis and Point Sets

IT is customary in X ray crystallography to regard a crystal as a continuous distribution of scattering matter, expressible in the form of the electron density function

$$\rho(x, y, z) = \frac{1}{v} \Sigma\Sigma\Sigma\, F(h, k, l) \exp\left[-2\pi i(hx/a + ky/b + lz/c)\right] \qquad (1)$$

$$= \frac{1}{v} \Sigma\Sigma\Sigma\, r(h, k, l) \exp\left[i\alpha(h, k, l) - 2\pi i(hx/a + ky/b + lz/c)\right]$$

Whereas X ray techniques permit the determination of the amplitudes r, they do not determine the phases α This, as is well recognized, has been the essential limitation in X ray analysis, not as a method of testing structures already proposed, but as a method of discovering the atomic structure of crystals This difficulty prompted the introduction of the derived function[1]

$$A(x, y, z) = \frac{1}{v} \int_0^a\!\!\int_0^b\!\!\int_0^c \rho(X, Y, Z)\, \rho(X + x, Y + y, Z + z)\, dxdydz$$

$$= \frac{1}{v} \Sigma\Sigma\Sigma\, R(h, k, l) \exp 2\pi i\, (hx/a + ky/b + lz/c), \qquad (2)$$

where

$$R(h, k, l) = |F(h, k, l)|^2 = (r(h, k, l))^2, \qquad (3)$$

which is thus expressible in terms of the observed amplitudes and is independent of the unobserved phases This function (representing the weighted distribution of density in the crystal about any point) can be used in conjunction with any structure already proposed, to pass it for further consideration or to reject it, according as its vector function does or does not tally with it

While in particular cases it must be agreed that passing a test of so high an order of delicacy is sufficient to establish a proposed structure to all intents and purposes the mathematical interest of the use of vector functions lies in the question as to the complete inventory of structures which satisfies a given vector map (which may be none) a question to which the method of expressing an electron density distribution in the form (1) supplies no answer For all that can be said is that all electron density functions of the form (1) share the same vector function, namely, the vector function (2), when and only when condition (3) is satisfied—and this brings us back again to the difficulty of the unobservable phases which, it would seem, the introduction of vector functions does nothing to dispel

To meet this difficulty, an alternative approach to the problem, originally introduced in a study of the structure of insulin[2] has been exhaustively developed[3] It bears to the customary approach the same relation as the quantum theory of light bears to the classical theory, picturing a crystal as a point intensity distribution in atomic space S_1, corresponding to which there is a second easily derivable point intensity distribution in vector space S_2, which may be compared with the experimentally obtained vector maps already discussed As an example of an S_2 distribution to which more than one S_1 corresponds, we may cite the periodic one dimensional arrays 3, 7, 2 5, 3, 7 2, 5 and 7, 1, 6 1, 7, 1, 6, 1, which share the same vector map It is possible systematically, in cases of gradually increasing complexity, to investigate all the S_1 distributions corresponding to a given S_2 Evidently the less symmetric the S_2 distribution, the smaller the multiplicity of its corresponding S_1 distributions This now method entirely alters the situation regarding the possibility of using vector maps to discover the atomic structure of crystals To illustrate the appropriate procedure, we discuss the projection on (0001) of the vector map of an insulin crystal[4] It is hexadic and has only four sets of marked maxima O, A, B, C shown in Fig 1, the intensities of which are in the order $O > B > A > C$ It has been found that this S_2 point distribution corresponds to two and only two S_1 point distributions shown in Figs 1 a and 1 b But the fact that the intensities of the S_2 points are in the order $B > A > C$ excludes the second of the two S_1 point distributions

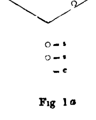

Fig 1a

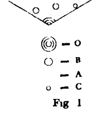

Fig 1

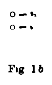

Fig 1b

Hence we deduce that, whatever the degree of approximation to which the point distribution in Fig 1 represents the vector diagram of insulin to that same degree of approximation the corresponding atomic distribution in crystalline insulin is represented by Fig 1 *a* (broken circle *c* appears at the centre and at each corner of the hexagon)

This procedure is further explained and developed in general in more detailed studies in course of publication It is also being used to derive from the vector diagrams of insulin further and more detailed information regarding the atomic structure of crystalline insulin in investigations which may be regarded as supplementary to those already published[3] [4], which have shown the delicate concordance between these diagrams and the vector map of the cage structure predicted for insulin[6] as a deduction from the cyclol hypothesis[7]

I am indebted to Prof F H Neville for advice in connexion with this work

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Nov 10

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[1] Patterson Z Krist 90 517 (1935)

[2] Wrinch J Amer Chem Soc 60 2005 (1938)

[3] Langmuir and Wrinch Nature 142 581 (1938) and forthcoming publications Wrinch *Phil Mag* (in the press)

[4] Crowfoot *Proc Roy Soc* A 164 580 (1938)

[5] Wrinch and Langmuir *J Amer Chem Soc* 60 2247 (1938)

[6] Wrinch, *Science* 85 566 (1937) *Trans Faraday Soc* 33 1368 (1937)

[7] Wrinch Nature 137 411 (1936) *et seq*

Ionization of Air in an Air conditioned Building

According to modern medicine, the electric condition of atmosphere is an important sanitary factor In closed localities ventilated normally, man lives in a medium which has not the electric field of open air but the average ionization of its air is, as a rule the same as in the open air There is normally also a slight excess of positive ions over negative ions as out of doors Cellars where the air stagnates and where there is accumulation of radon (radium emanation) released from the walls are an exception

It was therefore interesting to ascertain the order of ionization of air inside buildings provided with Carrier air conditioning equipment

This equipment consists, in principle, of filters (viscous layers, glass or steel wool, etc) or electric precipitators and air washers freeing the air from dust, and adjusting its humidity and temperature It might be expected that the air is simultaneously freed also from its ions, which may be regenerated in the cleaned air only by the influence of radio active radiation of the walls and other articles placed in the building, or by cosmic rays

We had the opportunity of measuring ionization of air in the central office building of the municipal electricity works of the city of Prague The central air conditioning equipment, described by one of us[1], consists of the main filters having a total surface of 48 sq metres, after which the air passes through a chamber where it is washed with water After being heated suitably, to adjust the humidity and temperature, the conditioned air is led through the main duct to the individual stories It passes there through the local machines, where it is mixed with the return air cleaned by local filters From the machine rooms, the air is guided in metal air ducts and inlets with grids, into the working rooms The ducts are provided with silencers made of 'Celotex and Fritex to reduce sound The amount of air drawn in per hour from the open atmosphere is 60,000 cub metres minimum, 200,000 cub metres maximum

The content of small ions was measured by a compensating ion counter of special design[2] giving directly the number of small ions in 1 c c

The results are given in the accompanying table, where n^+ and n^- are the number of small ions in 1 c c of air q is polarity of spatial charge The average temperature of the conditioned air was 19° C, relative humidity 62 per cent except measurement No 2 when the temperature of air was 12 3° C and relative humidity 89 per cent

	Place	n^+	n^-	$q = \frac{n^+}{n^-}$
1	Outside air (open atmosphere)	300	260	1 15
2	Pit immediately behind the air washer	530	10 600	0 05
3	In the main duct for conditioned air 1st floor	640	5 300	0 121
4	Ditto 4th floor	550	4 650	0 118
5	Air inlet into the working room	200	1 900	0 105
6	Close to the wall of the working room 70 cm above the floor	60	330	2 30
7	In the middle of the working room	7	895	0 866

Measurement No 2 shows that the air is not freed from ions even after it passes through filters and is washed with water There is an enormous excess of negative ions forty times more than in the open air which is evidently the Lenard effect that is separation of negative charges on breaking up water drops A considerable excess of negative ions over the positive ones is maintained in the main duct for conditioned air up to the 4th floor at an average speed of air of 195 metres per minute The radio active radiation of material of the walls and articles renews quickly (in about 10–15 minutes) the balance between the positive and negative ions The walls tend to eliminate the negative ions the mobility of which is greater than that of the positive ions so that they are more absorbed on objects (see measurement No 6) The average ionization ascertained in the working rooms, in the corridors and in the hall was twice as high as in the open air, the air showing as a rule a slight excess of negative ions over positive ions that is, inverted polarity as against the normal polarity of open air Permanently increased ionization of air in an air conditioned building may have a certain physiological influence It resembles a mountain climate, which is characterized always by a greater ionization than that of the lowlands

F Běhounek

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J Kletschka

Municipal Electricity Works of
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Oct 25

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[1] Kletschka J *Gesundheits Ingenieur* No 10 (1936)

[2] Běhounek F *La Presse thermale et climatique* 79 3 0 (1938)

Velocity of Sound in Liquid Helium

Burton and others[1] have measured the velocity of ultra sonic waves in liquid helium under its own vapour pressure, and compared the results with the thermodynamic properties of the substance In the helium I range they derive an adiabatic compressibility, which shows a minimum at 2 5° K In order to find the isothermal values, we have to multiply by $\gamma = c_p/c_v$. γ can be calculated from the specific heat[2] at vapour pressure c_s with the help of the thermodynamic

T °K	
	1 [illegible]
[illegible] 0	1 [illegible]
3 0[illegible]	1 3
3	1

diagrams[3]. It is interesting that in the isothermal curve the minimum has disappeared. The minimum in the adiabatic compressibility is connected with the rapid rise of c_p/c_v above the λ point.

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Burton, F. F., NATURE 141, 970 (1938). Findlay, J. C., Pitt, A., Smith, H. Grayson, and Wilhelm, J. O., *Phys. Rev.*, 54, 506 (1938).

[2] Keesom, W. H., and Keesom, Miss A. P., *Commun. Kamerlingh Onnes Lab. Leiden*, No. 235d; *Physica*, 2, 557 (1935).

[3] Keesom, W. H., and Keesom, Miss A. P., *Commun. Kamerlingh Onnes Lab. Leiden*, Suppl. No. 76b; *Physica*, 1, 128 (1933–34).

Vowel Vibrations and Vowel Production

PROF. E. W. SCRIPTURE, in a letter published in NATURE of October 1, suggests that the profiles of the various vowel sounds of which he gives examples—indicate that these sounds cannot have been produced by resonance.

I showed, in 1923 and 1924[1], that all the English vowels and consonants could be recognizably produced by the use of coupled resonators (of the Helmholtz type) suitably tuned to produce the principal resonant components that had been recognized by ear when listening to the speech sounds themselves—when those sounds were breathed or whispered. If the resonators were energized, by blowing (turbulent) air through or into them, they reproduced 'unvoiced' speech sounds. If they were energized by pulsating air—produced by first passing the energizing air current through a vibrating reed (equivalent to the vibrating action of the vocal cords)—the resonators reproduced voiced speech sounds. Incidentally, it was shown that vowel sounds could also be produced by coupling the resonators in parallel instead of in series.

That the resonant components were not imaginary was afterwards shown by I. B. Crandall and C. F. Sacia, of the Bell Telephone Laboratories[2], who proved their existence (together with other subsidiary resonances, not detected by ear) by purely instrumental means. Later, John Q. Stewart[3], in the Research Laboratory of the Western Electric Company of New York, and Dr. W. H. Eccles[4] showed that similar, recognizable, voiced vowel sounds could be produced by substituting electrical tuned circuits for Helmholtz resonators, and intermittent electrical impulses, in the place of intermittent air pulses for energizing the resonators. The resulting complex current, amplified and passed into a loud speaker, produced the voiced vowel sounds. In all these experiments, vowel (or in some cases also consonant) sounds were produced by the action of resonators.

It must be admitted that, in the case of human speech, the resonant conditions are more complex than in the experiment cited. The human pharynx, in particular, constantly varies in form during speech; the vocal cords also—as Prof. G. Oscar Russell has shown at Ohio University[4]—appear to modify their attitude, so as to assist the resonant effects. They probably supply a reed note which is rich in resonant components of about the right frequency to energize the principal oral resonance of each vowel sound.

There is the further difference that whereas the impulses produced experimentally by the artificial reeds (or equivalent) were relatively constant in frequency, those produced by the vocal cords are highly variable. But the evidence of the models appears to be conclusive that the human vowel sound is essentially an effect of resonance.

My own time is now fully occupied with the investigation of other aspects of human speech; but if any physicist (preferably in London) would care to make profiles of the artificial vowel sounds produced by some of my resonators, to compare with those of human speech—I would gladly lend them for the purpose of the experiment.

R. A. S. PAGET

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Oct. 17

[1] *Proc. Roy. Soc.*, A, 102 (19 3); A, 106 (19 4).

[2] "A Dynamical Study of the Vowel Sounds", *Bell System Tech. J.*, 3, No. 2, 23 -237; and "Human Speech", 88, 89.

[3] NATURE, 110, 311 (July 8, 1922).

[4] Royal Institution, 1923; and Phys. Soc. Jubilee Meeting, 19 4; "Human Speech", 08.

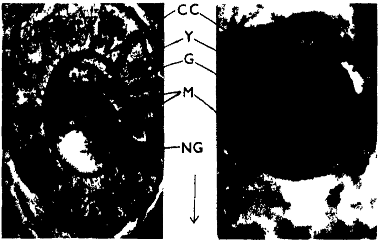
Effect of Ultra-centrifuging the Oocytes of the Mouse

OVARIES of the mouse were centrifuged in the Beams ultra-centrifuge. In the young oocytes the cytoplasmic inclusions and components are stratified into three layers. The mitochondria occupy the centrifugal end of the cell. The Golgi material and the nucleus, together with a few small granular mitochondria, are situated in the middle region of the cell, while the centripetal end is filled with clear cytoplasm which may contain a few small Golgi elements.

The accompanying illustrations are photomicrographs of two older oocytes. With the growth of the oocyte a layer of non-granular cytoplasm makes its appearance at the centrifugal pole ((a), N.G). At a later stage a layer of deeply stained material is present centripetal to the Golgi layer (G); this is identified as yolk (Y). In the mature oocyte the mitochondria (M) occupy the centrifugal half of the cell, while the Golgi material forms a thin layer centrifugal to the clear cytoplasm in the centripetal end of the cell (C.C). As in the earlier stages, a few small Golgi elements may lie in the cytoplasm towards the centripetal pole. The yolk lies between the Golgi layer and the centripetal pole. At this stage the nucleus (not shown in the photomicrograph) is displaced towards the centrifugal end.

The presence of a non-granular layer at the centrifugal pole of oocytes of a certain age, and its absence from the young and from the mature oocytes, must be due to changes in viscosity correlated with the growth of the egg. It is also of interest that the position of the nucleus varies in eggs of different ages.

So far as I am aware, the only published work on the centrifuged mammalian egg is that of Beams and King[1], for the guinea pig egg. Beams and King do not mention a layer of non-granular cytoplasm at the centrifugal pole at any stage in the development of the egg of the guinea pig, nor do they record a marked change in viscosity correlated with the growth of the oocyte



(a) (b)

An examination of centrifuged oocytes of the mouse, fixed in formol and stained with Sudan IV, failed to reveal the presence of fat The absence of fat from the mouse egg agrees with previous findings for the uncentrifuged oocyte[2]

This work was carried out at the University Zoological Department, Trinity College, Dublin

R A R Gresson

Zoology Department,
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Beams, W. H, and King, R L, *Cytologia*, **8**, 353–367 (1938).
Gresson, R A R, *Quart J Micro Sci*, **75**, 697–721 (1933)

A Modified Phase Rule Equation

The interesting and useful modified phase rule equation recently proposed by Dr. S T Bowden[1] contains what he calls a restriction term, *r*, which "is equal to the number of pairs of phases having the same concentration or composition".

In applying the modified phase rule equation to one-component systems, however, it appears that *r* must be equal to the number of pairs of phases which are *identical* Sublimation, fusion, evaporation and the triple point in one-component systems all involve pairs of phases which have the same concentration or composition Now at the triple point, for example, Dr. Bowden's equation reads

$$3 + 0 + 0 = 1 + 2 - 3,$$

which is not correct At the critical point of a pure substance, however, where the liquid and vapour phases are usually supposed to become identical[2], Dr Bowden's equation reads correctly

$$2 + 0 + 0 = 1 + 2 - 1.$$

George Novello Copley.

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Oct. 26.

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[1] Nature, **141**, 331 (Feb 19, 1938)

[2] See "Symposium on the Critical State, etc", *Chemical Reviews*, **23**, 1 (1938); Traube, I, *Trans Faraday Soc* **34**, 1234 (1938)

I am obliged to Mr. Copley for pointing out what appears to be an ambiguity in the use of the expression 'concentration' in the definition of the restriction term of the modified phase rule. Naturally, in the case of unary systems, the restriction term refers to identity of the phases and for a system at the triple point, $r = 0$, since the phases are not identical Accordingly, we have

$$P + F + R = C + 2 - r$$
$$3 + F + 0 = 1 + 2 - 0,$$

which is correct I made no reference to this simple example in my first communication because it is easily solved by means of the ordinary Gibbs equation

Actually, the restriction term was defined to cover the more complicated cases, and it was taken for granted that the restriction referred to phase identity in all simple unary systems At the time of writing, I was unaware that T W. Richards[1] had also pointed out that much of the subtlety of the phase rule lies in the restrictions imposed on the system "when one individual is kept in a definite weight ratio or at a definite concentration in a variable phase". The matter is explained in more detail in my book on the phase rule[2], where for simplicity the expression 'identity restriction' is employed throughout.

Apart from the fact that the equation gives a correct interpretation of all the cases cited by Mr. Copley, I may add that its primary aim was to supply a more informative rule, capable of distinguishing between physical and chemical change

S. T. Bowden

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Oct. 31.

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[1] *J Amer Chem Soc*, **38**, 983 (1916)

[2] "The Phase Rule and Phase Reactions" (Macmillan and Co, Ltd, 1938)

A New Decalcification Fluid

Decalcification of tissues by means of the usual acid reagents is rarely satisfactory, and unless carried out carefully and slowly the evolution of carbon dioxide leads to the production of artefacts This disadvantage is particularly felt in dealing with the highly calcified integuments of some Crustacea

To overcome the difficulty, tissues, after fixation, have been treated with aqueous solutions, in strengths up to 30 per cent of a neutral salt, of sodium hexametaphosphate. Complete decalcification of such a decapod as *Porcellana* (which would take at least a week in acid) was effected in a day and, since the reaction involved is a simple replacement of calcium by sodium, no distortion occurred. All the products of the reaction are water-soluble and are removed by washing in water:

$$2CaCO_3 + \underbrace{Na_2\{Na_4(PO_3)_6\}}_{\text{Sodium hexa metaphosphate}} = 2Na_2CO_3 + Na_2\{Ca_2(PO_3)_6\}.$$

The method was also used on echinoderm and mollusc material and, although the process was slightly slower, the results were equally successful.

Mammalian bone was also softened, but the penetration was much slower Despite the fact that the reagent is only water soluble, it is sufficiently rapid in action not to cause maceration or damage to the tissues, and in all the material tested the histology was particularly excellent

It should be emphasized that, as the salt is insoluble in alcohol, it must be well washed out, and the fixative employed before decalcification must be one which admits of this treatment

R A C WILKS

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Sept 27

Binocular Illusion

IN the correspondence on this subject, there does not appear to be mention of the faculty for viewing stereoscopic photographs possessed by those who can comply with Mr J D Morton's manner of viewing a lattice[1]

In this case, as distinct from the binocular sequence described by Sir Richard Paget[2] and others, the eye axes are turned more nearly parallel than normally, while keeping the focus adjusted to the lattice distance The suspended image is then apparently behind the pattern

Now this optical condition is that necessary for viewing a pair of stereoscopic photographs, without mechanical aid My own eyes tend to move their axes apart more readily than to converge from the normal angle for focused vision at medium distances They will even diverge about 1° out of parallel - shown by the fact that I can see a single binocular image formed by two similar objects 1 ft apart, at a distance of about 50 ft A pair of stereoscopic photographs are easily seen in correct perspective' —more easily than with a lens viewer' in fact

The late Mr R C Clinker, chief of the B T H Research Laboratory, was also endowed with this faculty, I believe but I have not met many other persons who were

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[1] NATURE 142 53 (Sept 1 1938)
[2] NATURE 142 77 (July 9 1938)

Points from Foregoing Letters

A MAP showing the percentage distribution of the common guillemot, *Uria aalge*, having a white circle around the eye (bridled form), at various points around the coast of the British Isles, is submitted by H N Southern The bridled form apparently depends on a single gene difference and the survey of its cline gives important information as to the process of species differentiation

The preparation of tellurium tetrafluoride, which on account of its reactive behaviour with glass and silica and its instability in the presence of traces of moisture had not been isolated previously, is described by G A R Hartley, T H Henry and Prof R Whytlaw Gray

From the finding that the greater part of the sulphate (containing heavy oxygen for identification purposes) which had been injected into a rabbit was afterwards recovered unchanged in the rabbit's urine, A H W Aten, jun and Prof G Hevesy conclude that only a small part of the ingested sulphate ions exchange with the sulphate ions already present in the tissues

The distribution of phosphorus in the leg bones of normal and rachitic chickens has been investigated by Dr M J L Dols and Prof B C P Jansen in collaboration with Prof G J Sizoo and G J van der Maas A radioactive isotope of phosphorus was used as an indicator The phosphorus metabolism seems to be greater in the rachitic birds than in the normal chickens, and it is greater in the epiphysis than in the diaphysis of the same bone These results were confirmed by radiographs.

From the cell free solution of *B fluorescens liquefaciens*, Prof A I Virtanen and J Erkama have obtained a mixture which seems to contain two new enzymes one of these catalyses reversibly the reaction aspartic acid ⇌ fumaric acid + ammonia and the other leads, through hydrolysis, to the irreversible deamination of aspartic to malic acid

Dr Dorothy Wrinch describes a new procedure for deriving the crystal structure from the intensity maxima in X ray diagrams and shows how this can be applied in the case of insulin to derive from the vector diagrams the cage structure based on the cyclol hypothesis

A table showing the concentration of positive and negative ions in the air, as affected by air conditioning in closed buildings, is given by Dr F Běhounek and J Kletschka There is a large temporary increase in the number of negative ions due to the break up of water droplets, but this is soon reduced by the action of the walls and other objects in the room

H J Groenewold finds that the maximum in the velocity of sound in helium I is connected with the rise of c_p/c_v above the λ point

Commenting on Prof Scripture's statement that vowel sounds cannot have been produced by resonance, Sir Richard Paget recalls some of the evidence in favour of the resonance hypothesis and offers the loan of some of his resonators to make profiles of the artificial vowel sounds for comparison with those of human speech

Dr R A R Gresson has centrifuged the ovaries of the mouse in the Beams ultra centrifuge The cytoplasmic inclusions and components of the oocytes are stratified according to their specific gravity An examination of oocytes of different ages indicates that there are changes in viscosity correlated with the growth of the egg Treatment with Sudan IV failed to reveal the presence of fat in the centrifuged egg of the mouse

Mr R A C Wilks recommends sodium hexametaphosphate in aqueous solution as a decalcifying fluid It acts rapidly and has the advantage over other fluids of replacing insoluble calcium by soluble sodium compounds without the evolution of gases, thus enabling delicate histological structures to be preserved without distortion

Research Items

American Indian Place Names

Dr John P Harrington has been engaged in an investigation of the origin and meaning of some well known American place names of Indian derivation A preliminary report issued by the Smithsonian Institution, Washington deals with certain of his results Utah, it has been assumed generally was taken directly from the tribal name the Utes of the people who lived in this territory originally This, however, was not their own name for themselves, but one bestowed upon them by the Navajos and Apaches In Navajo linguistics, it would appear the term is derived from the word for upper and the name means the upper people, hill dwellers or highlanders Cheyenne is a direct derivation from the Sioux word meaning barbarian', or one who does not speak our language It may have conveyed dislike or contempt as the Sioux regarded the Arapahos, Crows and others in the Cheyenne River valley as intruders into territory which did not belong to them Tacoma is a mispronunciation of Puget Sound Indian for snowy mountain, Ta ko bed, a name applied to Mt Ranier, Mt Baker Mt Hood and Mt McLaughlin, which early settlers mistook to be a specific name for Mt Ranier Seattle at present is unexplained It derives directly from Seh Ahl', the name of an influential Indian at Lake Union, but names of individuals usually had some definite meaning In this instance, it defies analysis Manitoba is relatively easy It means land of the spirit, and comes from the Algonquin word Manitoowa', meaning spirit It was a generic term, identical with the term manitu in eastern dialects

Swineherds Disease

E Fried (*These de Paris* No 139 1938) who records three illustrative cases in men aged 27, 28 and 29 years, states that this new infectious disease which is also called swineherds benign meningitis, swineherds meningo typhoid and fruiterers disease, has hitherto only been found in certain parts of France (Upper Savoy) Switzerland and Italy, where it has been described by Bouchet (1935), Muller (1932) and Penso (1934) respectively It is an occupational disease which affects both sexes equally The pig is the probable source of infection either directly by its dejecta or indirectly by an intermediate host such as the louse The disease has been reproduced experimentally in man and in certain animals besides the pig, such as the rat, cat, ferret, monkey and mouse The pathogenic agent is a filterable virus which is found in the blood between the second and sixth days of disease, and is eliminated in the urine and fæces The cerebrospinal fluid is much less virulent than the blood The virulence of the brain, spleen and liver has not yet been determined The disease runs its course in three successive stages The first is characterized by moderate fever, vomiting, diarrhœa and a polymorphous eruption Then follows a period of remission in which the fever and other symptoms subside In the third stage the temperature rises higher than before and a meningeal syndrome develops Spontaneous recovery takes place, and no sequels ensue

Nature of Lachrymatory Substance in Onions

According to Science Service, E F Kohman has suggested at a meeting of the American Chemical Society at Milwaukee, September 1938, that the lachrymatory substance in onions is aldehydic Mr Kohman suggests that these aldehydes may account for the putative value of the vegetable in cases of colds, as a palliative for rheumatism and arthritis etc Pre treatment of the seeds with formaldehyde controls smut disease in onions, after planting Kohman suggests that these aldehydes are developed the onion itself thus maintaining its resistance

Rodents from Galapagos Islands

The native species of Galapagos rodents belong to two closely related genera *Oryzomys* and *Nesoryzomys* of which all the endemic species known to occur in the island were represented in the California Academy of Sciences Expedition of 1905 6 with the one exception of *O galapagoensis*, which has not been taken since Darwin's visit in 1835 Re examination of the Expedition s collection by Robert T Orr has brought several new facts to light (*Proc California Acad Sci*, Ser 4, 23 303, Sept 1938) Two examples of *N darwini* from Indefatigable Island bring the known examples of that species in collections up to six From James Island from which no mammals had previously been recorded four specimens of *Nesoryzomys* were obtained, and these present characters sufficiently distinct to warrant the creation of a new species, *N swarthi* which the author describes The type specimens were collected in July 1906, and since more recent expeditions have failed to collect this species, the possibility exists that it may now be extinct as the result of competition with introduced Old World rats Examples of *Rattus rattus alexandrinus* were obtained on James Island during the visit which produced the native species

Internal Fluid of Ascidian and Sea Water

The resemblance in composition between internal fluids and sea water is further illustrated by an analysis of the Pacific Ocean ascidian, *Chelyosoma siboja*, by Satarô Kobayashi (*Sci Rep Tôhoku Imp Univ*, Ser 4, 13, 25, 1938) In this case the inorganic composition of the perivisceral fluid which surrounds the heart almost exactly corresponded with that of sea water at the Biological Station of Asamushi although there were slight discrepancies as regards potassium and magnesium The freezing point depression, 1 95, was also almost identical with that of sea water On the other hand, the composition of the perivisceral fluid differed remarkably from that of the blood fluid (body fluid), especially of the corpuscle fluid as formerly described by the same author The body fluid in the test arises from the blood vessels distributed in the test and in the soft body, and the blood sinus on the ventral side of the ascidian body is the connecting link between the two groups of vessels. Although in the cartilaginous test no trace of acid was detected, both test fluid and blood fluid gave an acid reaction, and the source of this acid appeared to be in the cell sap of the relatively large vacuolated vesicular cells in these fluids

Cave Fauna of Yucatan

An interesting quarto memoir on this subject has recently appeared as Carnegie Institution of Washington Publication, No 491 (June 1938) With an introduction by Mr A S Pearse, of Duke University, there follow some twenty three articles by a panel of specialists on the various animals collected in these caves, together with a short account of the fungal flora The Yucatan caves, it may be added, were visited by Mr Pearse in 1936 Altogether twenty seven were examined, and most of them are of the so called two cycle solution type and occur below ground water level, being formed by the passage of water which contains carbon dioxide, through limestone Their form is irregular with high vaulted chambers and without evidence of streams or large pools Some other of the Yucatan caves are evidently produced by faults while the limestone sheet which forms this peninsula was being elevated More than three hundred species of animals were collected in these caves by Mr Pearse and of these 78 are described as new in papers in this memoir, as well as 19 new genera About one tenth of the fauna encountered were troglobites or exclusively cave types One fifth of the animals were troglophiles, or those which live in caves and may breed there but live outside also The others were trogloscenes, or animals which occur in caves as accidental guests but may live indefinitely outside these number about seven tenths of the fauna Among the important troglobites of Yucatan are arthropods and vertebrates —shrimps, isopods, millipedes, chelonethids, spiders, collembolans, crickets, ants, together with a brotulid fish and a symbranchid eel

Evolution of Annelida, Onychophora and Arthropoda

In an informative and stimulating publication R E Snodgrass (*Smithsonian Misc Coll*, Aug 1938) has set forth in considerable detail his views on the evolution of the Annelida, Onychophora and Arthropoda To do this he has considered in sufficient detail to support his thesis and to allow of a discussion of metamerism, the development of non specialized members of the three groups Further the structure of the adult is considered, system by system, fully enough to permit discussion of the homologies of various organs in the different groups and also those organs which, while superficially resembling one another, cannot be regarded as homologues Certain lines of divergence from the generalized examples are also indicated All this is done in a critical manner and illustrated by 54 figures, a number of which include as many as six or seven drawings, some original but most taken from other authorities To document the statements, a reference list of 173 works is provided, this includes the most recent and the most important papers The last part consists of what the author terms phylogenetic conclusions, and this occupies 16 pages and is divided into 25 paragraphs Here are set out clearly and succinctly the deductions drawn from the data furnished in the preceding pages and a suggested phylogeny of the groups The author postulates as an ancestral form a planula like organism with a posterior blastopore This by adopting a creeping habit is presumed to have become elongated, and as a result of creeping on the blastopore surface this aperture became correspondingly elongated The mid region of the slit then closed up, leaving an opening at each end, a subterminal mouth anteriorly and a terminal anus posteriorly, and *connecting the two an alimentary canal* Henceforward the transformations into the three groups are followed by more close reference to actual developmental or adult conditions

Soil Organisms and Seed borne Pathogens

A brief but interesting note by A W Henry and J A Campbell (*Canadian J Res* 16, No 9, Sept 1938) directs attention to an aspect of the natural fauna and flora of the soil which is certainly not usually held in mind Two diseases of flax, the browning caused by *Polyspora lini* and the anthracnose disease, *Colletotrichum lini*, are both frequently carried by infected seed The authors supply very definite evidence that the infection of the crop from this source is much heavier when it is sown in sterilized soil than in untreated soil The reduction in infection thus brought about by the natural action of other soil organisms is indeed more effective than pre treatment of the seed with various sterilizing agencies, unless this treatment is so drastic as itself to reduce very considerably the germination of the seed On the other hand, preliminary experiments with certain smut fungi, causing bunt of wheat, suggest that in this case the natural soil does not inactivate the seed borne pathogens, so that the disease may be as prevalent upon plants grown in natural as in sterilized soil

Zygnemales from Northern India

The slowly flowing streams of the plains of the Fyzabad District are rich in species of this group, and Randhawa has made a thorough survey over a period of two years (*Proc Indian Acad Sci* 8, Sect B, 1938) In streams which dry up during the hot weather it is interesting to find that many species do not germinate until some months after the refilling of the water channels The streams contain water from July onwards a few species germinate at the end of August and are prolific by the end of September but the majority of the species do not germinate until December On this basis, the species fall into three groups a small group of late autumn and early winter annuals, a large group of late winter and spring annuals, and a small group of ephemerals This is summarized in a chart which also shows the period of conjugation An interesting species is *Zygnemopsis minutum* The plant is filamentous, but the cells are loosely connected and fall apart prior to conjugation The free floating cells meet and fuse in any direction, giving rise to zygospores of very varied forms This species bridges the gap between Saccoderm desmids and filamentous Zygnemales A useful survey of characteristics used for generic and specific identification precedes the description of the species

New Records of the Larger Fungi

Mr A A Pearson has cleared up several taxonomic puzzles of the larger Basidiomycetes, in a recent communication (*Trans Brit Mycol Soc*, 2, Pts 1 and 2 27–46, Aug 1938) Two new species are described, namely, *Tricholoma inocybeoides* and *Mycena uracea*, and both are illustrated in colour Of most general mycological interest of Mr Pearson's paper, however, will probably be his descriptions of various species of the genus *Russula* in relation to three chemical tests Sulphovanillin, phenol and ferrous sulphate give distinctive colour reactions with many species, and these are included in the descriptions of twelve uncommon kinds Two species of *Inocybe* have been transferred to the genus *Astrosporina* by virtue of their spore characters They are now *A decipientoides* and *A napipes*

Insect Transmission of Maize Streak Virus

Some interesting results of experiments on insect transmission of maize streak virus have recently been published by H H Storey (*Proc Roy Soc*, B, 125 455–477, Aug 1938) Special attention has been given to the part played by puncture of the plant s tissues by the insect *Cicadulina mbila*, in transmission It seems necessary, in this particular host virus combination for the insect s proboscis to reach the phloem tissue in the host, and infections fail if this degree of penetration is prevented artificially Punctures maintained for less than 5 min fail to infect, and it is concluded that the insect inoculates virus in distinct doses Each dose appears to be independent in its effect of any other doses inoculated by the same or another insect The vector can take up virus from the mesophyll in a chlorotic area of a diseased leaf but cannot take it up from either the mesophyll or phloem of a green area Probability of infection, moreover is not diminished by the removal of inoculated leaf tissue shortly after the inoculation so the virus must spread with considerable initial rapidity

Boundary Waves at a Surface of Discontinuity

Prof K Sezawa and K Kanai, in a very valuable paper (*Bull Earthquake Res Inst*, *Tokyo Imp Univ*, 16 Pt 3, Sept 1938), have recently followed up the work of Stoneley on Love and Rayleigh waves (*Proc Roy Soc*, A, 106) by discussing the formation of such boundary waves In this, they have used a method of calculation similar to that employed by A Sommerfeld (*Ann Phys*, 4, 28, 1909) and make the problem two dimensional They obtain equations for dilatational waves, distortional waves in a horizontal plane and distortional waves in a vertical plane paying particular attention to the amplitudes of such waves at both large and small epicentral distances One outcome is that larger amplitudes are to be expected in the horizontal distortional waves than in the other two at all epicentral distances A second is that in the case of dilatational primary waves and distortional primary waves with amplitudes orientated in a vertical plane, the energy of the body waves is converted usually into boundary waves in passing through or in being reflected from a surface of discontinuity In the case of distortional waves with amplitudes orientated horizontally, no boundary wave is formed A third is that the large amplitudes of S_cS which sometimes exist may be explained on the above theory Sezawa and Kanai modestly say that their present work is really only qualitative and that they are investigating the three dimensional problem more rigorously

Corresponding States

In a discussion of an equation of practical interest for gases removed from the ideal state, F G Keyes (*J Amer Chem Soc*, 60, 1761, 1938) has examined the equation $B_0 p_c/T_c = -R\theta f(\theta)$, where p_c, T_c are the critical pressure and temperature, $\theta = T/T_c$ is the reduced temperature, and $B_\theta = \beta - A/RT - (\alpha^2)A^2/(RT)^2\beta^2$, where A, β are constants, α^2 is a quantity which may vary from substance to substance It is suggested that

$$B_{\theta 0} = \beta_\theta - A_\theta/\theta - C_\theta/\theta^3$$

where β_θ, A_θ and C_θ are expected to be the same regardless of substance This has been shown to be the case for a number of different substances, but the value of C_θ is different for non polar and polar substances It is noteworthy that the constants are derived from values of the van der Waals constants, and hence the van der Waals type of molecular field is assumed to be valid It is shown that the reduced equation is useful in making approximate physico chemical calculations involving gases under pressure

Specific Heat—Temperature Relationship of Certain Steels

At the adjourned autumn meeting of the Iron and Steel Institute a paper of very considerable importance was presented by Dr C Sykes and Mr H Evans For many years past, there has been evidence that in commercial iron and steel certain abnormalities occur at temperatures below the carbon change point Dearden and Naesar have found such abnormalities in the specific heat relationship at 120° C Using a very delicate method Sykes and Evans have failed to find this point and it must be accepted that, at any rate in the materials with which they have dealt, no such abnormality occurs in the specific heat With the exception of a slight deviation at the temperature at which the iron carbide becomes non magnetic, all their curves, both for iron and for carbon steels are smooth By introducing into their test pieces small amounts of low melting point metals of known latent heat, they have proved that changes of the order of those previously observed could not have been missed with the experimental technique which they have employed It is pointed out, however, that these results are not necessarily incompatible with abnormal changes in the mechanical properties of the materials

New Diffraction Gratings

Prof R W Ditchburn, of the University of Dublin has recently discussed the problem of diffraction by gratings with irregular spacings and finds that they may be designed so as to give with fewer elements the same resolving power as gratings with equal spacings (*Proc Roy Irish Acad*, 44, A 1938) For echelon gratings with an even number of plates, each plate of thickness a small multiple of a fundamental thickness, and the plates equidistant from the middle plane of the grating of the same thickness, he shows that the diffraction pattern produced may be predicted without much difficulty Thus for an echelon which would normally have 56 plates if each 13th plate from the centre plane be of the normal width but of 7 times the normal thickness so that it replaces plates 7 to 13, the 20th plate and the 27th plate of three times normal, and the inner part of each widened step be covered by an opaque screen which reduces the transmission width of the step to the normal width, the resolving power of the 36 plate echelon produced is equal to that of a 65 plate echelon of the usual type A similar improvement of the plane ruled grating is produced by ruling groups of about 50 lines with the centres of the groups at certain irregular specified distances apart, which leave unruled spaces between groups, and the unruled spaces are covered by screens, 60 per cent of the ruling is saved and the resolving power of the grating is increased 10 per cent

The Present Position of Sociology*

IN considering the achievement of sociology, the principal problems can be set out under four heads

Social Morphology, including (1) the quantity and quality of the population in so far as this affects social relations and the character of social groups, and (2) social structure, that is, the classification and analysis of the principal types of social groups and social institutions

On the qualitative side, early studies were dominated by the hypothesis of racial differences in mental character without realization of its difficulties Their successors are represented by the eugenists and the numerous race theories of civilization, although it is probable that culture is independent of race, and that changes in social structure do not depend on changes in inherited structure It would appear from studies of the distribution of intelligence in the various social groups that there is no conclusive evidence of genetic difference between the social classes A good deal of work has been done on the question whether the existing difference in fertility among various social groups is likely to affect the inborn constitution of the stock Since the differences between the groups are not genetic, the dangers of deterioration on this score are not great There is no reason to believe that the lower social grades are being drained of ability through the operation of the social ladder Studies of social mobility lead to the conclusion that conditions making for greater mobility would also make for greater equality in the distribution of wealth, and differential fertility, so far as it is conditioned by varying standards of life, would tend to disappear A social system which is based on justice and equity would, on the hypothesis of genetic differences, be the most eugenic of agencies

The subject of social stratification has recently attracted attention widely It is now possible to give estimates of the proportions of the social classes in the different European countries The proportion of middle class in Germany is about 34 per cent of the occupied population, in France about 40 per cent, and in England about 25 per cent, though these figures are not comparable, owing among other things to the differences in the number of peasant proprietors in these countries, while in England since 1881 the ratio of increases of the middle class is placed by Prof Bowley at 100 195, as against an estimate of the ratio of increases of the working classes of 100 168—an interesting commentary on the theory sometimes urged that the middle class is in process of elimination An interesting result of recent studies in social mobility is the relatively caste like character of the higher ranges in the world of business In Germany, in the main, big industrialists, big business leaders, and big landowners are self recruited, while in America, too, big business is increasingly self-recruited, and tends to become caste like, the self-made man now being rare It is generally recognized that one of the major sources of instability in modern democracy is to be found in group conflicts represented in the multiplication of political parties and in the drastic measures taken in authoritarian countries to abolish all parties save one The position of the middle classes is of special importance in this connexion as is the whole problem of occupational restratification, which has evidently been going on in Europe since the Great War

Social Control The sociology of social control is at bottom part of the sociology of social structure, since clearly a great deal of the structure of society consists in the norms regulating and controlling behaviour in law, morals, religion conventions and fashion To the sociologist, the most important types of problem are the differentiating characters of the norms the conditions under which they arise, and their influence on social conditions and on one another while important psychological problems are connected with all

There are many who think that the chief difficulties that confront the modern world in the effort to bring about some form of unity among classes and peoples are due to different valuations that are found among them Others hold, on the contrary, that with regard to the fundamental ends of life there is general agreement, and that the clash of contradictory opinions relates rather to the means which have to be adopted in order to attain these ends It is surely of the greatest importance to ascertain wherein the difference really arises, and this is not possible without a careful study of the actual beliefs and behaviour of individuals and groups, and a careful discrimination of the factual from the valuational components of moral judgements

Social Process In evolutionary sociology, among points which appear important are First, that sociologists have not yet succeeded in establishing any general laws of social evolution, though this is not to say that significant trends do not occur There has been, for example, an enormous process of unification, including increase in the size of political aggregates and in intercommunication and interdependence, political and economic, and possibly, despite cultural diversity, an underlying assimilation, or convergence, in science, art, religion, and culture Secondly, there is an increase in the command of the conditions of life, intensified by increasing knowledge of Nature, including mind and society Thirdly, various experiments have been made in reconciling order with freedom, and there has emerged in the consciousness of man the sense of the unity of mankind and the need for reconciling the requirements of order and liberty on a world scale Fourthly, if development has occurred in the history of humanity, it has certainly not been automatic or rectilinear, and its continuance in a given direction is not secured Fifthly, if development has occurred, it has been uneven, and advance in one direction has often constituted a hindrance to advance in others

Increase in the scale of organization has often been achieved at the cost of freedom, and collective efficiency may result in stultifying and thwarting the deepest needs of individuals The growth of knowledge and the command over the conditions of life has also been extremely uneven. Our powers over inorganic Nature are much greater than our powers over life, mind and society, and since the former may be used for purposes of destruction there is danger that before mankind has acquired sufficient knowledge of the causes of social change and sufficient moral wisdom to use it aright the whole structure may be wrecked and the work of organizing mankind may have to be begun all over again. Scale of organization is of especial importance at the present time.

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* Substance of a paper by Prof M Ginsberg to Section F (Economics) at the Cambridge meeting of the British Association read on August 19, 1938

Self development even on the part of large communities is becoming more difficult and precarious. This infinitely complicates the problem of reconciling order with freedom. Both logical and historical analysis suggest that efficient control over the forces of external Nature and of the inner nature of man must rest upon an organization on a world scale and must rely on methods which can call forth the spontaneous responses of all its members in the service of ends they can recognize as common.

Social Pathology This brings out the complexity of social causation and the importance of bringing together the results of different modes of investigating and interpreting social phenomena. Taking one example only the study of cause of crime has to be approached by way of broad social and economic studies, such as (1) correlating various types of crime with social and economic variables such as price rate of commodities, density of population, rural and urban conditions of life, etc, (2) genetic studies and (3) individual case study, to which belong therapeutic methods of psychopathology. So little has been done to view the facts in relation one to another that at different times undue prominence has been given to one or other factor in the causation of crime. To the sociologist taking a broad view it is clear that no invariant relation can be established between any single factor and crime while these factors in themselves are complex and by no means independent. There are signs that the sociological method of approach is beginning to influence the study of crime both in Great Britain and in the United States.

Agricultural Research in India*

THE Imperial Council of Agricultural Research was set up as a result of the Royal Commission on Agriculture in India in 1926. One of the conditions laid down was that the Council's activities should be periodically reviewed by some disinterested expert, and in 1936 Sir John Russell was invited to make an extensive tour of the provinces with this end in view in so far as plant industry was concerned.

Sir John's report has now been published. The volume is divided into two parts, the first of which describes the type of agriculture, the crops and the factors which make for improvement in their yield, the special difficulties confronting Indian agriculture and the machinery for dealing with them. In the second part of the report, the various research schemes fostered by the Council and in progress throughout the country are described in detail.

Agriculture in India is not merely an industry but also the mode of life of a large part of the population, and in consequence the scope of the Council's activities is of a far reaching nature. Village improvement is in fact an essential preliminary to any fundamental advance in agriculture. The gulf that separates the experiment stations and the few large scale farmers from the peasants, who cultivate the largest proportion of the land, needs to be bridged, and this is rendered peculiarly difficult to effect owing to the absence of the educated middle class farmers, who form such an important section of the farming community of the West.

A vast amount of pioneering work has been successfully accomplished by the Council since its formation, and the necessary extension now lies in the co-ordination of theory with practice, that is, work in the field rather than in the laboratory, increased productiveness being always the central problem. The great increase in the area under cash crops such as cotton, sugar cane and tea compared with that under food crops, is one of the most remarkable features of modern Indian agriculture, and although much progress has been made both in their production and utilization particularly in the case of sugar cane, greater co-operation with the buyers is desirable. Advances in this direction have already been made in the case of cotton and tea, as each crop has its own research station which is in touch with the appropriate buyers. Similarly, work on food crops needs to be carried out in association with nutrition experts and inquiries made into the possibilities of extending dairy husbandry and fruit and vegetable growing if diet is to be raised to a more satisfactory level.

In view of the supreme importance of water supply the establishment of a separate research institute for the study of irrigation and water relationships between soil and crops is deemed desirable. The proper unification of dry farming schemes is, of course, equally important. Questions concerning soil erosion and alkali trouble might well be dealt with by a soil conservation committee, which could also usefully collect and collate results of manurial trials and soil analyses. Similarly, matters relating to crop planning schemes and insect and fungus pests might be in the hands of a crop production committee which would provide a convenient central body for co-ordination. Special problems such as locust control, on the other hand, need their own organization, and in spite of the fact that invasions only occur sporadically, a permanent service seems eminently desirable so that immediate action may be taken when the need arises. The Imperial Agricultural Research Institute recently opened at New Delhi will, no doubt, play a specially important part in the co-ordination of the Council's schemes, and its programme be largely determined by the most pressing problems of the moment. A number of questions to which it could usefully give attention are suggested in the report.

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* Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India (Delhi Manager of Publications 1937)

During his tour, Sir John Russell visited more than forty experiment stations and inspected nearly ninety research schemes, in most cases discussing the work with the individual in charge The posts under the Council's schemes are of temporary nature only and a plea is made for the provision of a number of permanent appointments, to be filled gradually by selected investigators of proved ability By this means, specially experienced men would be available to deal with difficult problems at the various stations, where local resources were inadequate Such a scheme would inevitably necessitate an increase in the financial grant made to the Council, but the return in enhanced efficiency would seem to justify this

Much of the research in agricultural science in India is not so widely known as it deserves to be, due largely to the practice of publishing results in a number of small communications The preparation of a series of monographs by competent persons is suggested, setting forth the results obtained by Indian workers and pointing out how they differ from those obtained elsewhere Such publications would greatly raise the prestige of Indian research work and also prove of value to teachers and research workers throughout India itself

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Radio Transmission and the Ionosphere

MARCONI'S discovery that radio waves followed the curvature of the earth indicated that the signals were reflected back to earth by an electrified condition of the upper atmosphere In 1925 Prof E V Appleton in England and Breit and Tuve of the Carnegie Institution (U S A) gave definite experimental demonstrations of the existence of such a mirror

Since these experiments were made research on the electrified region of the atmosphere, called the ionosphere, has made great progress It is now known that several distinct layers of ionization exist The first, called the E layer, is at a height of about sixty miles and is capable of reflecting fairly long waves The second called the F_1 layer, is capable of reflecting shorter waves, at a height of about 120 miles, and the third the F_2 layer, reflects still shorter waves at a height of about 180 miles The ability of these layers to reflect radio waves depends on the number of electrified particles present, either electrons or electrified air molecules In an article communicated to the *Radio Review of Australia* of June by a member of the staff of the Carnegie Institution, it is described how the ionosphere affects radio transmission

The author refers to the recent discovery by Dr J B Dellinger, of the U S Bureau of Standards, of sudden fade outs of high frequency radio signals on the daylight side of the earth, and that these fade outs were connected with the hydrogen prominences which sometimes appear on the sun It is believed that all these fade outs occur simultaneously with solar eruptions When a fade out occurs, no reflections are obtained from the E, F or F_1 layers It is just as if one were looking into a looking glass and suddenly the reflection disappeared The cloud of electrons which prevent the waves being transmitted may be considered as a 'blanket covering the entire daylight hemisphere of the earth at a height of 40–60 miles

A very pronounced fade out occurred in April 1936, a sudden brightening was observed in the region around a spot on the sun One minute later radio reflections from the ionosphere ceased and a large change also occurred in the earth's magnetism and in the earth currents The heights of the reflecting layers recorded at the Carnegie Institution's observatories in Peru and Western Australia and by other organizations, serve to indicate the nature of the effects produced.

The improved quality of the ionosphere during times of sunspot activity makes a greater range of wave lengths available for long distance transmission Unfortunately, times of sunspot maximum are most favourable for the occurrence of magnetic storms These storms are believed to be due to swarms of ions and neutral corpuscles ejected from the sun with such speed that they reach the earth in about a day Impinging on the atmosphere, these corpuscles give rise to auroral displays in high latitudes and seriously impair radio communication, when the path of the radio waves passes close to the radio zone —a region about 20 from the geo magnetic pole Most of the radio traffic between the United States and Europe traverses such a path, with the result that on days of great magnetic disturbances those radio circuits are never available

On the other hand, radio traffic between the United States and points in South America is not seriously impaired by magnetic disturbance An ingenious application of this fact was made by one of the commercial companies during the severe magnetic disturbances on April 24 28 1937 Radio messages intended for European points were routed' through the company's station in South America and retransmitted to Europe, with the result that communication was maintained throughout the disturbance

Another interesting application of scientific knowledge concerns the scheduling of trans Atlantic broadcast programmes Research has shown that times of magnetic disturbances tend to recur at 27 day intervals, corresponding to the period of rotation of the sun On this basis, it is possible to predict a month or two in advance the days that are likely to be unsatisfactory for long distance transmission and the days that are likely to be satisfactory International broadcasts, scheduled for pick up by one of the large networks, are arranged so far as possible to come when no magnetic storms are expected

The means by which magnetic storms affect radio transmission is not clearly understood The effects of magnetic storms on radio transmission are markedly different from the effects produced by the ultra violet light from solar prominences While storm effects are most strongly manifested in high latitudes, the fade outs are most pronounced near the equator Furthermore, the fade outs occur only during daylight hours, while the storms disturb radio transmission on both the day and the night sides of the earth

Acid and Basic Open-Hearth Steel-making Practice

THE annual meeting of the Iron and Steel Institute held on May 4–6 was devoted to a general discussion of open-hearth steel-making practice. A very large amount of data was brought together from all of the main steel-producing areas of the British Isles, and this material is most excellently summarized. As a result, it has been possible to determine in a manner hitherto impracticable the main factors on which high furnace efficiency depends.

It is confirmed that, within the working limits imposed by the refractory materials, etc., the output of a furnace is directly proportional to the heat input. For furnaces producing ordinary commercial steels, an average of 2 lb. of steel per hour per therm may be expected in the case of fixed furnaces and 1.6 lb. for tilting furnaces. Large furnaces of the latter type show the lowest output of any of those examined, probably on account of the long period of refining required with the high percentages of hot metal employed. On the other hand, such furnaces have the advantage of a much lower consumption of refractory materials than obtains with other types of furnace.

For furnaces of normal port design, a high ratio of the velocity of the gas to the air gives the best performance, which requires that the area of the air port should be at least six times that of the gas port. Where this adequate gas/air velocity is obtained, conventional designs of the ports have given results which are as good as those obtainable with special constructions. Whilst the relative area of the hearth should be large when high proportions of scrap are being used, this factor of design is dependent on that of the ports and on the direction of the flame. On the other hand, when the percentage of hot metal is high and of high metalloid content, deeper baths are employed with correspondingly reduced areas of hearth.

The highest rates of production are shown to be obtained from basic, hot-metal, fixed furnaces, averaging 7·53 tons per hour per 100 tons capacity, a figure which may be compared with 7·46, 6·49 and 5·78 tons per hour for basic, cold-metal fixed; acid cold-metal fixed; and basic hot-metal tilting furnaces respectively. They have, however, a higher average total heat consumption per ton of 86·2 therms as compared with averages of 82·8, 84·6 and 76·7 therms per ton for the other types.

"With our ever-increasing knowledge of the subject the physical chemistry of steelmaking has become of great importance in the operations of steel manufacture, and there are few sections of the industry to-day which have not benefited from the wider appreciation of the possibilities of this branch of applied science." Thus Dr. McCance introduces his paper on the application of physical chemistry to steel-making, in which he surveys the work done by himself and others in Great Britain, the United States and Germany. Starting with a general discussion of the basis on which this work has been built, the paper proceeds to direct attention to the more important conclusions already reached which have a direct bearing on the practice of steel-making by the open-hearth processes. The reduction of oxides by carbon, the manganese and silicon reactions; the reduction of manganous oxide by silicon, the reactions due to sulphur compounds and those in which phosphorus are involved are considered in turn, together with the question of ingot cracking.

Although the paper is unsuitable for further condensation here, it may be said without fear of contradiction that it represents the most substantial attempt ever made to consider any process of metallurgical production on a really scientific basis.

F. C. T.

Scientific and Industrial Research in Canada

THE twentieth annual report of the National Research Council, Canada, covering the year 1936–1937[*], contains the report of the president of the Council as well as reports from the various divisions. Even the president's brief review of the organization of research, both pure and industrial, indicates that the work of the Council makes contributions to the progress of industry in Canada comparable with the contribution of the Department of Scientific and Industrial Research in Great Britain. The Division of Biology and Agriculture is devoting considerable attention to studies in the storage and transport of food. Valuable information obtained by visits to Europe during the year is being applied to the improvement of export trade arrangements. Simple and rapid methods have been worked out by the Division for determining the probable effectiveness of weed killers by their effect on the rate of growth of plants in water culture. A new method of experimental malting has been developed which seems to give the true value of varieties of barley, even though these require widely different malting conditions to give the best results. A new paper box packing has been developed for storing and shipping poultry, which can be sealed conveniently to prevent loss of moisture and the danger of freezer-burn. Apparatus has been developed for accurate measurement of atmospheric humidity at low temperatures and when only small amounts of moisture are present in the air. Work has been carried out on the relation of bacteria to the curing and to the uniformity of cured bacon, and other work has been carried out by the Division on the baking quality of wheat and in co-operation with the Canadian National Railways on a method of heating refrigerator cars which has led to the development of an underslung charcoal heater.

The Division of Chemistry has developed a relatively cheap synthesis for α-naphthylacetic acid as well as methods for the synthesis of indolyl-butyric acid and indolyl-acetic acid. A fundamental study is being made of the problem of corrosion, and further work has been carried out on the novel form of distillation, which was invented by the Division, arrangements having been made for the manufacture of the gauze packing Research on plastic casein has also been undertaken and research on the preparation and properties of carbon black from waste gases from the pyrolysis of natural gas has been concluded, while further work has been carried out on the preparation of carbon black by the channel process Work on the use of formalin for the disinfection of seed wheat has been extended to include the study of many organic compounds as seed disinfectants Good progress is reported in work on the fundamental laundrying operation bleaching, as well as in work on the fading of dyed textiles in sunlight, determination of damage to silk by a viscosity method and the regain of raw wool

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[*] Twentieth Annual Report of the National Research Council, 1936–1937. Pp. 182. (Ottawa: National Research Council of Canada, 1938.) 75 cents.

In the Division of Mechanical Engineering, the Aerodynamic Laboratory has carried out tests on models of three service aircraft in the wind tunnel to prove the accuracy of prediction of the performance of aircraft from the results of wind tunnel tests Comprehensive wind tunnel tests have also been made for a Canadian aircraft building firm in connexion with the development of an aeroplane being designed specifically for commercial service in Canada Measurement of hydrodynamic forces on stop logs for emergency dams in ship canals was a new and interesting study commenced during the year Other problems under investigation include the work on fire hazard testing farm windmills, gasolene specifications aircraft instruments and the inspection and labelling of oil burners The Division of Physics and Electrical Engineering has undertaken fundamental work on light, sound, heat and electricity as well as standardization in these and in related fields The development of an improved and highly satisfactory means of heating refrigerator cars in winter which makes it possible to maintain uniform temperatures in the cars is now being taken up commercially Studies in heat transfer are being applied to the tests in insulating material and to the investigation of heat conservation qualities of textiles used for clothing Tests are also being made to determine the sound absorptive properties of building materials and the proper design of rooms for the best acoustical effects Other experiments have been concerned with electrical methods of packing poultry in preparation for marketing A second cathode ray direction finder was built during the summer and a development programme to adapt this type of radio direction finder to commercial service has been undertaken

In addition to the work of the various Divisions, important work has been carried out through the joint or associate committees, including research on the breeding of rapid growing rust resistant strains of wheat, oil seeds research, feeding stuffs research, investigations on seed treatment with formaldehyde, on the effect of environmental factors on wool, on deficiency diseases of sheep, on asbestos, etc The Associate Committee of Parasitology has been responsible for studies of liver fluke disease, warble fly eradication anthelmintics etc

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Explorations of the Smithsonian Institution, 1937

IN the annual review of the research activities in the field of the Smithsonian Institution, Washington, D C (*Explorations and Field Work of the Smithsonian Institution in 1937*' Pp 122), a preliminary announcement is made of the results of twenty four expeditions, for the most part in geology, biology and anthropology Some of these were financed wholly by the Institution, others were cooperative undertakings with institutions interested in the promotion of those respective branches of science Most of the expeditions in 1937 were within the American continent, including the West Indies Of the expeditions to other continental areas, Mr H G Deignan describes an exploring expedition to Siam for the purpose of observing and collecting specimens of the fauna

An expedition to the East Indies in conjunction with the National Geographic Society led by Dr W M Mann visited Sumatra, Amboina, the New Guinea coast, Java, and Singapore, collecting living animals, birds and reptiles for the National Zoological Park The minerals of Russia were investigated by Mr E P Henderson, who visited the Kola Peninsula before attending the International Geological Congress at Moscow The American expeditions and investigations included catching walrus pups in Greenland and moose hunting in Alaska, collecting insects in the West Indies and Virginia, fossils in Michigan, Utah, Arizona and elsewhere, and studies of the Montagnais-Naskapi Indians of the St Lawrence river

Among the archæological investigations an account is given by Mr David I Bushnell, jun, of an ancient site on the banks of the Rapahannock in Virginia, exposed by flood water in the early months of 1937, which produced stone implements of varied types and pottery bearing the impression of coiled basketry, considered to be the oldest form of pottery found in the Rapahannock valley Other village sites of a similar character and exposed by the same agency, were visited, which suggest that much instructive evidence would be obtained by systematic excavation Further investigations on the Lindenmeier stone age habitation site in northern Colorado have produced evidence of importance relating to Folsom man, though the skeletal remains of this early type of man in America still evade search Dr F H H Roberts, jun, who describes the results of his investigations here in 1937, records the discovery of a number of anvil stones still *in situ*, on which Folsom man manufactured his implements and cracked bones for marrow, as is shown by the fragments of various kinds of stone and bone found in the surrounding ground The stratified deposits show that the site was occupied after the climax of the Wisconsin period, but within the late Glacial, when a colder and moister climate, which was responsible for the heavy soil zone overlying the evidence of occupation, was approaching Dr Aleš Hrdlička adds details relating to his investigations in the Aleutian islands of the problem of the migration of early man into America further to those already reported (see NATURE, 140, 577)

Science News a Century Ago

Methods of Using the Theodolite

Before the Society of Arts for Scotland, on November 28, 1838, Edward Sang, a civil engineer and machine maker of Edinburgh, read a Notice of an Erroneous Method of using the Theodolite with a Strict Analysis of Various Arrangement of Readers When conversing with one who had been engaged on the Ordnance Survey, Sang learned of a peculiar arrangement of the readers which existed in some of the instruments used Expressing the opinion that the method was erroneous, he developed an analysis and submitted it that it might help to remove that blind reliance on the authority of names which was too prevalent The errors, he said, would not visibly affect maps of counties but they were high enough to render inaccurate determinations of the degree of meridian In the course of his paper he said Mere opinion has too long held the place of accurate study in the construction of angular instruments In particular, the question whether the method of repetition or that of frequent readings, be preferable, had been discussed with almost national warmth Repeated observations were French single observations were English, as if there be national scientific creeds

The Botanical Society

At the anniversary meeting of the Botanical Society, held on November 29 1838, the report of the council showed that 48 members had been elected since the last anniversary and the total number was 98 The number of British plants received amounted to 18 592 specimens including 1,050 species The foreign plants received amounted to about 10,000 specimens including about 4,000 species The distribution of British plants, it was stated, would take place in January, when each member would receive such of his desiderata as were in the herbarium, in proportion to his contribution

The Royal Society

At the anniversary meeting of the Royal Society on November 30, 1838, the Marquis of Northampton was elected president, while Sir John William Lubbock was elected treasurer, Roget and Christie, secretaries and Capt W H Smyth, foreign secretary The Copley Medal was awarded to Faraday, the Rumford Medal to J D Forbes, and the Royal Medals to H Fox Talbot and Thomas Graham

Macroscelides

'The curious insectivorous mammal called macroscelides,' said the *Athenæum* of December 1, 1838, "which inhabits the rocky mountains of the western part of the district of Algeria, has recently been observed by M Wagner It inhabits the crevices of rocks, and makes its bed in the underwood of the dwarf palm, it eats the larvæ of insects, grasshoppers and terrestrial mollusca, introducing its rostrum into the snail shells before the animal has time to retreat It is remarkably gentle, only expressing uneasiness by a low sound, something like a sigh It raises itself on its hind legs when it hears any sudden noise, and also leaps upon its prey, but never walks solely on two legs like the Jerbra It disappears in the rainy season and during the great heat"

Societies and Academies

Paris

Academy of Sciences (*C R*, 207 693–752
Oct 24, 1938)

D Riabouchinsky Supersonic analogy of the electromagnetic field

L Roy Analogy between the forces exerted on currents and magnetic forces

J Cabannes Water of crystallization of gypsum Examination of a single crystal in ordinary light shows valency oscillations of the molecule H_2O without the complications of liquid water

M Lugeon Geological observations in Antolia

W Dœblin Kolmogoroff s equation

G Tzitzeica Certain deformations of superior order

G Pólya Indetermination of a problem akin to the problem of moments

S Bergmann and M Schiffer Bounded families of functions of two complex variables in domains with a *surface remarquable*

G Roux Measurements of the intensity of gravity in Morocco A Holweck Lejay pendulum was used

O Sing Mo A theorem of Lord Rayleigh [relating to the stability of fluid movements]

I Reingold Energy study of combustion at constant volume imaginary and real combustion

T De Donder and J Géhéniau Internal tensions and the dynamics of the radiating electron

P Barchewitz and G Costeanu Absorption spectra in the very near infra red (6,000 10,000 A) of ammonium salts

B Kwal Initiation of an ephemeral electric discharge by ionizing radiation in tubes with plane parallel electrodes

G Brooks Relation between fluorescence and the chemical constitution of laccol, moreacol and their derivatives These polyphenols represent a new type of fluorescent body in which fluorescence is connected with the double bond of the C_{16} side chain

Mme M Freymann, R Freymann and Y La Absorption spectra in the near infra red and Raman spectra of ammonium salts

A Lassieur Apparatus for the microdosage of carbon in ferrous metallurgical products

C K Lin Structure and absorption of benzoyl benzoic acid and its derivatives

R Duschinsky Rotatory power of citrulline synthesis of the optically active product

J Fejfer and M Jahoda Double crystal spectrometer with photographic registration, and the measurement of the imperfection of crystals

J P and P Destombes The Albian of Pays de Bray

P Lesage Researches on the inheritance of acquired physiological characters precocity Continuation of experiments with *Lepidium sativum* which maintain early development acquired at a higher temperature when grown at a lower temperature Similar results were obtained with a dwarf pea

Mlle V Kovarsky Is it necessary to re-educate left handed persons? Examination of 2,500 children leads to the view that left handedness is a natural phenomenon which does not imply any inferiority, and attempts should not be made to enforce right handedness

H Bulliard, I Grundland and **A Moussa** Detection of the phosphorus of supra renal phosphatides by radio phosphorus Thin sections of tissue are allowed to act on radiological film which shows the area affected by the radio phosphorus

F Kahane and **Mlle J Lévy** Water soluble choline of invertebrates study of the limpet (*Patella vulgata*)

S Nicolau Data on the morphology of the virus of yellow fever and the morphogenesis of the inclusions which it provokes in the tissues

Budapest

Hungarian Academy of Sciences October 24

G Rados Deduced substitution of unitary substitution

K Schaffer Finer anatomy of the cerebellum region of the pyramidal path

A Zimmermann Functional structure of the fascie

F Konek Alkaloid betains (1) The α betain of chinin and chinidin

G Zimmermann Comparative anatomy and embryology of the omentum

K Sasvári Fourier analysis of the crystal structure of $AgMnO_4$

L Buza Dissolution of the blood cell by the leprous bacilli

I Lipka Zero points of power series (2)

Cape Town

Royal Society of South Africa, October 19

A J H Goodwin Skull thickness and external measurements in relation to capacity Research detailing the relationship of skull thickness to internal capacity was described It was pointed out that skull thickness varies from 2 3 mm average to 8 3 mm with a difference in the region of three per cent of capacity for each millimetre of skull thickness Maximum length, plus width, plus supra auricular height is employed in relation to skull thickness to determine internal capacity

P J G de Vos Production of secondary rays in copper by cosmic radiation Cosmic rays produce showers of secondary rays in any matter traversed The density of this secondary radiation increases with the thickness of material traversed, reaches a maximum, and then decreases again A description is given of the reliable counters constructed a high voltage source working from the town supply, and a circuit selecting only the coincident discharges of the counter tubes The thickness of copper under which a maximum of secondary rays occurs can be calculated by means of the theoretical formulæ of Bhabha and Heitler The calculated and experimentally found thicknesses show good agreement The absorption of the secondary rays from copper in lead shows the presence of two components of secondary rays having absorption coefficients 0 69 and 0 30 cm^{-1}Pb respectively

W G Sharples A *coup de poing* factory site from the Nieuwveld A site at Steenkamp s Poort in the Nieuwveld is surprisingly rich in *coups de poing* in dolerite and lydianite Associated with them are a number of flakes and points Many of the *coups de poing* appear to be made from rough fragments of rock Some are typically Stellenbosch and some typically Fauresmith in appearance It is suggested that this is a factory site and that it is an example of Stellenbosch developing into Fauresmith

Moscow

Academy of Sciences (*C R*, 20, Nos 2 3 1938)

G J Khajalia The theory of conformic representation of doubly connected domains

S Soboleff The Cauchy problem for quasilinear hyperbolic equations

S Rossinski (1) Permanent conjugated systems and permanent orthogonal systems of the surfaces of rectilinear congruences (2) Permanent isoclinic systems of the surfaces of rectilinear congruences

S G Michlin Reduction of singular integral equations to the equivalent equations of Fredholm

S A Tchounikhin The Sylow subgroups of simple groups

P M Riz and **N V Zvolinsky** Torsion of a prismatic bar simultaneously subjected to tension

V S Ignatovskij Contribution to the grid theory

N Malkin Propagation of heat in a medium of several layers

A I Alikhanov and **V P Dželepov** (1) Positron spectrum of an active thorium deposit (2) Positron spectrum emitted by lead on irradiation with thorium C″ γ rays

E Konorsky Irreversible and reversible changes of magnetization in ferromagnetics under tension, and mode of increasing magnetic field

V I Likhoff and **V I Pavloff** Method for the augmentation of tension of continuous current with the aid of condensers

M Markov Non elastic dispersion of photons about nuclei with pair production

J I Frenkel Mechanism of muscular activity

V Flofilaktov and **A Oniščenko** Synthesis of oxyproline (γ oxypyrolidine α carboxylic acid)

V O Lukashevitch Azoxy compounds Mechanism of their formation during the reduction of nitro compounds with sodium amalgam

N A Schlesinger, **I B Feigelson** and **A I Spiriagina** Solubility of sodium borates in saturated solutions of sodium chloride in the presence of magnesium sulphate

A T Gladyshev and **J K Syrkin** Equilibrium and kinetics of the formation of oxonium compounds

D M Michlin Hydroxylamine formed in plants in the course of nitrate and nitrite assimilation

D L Talmud Structure of protein molecules and their catalytic properties

S M Manskaya Oxidation processes in wine

P P Avdusin and **M A Zverkova** On the structure of por spaces of arenaceous oil collectors

Dontcho Kostoff Abnormal meiotic processes induced by acenaphthene

R A Masing Increased variability of hetero zygotes for a lethal in *Drosophila melanogaster*

S M Bukasov *Solanum boergeri* Buk —a new potato species from Uruguay

J V Rakitin and **P M Shumova** Degeneration of potato cultivated in the south

A A Yatsenko Khmelevsky Physiological drying of beech timber

N P Glinyany Vernalization of grain at the time of the embryo formation

A N Klechetov Effect of tau saghyz seed treatment with the preparation granosan

I. V. Kozhantchikov Role of metamorphosis in the zonal distribution of insects

B. A Zenkovich Milk of large cetaceans

I I Morosow Inhibition and recovery of the regenerative processes in the extremities of axolotl

J A Vinnikov Growth and transformation *in vitro* of the iridescent portion of the choroid coat (tapetum)

B I Balinsky Determination of endodermal organs in Amphibia

V Fomitchev *Rugosa* corals from the Middle and Upper Carboniferous deposits of the Donetz basin

A I Argyropulo Fauna of the Tertiary Cricetidae of the U S S R

I A Efremov Discovery of a Triassic anomodont in the Orenburg province

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, November 28

University College, London, at 5 30 Prof Jacques Errera Intermolecular Forces and Infra Red Spectroscopy *

Royal Geographical Society, at 8 30 Miss Freya Stark An Exploration in the Hadhramaut and Journey to the Coast'

Thursday, December 1

London School of Hygiene and Tropical Medicine, at 5 —Prof F W Twort, F R S "The Position of Viruses in the Organic World" (Brown Institution Lectures Succeeding lectures on December 2, 5, 8 and 9) *

Chemical Society, at 8 —Discussion on "Aggregation of Ions in Paraffin—Chain Salt Solutions", to be opened by Dr G S Hartley

Friday, December 2

Institution of Naval Architects (at the Institution of Mechanical Engineers), at 6 S S Cook, F R S "Sir Charles Parsons and Marine Propulsion" (Parsons Memorial Lecture)

Geologists' Association (at University College, London) at 7 30 —Prof W W Watts, F R S 'The Work of Charles Lapworth"

Royal Institution, at 9 —Viscount Samuel 'The Scientist and the Philosopher"

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Head of the Engineering Department of Hendon Technical Institute—H M Walton (T) Education Offices 10 Great George Street Westminster S W 1 (December 9)

Research Assistant in Biochemistry in the Imperial College of Science and Technology, Royal College of Science South Kensington, London, S W 7—The Secretary (December 10)

Senior Lecturer in Civil Engineering in the University of the Witwatersrand—The Secretary, High Commissioner for the Union of South Africa, Trafalgar Square, London, W C 2 (December 12)

Lecturer in Mathematical Physics in the University of South Africa—The Secretary

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research Forest Products Research Records No 26 (Seasoning Series No 5) Kiln Drying Schedules By *R G Bateson and R E Hodge* Pp ii+21 (London H M Stationery Office) *6d* net [411

University of London University College Calendar Session 1938 1939 Pp 12 + lxxxi + 612 + 13 22 (London Taylor and Francis Ltd) [411

Machinery Design and the Control of Moth Pests in Factories Pp 32 *2s* n t Factory Fittings Mountings Appliances and Furnishings, with regard to the Control of Moth Pests Pp 40 *2s 6d* net (London British Association of Research for the Cocoa Chocolate Sugar Confectionery and Jam Trades) [711

Battersea Polytechnic Report on the Work of the Session 1937 38 by the Principal being the 45th Annual Report presented to the Governing Body Pp 36 (London Battersea Polytechnic) [811

The Journal of the Institute of Metals Vol 62 Edited by S C Guillan Pp 334 + 38 plates (London Institute of Metals) *31s 6d* [811

Metallurgical Abstracts (General and Non Ferrous) Vol 4 (New Series) Edited by G Shaw Scott Pp vi + 861 (London Institute of Metals) £4 including 2 vols of the Journal [811

Other Countries

Reprint and Circular Series of the National Research Council No 108 Third Report of the Committee on Photochemistry Pp 156 (Washington D C National Research Council) 1 50 dollars [411

Bulletin of the American Museum of Natural History Vol 74 Art 7 The Stingless Bees (Meliponidæ) of British Guiana and some Related Forms By Herbert F Schwarz Pp 437 508 + plates 52 62 (New York American Museum of Natural History) [411

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 90 A Small Collection of Fresh Water Fishes from Eastern Cuba By Henry W Fowler Pp 143 148 Description of a New Carangid Fish from New Jersey By Henry W Fowler Pp 149 152 (Philadelphia Academy of Natural Sciences) [411

New Zealand Annual Report for the Year 1937 38 of the New Zealand Standards Institute Pp 16 (Wellington Government Printer) *9d* [411

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 120 Some Effects of Green Manuring on Citrus Trees and on the Soil By E S West and A Howard Pp 36+9 plates Pamphlet No 84 A Population Study of the Red legged Earth Mite (*Halotydeus destructor*) in Western Australia, with Notes on Associated Mites and Collembola By K R Norris Pp 28 (Melbourne Government Printer) [711

Imperial Council of Agricultural Research Scientific Monograph No 12 Fungi of India Supplement 1 By B B Mundkur Pp iv + 54 (Delhi Manager of Publications) 1 6 rupees *2s 6d* [711

Indian Forest Records (New Series) Entomology Vol 3 No 11 Entomological Investigations on the Spike Disease of Sandal (3) Heteroptera (Hemipt) By N C Chatterjee Pp 213 226 8 annas *9d* Entomology Vol 3 No 12 Immature Stages of Indian Coleoptera (24 Curculionidæ cont) By J C M Gardner Pp 227 262 + 6 plates 1 6 rupees *2s* (Delhi Manager of Publications) [711

Southern Rhodesia Geological Survey Bulletin No 34 The Geology of the Lower Umfuli Gold Belt Hartley and Lomagundi Districts By A F Phaup and F O S Dobell Pp v + 150 + 12 plates (Salisbury Government Stationery Office) *5s* [711

Smithsonian Miscellaneous Collections Vol 97 No 7 The Direct Historical Approach in Pawnee Archeology By Waldo R Wedel (Publication 3484) Pp 21 + 6 plates (Washington D C Smithsonian Institution) [711

Indian Lac Research Institute A Note on the Iodine Absorption by Lac and similar Natural Resins and a Rapid Method for its Estimation (Work under United Kingdom Scheme) By Dr A Karim and Dr Dorothy E Cook Pp 10 2 annas A Study of the Mechanical and Electrical Properties of some Commercial Standard Lacs (Work under United Kingdom Scheme) By Dr A Karim Pp 21 2 annas Annual Report for the Financial Year 1937 38 Pp ii + 43 Bulletin No 28 Conservation of the Baisakhi Ber (*Z Jujuba*) Brood of the Lac Insect and Possibilities of Effecting Better Returns from Lac Cultivation on Ber By P S Negi Pp 14 + 9 plates 4 annas Bulletin No 29 Contribution to the Study of the Bleaching of Lac Part 1 The Action of the Chlorine Bleach on the Resin Constituents of Lac By N N Murty Pp 17 2 annas Bulletin No 30 Shellac Plastics Part 1 Compositions containing Urea By S Ranganathan Pp 8 2 annas Bulletin No 31 Fluorometric Determination of the Acid and Saponification Values of Lac By N N Murty and H K Sen Pp 8 2 annas (Namkum Indian Lac Research Institute) [811

1587–1937, Hortus Academicus Lugduno Batavus, The Development of the Gardens of Leyden University By H Veendorp and L G M Baas Becking Pp 218 (Harlemi Ex Typographia Enschedaiana) 8 60 florins [811

Catalogues, etc.

Aeronautik und Meteorologie in Auswahl Bücher Zeitschriften Abhandlungen (*Antiquariatskatalog Nr 724*) Pp 32 Reine und angewandte Chemie Zeitschriften Sammelwerke, Bücher und Abhandlungen (Antiquariatskatalog Nr 725) Pp 242 (Leipzig Gustav Fock G m b H)

Dent's Almanack No 1 1938 Pp 96 + 16 plates (London J M Dent and Sons Ltd)

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Vol 142 SATURDAY DECEMBER 3 1938 No 3605

The Scientific Approach to Modern Life

THE spirited address in defence of modern youth which Lord Tweedsmuir delivered on his installation as chancellor of the University of Edinburgh in July last has much to commend it to the attention of scientific workers In describing the functions of a university he added one more to the many voices warning us to day that we must zealously defend the freedom and the integrity of our thought boldly facing new conditions ready to meet every problem shirking no difficulty but rigid in our fidelity to the laws which govern our intellectual being

A university Lord Tweedsmuir asserted must transmit and advance knowledge It is not only a seminary for the training of youth but also a museum for record a laboratory for discovery and a power house for inspiration Those duties are closely united for without a centre of creative thought behind them the professions for which the university trains youth will become stagnant and blind

The maintenance of the delicate structure which we call civilization in the face of the destructive forces at work in the world to day is a task to which the university must make an indispensable contribution That task is not rendered the easier by any retreat to the older philosophies Even if we can select one of the older systems as the basis of all learning it is no simple matter to link it up with the multitudinous activities of the modern world, the study of the physical universe and of the infinite ramifications of human society To select arbitrarily a set of first principles and to make all studies subordinate to them is in effect as Lord Tweedsmuir pointed out to establish an intellectual dictatorship and to kill the freedom of the mind

Significantly enough Lord Tweedsmuir suggested that we should aim at giving our youth minds accustomed to think and inspired by a reverence for thought At the same time they must have the perspective created by some understanding of our long human story Only thus can we endow them with what is most needed —confidence and hope He went on to urge the claims of scientific research as a career whether in the service of the universities or industry or of the State Such a career he said offers a life of perpetual adventure and in that field every university can do useful work

There is indeed ample room for the spirit of adventure to day and for the discipline behind it which makes adventure fruitful Conceived in this way scientific research offers a great opportunity for it becomes linked to the development of personality and the exploration and recognition of human values The great and enduring human values inherent in our democratic institutions cannot be maintained by trying to stabilize the machinery through which they find expression They can only be defended by being made to work effectively and unless we can modify our institutions in line with the profound changes in the complexity and conditions of government they may well perish

Here as Major L Urwick suggested in a recent stimulating paper published in the *British Management Review* on Administration and Society is one of the challenges thrown down to modern youth research into the human and social aspects of administration and government which will yield the scientific knowledge by which we can bring mechanization under control and adjust accurately our social organization The ideals and experiments outlined by E Mayo in Human Problems of an Industrial Civilization (New York The Macmillan Co 1933) or T N Whitehead in Leadership in a Free Society (Oxford University Press) are only beginnings but are pregnant with possibility

It is indeed the neglect in the past of human purpose psychological factors and social factors by industry that leads Gillespie in his recent book The Principles of Rational Industrial Management (London Sir Isaac Pitman and Sons Ltd 1938) to reject the whole term scientific management for some of the protagonists and practitioners have undoubtedly been prone to overlook the limitations of science in management Scientific method is only a tool of management It is not the whole of management and is not a substitute for personal values Moreover as Gillespie points out not only has the social purpose of industry been neglected and its social responsibilities overlooked but also management has often failed to recognize the significance of its own obedience to the purpose which industry is serving It is a sound principle that one of the first steps in training for leadership is learning to obey and management has often failed in obedience to its own rules and precepts and to the full purpose which industry should serve

Conceived on these lines we need not fear that democratic institutions cannot be moulded by youth to meet the challenge of to day The problem of freedom once more a cause to fight for is encountered everywhere no less in industrial than in national life No less in the industrial unit than in the nation the first condition of freedom is stability and a sense of justice inspiring the loyalty which accepts not discipline so much as self discipline and the co operation and good will for free service in a common aim

This is essentially the moral rearmament of which Sir William Bragg spoke in a recent broadcast address Only the vision and inspiration of a great and noble purpose can suffice to rally youth to the task not of service in the sense of defence only but of building a new world order in which every individual and every community may find full opportunity for self expression and development and in which the national defences now being so hurriedly erected can be made unnecessary This task demands much patient and painstaking research It involves a wide vision and wise judgment in the direction of such research and the reorientation of such effort as well as the institution of research in fields yet largely untouched It demands too the free acceptance of discipline and loyalty to the idea of service and a capacity to evaluate all the issues to see life steadily and to see it whole which should appeal to all that is best in youth and command its steadfast allegiance and noblest endeavours no less than the daring and fortitude to which Lord Tweedsmuir paid tribute Lord Tweedsmuir's address has earned the gratitude of all scientific workers whether of the younger or of the older generations no less for the clarity with which he has defined the challenge than for the inspiration with which it summons them to seize the opportunities which lie beyond that challenge

International Co-operation in Geology

Lexicon de Stratigraphie
Vol 1 Africa Edited by Dr S H Haughton Pp vi+432 (London Thomas Murby and Co 1938) 31*s* 6*d* net

A COMMISSION elected at the fifteenth meeting of the International Geological Congress assembled at Pretoria in 1929 decided to produce a Lexicon de Stratigraphie with a volume devoted to each continent in turn The general editorship was entrusted to Dr S H Haughton who has naturally started with Africa

The purpose of each volume is to furnish definitions of all stratigraphical terms that have appeared in the geological literature of the particular continent and to arrange them for convenience of reference in alphabetical order The definitions must be accompanied by appropriate references and must indicate past and present meanings Thus in the case of a formation of local origin the original meaning is cited along with the more significant of subsequent changes Comments are added regarding geographical and geological relations the whole of course in brief dictionary style

In the present volume Dr Haughton has been assisted by twenty three collaborators whose contributions are duly initialled Most of them have written in English or French a few in Italian

In the text the stratigraphical unit is used as the main heading under which detail is subdivided according to country In the index this arrangement is reversed— a very convenient device

There are more than 1 100 stratigraphical headings in the course of 419 pages Groups of systems such as Palaeozoic are not mentioned but from systems downwards any unit seems to have been acceptable At the same time there are very few in the list which owe their name to a fossil Thus though the *Nummulites gizehensis* Beds and the *Tapinocephalus* Zone occur in their alphabetical position one must look up Cénomanien to find mention of the Zone à *Acanthoceras rotomagense* and Aalénien for the Zone à *Harpoceras murchisonae*

Obviously the treatment is uneven this however is not only unavoidable but also within limits desirable The result is extremely valuable and definitely intriguing One is led on from page to page among unfamiliar names or names with unfamiliar associations The Chiwondo Beds one learns along with much other information have *Cleopatra* among their characteristic molluscs the Variegated Marls defined in 1900 occur in the lower part of the Uitenhage Series and in 1928 have been classed with the Wood Beds Taking the volume as a whole the best comparison perhaps that can be made among geological utilities is with Holmes's Nomenclature of Petrology

This lexicon should certainly be added to every important library that deals with the pure or applied aspects of geology It represents one of the many benefits which have been derived from the International Geological Congress British geologists now await instructions from Dr Haughton before starting on their share of the European volume which we may hope— will appear in separate parts We want to be able to report good progress when the Congress meets in London in 1940

L B BAILEY

The Negro in the United States

The Negro's Struggle for Survival
a Study in Human Ecology By Prof S J Holmes Pp xii + 296 (Berkeley Calif University of California Press London Cambridge University Press 1937) 13s 6d net

THROUGHOUT Nature the struggle for existence is usually an orderly and peaceful process and it may not be possible to explain in simple terms just why one species succeeds in supplanting another Only occasionally even in the animal world can such replacement be attributed to superiority in open conflict In the history of man too it has been the bloodless battles in times of peace between obscure biological forces affecting the balance of births and deaths which have generally proved more decisive than wars in deciding which peoples shall survive and which shall disappear This aspect of human evolution is emphasized and well illustrated by Prof S J Holmes in his thoughtful examination of the vital statistics of the Negro in America

The white man's impact on primitive peoples has often been deadly in its results In his explorations he has inadvertently taken with him the scourges of measles influenza pneumonia and tuberculosis In his civilizing mission he has introduced the curses of alcohol venereal disease and clothes Some native populations such as those of Tasmania and Australia have in consequence given up the struggle for survival whilst others as in the Pacific Islands have been threatened with extinction In some parts of the world the Negro peoples have been able fortunately to survive the devastations of their first contact with the white race They have thus been able to reap some of the benefits of improved hygiene the prevention of tribal wars and the saving of infant life but now they are faced with a more insidious threat to their future welfare in the fall of their reproduction rate It is mainly with this problem of the balance of births over deaths amongst the Negro population of the United States of America that Prof Holmes deals

Under slavery most Negroes were employed on farms and plantations of the southern States and their health was relatively good but the Civil War changed this The terrible conditions of the Negro's first decade of freedom brought in their train a great increase in tuberculosis syphilis malaria pellagra and other debilitating diseases The records of the cities indicate that the Negro death rate continued to rise for nearly a quarter of a century after the Civil War but notwithstanding an infant mortality which carried away every third or fourth child their high fertility still enabled the Negro population to increase The first decades of this century witnessed a rapid fall in their mortality but the effects of this were offset by a falling fertility amongst those who took to town life Urban life is not so well tolerated by the Negro as by the white the advantages of a relative immunity to some infections such as scarlet fever diphtheria and erysipelas being more than counterbalanced by a greater liability to bronchitis pneumonia and other diseases of towns The great trek of 1917 18 to the cities of the north which resulted from restriction of alien immigration therefore exacted at first a heavy toll on the balance of births over deaths but the adjustment was made

At present according to all available measures of fertility the Negro women are reproducing more rapidly than the white women in the United States and taking into account their greater death rate Prof Holmes concludes that there is at the moment a neck and neck race with a fair prospect that the Negro may soon be increasing at the faster pace This depends on many uncertainties such as the increasing use of contraceptives in rural communities and the conquest of the scourge of venereal disease It is a problem which will engage the attention of students of population and eventually of administrators to an increasing degree and Prof Holmes has rendered no small service by gathering together such a wealth of statistical material and interpreting it with such commendable caution P S

Early French Men of Science

Figures de Savants
Tome 3 l Académie des Sciences et l Étude de la France d Outre Mer de la Fin du XVII Siecle au Début du XIX^e 1 Antilles et Guyane Par Alfred Lacroix Pp xiii + 220 + 38 plates 125 francs Tome 4 l Académie des Sciences et l Étude de la France d Outre Mer de la Fin du XVII Siecle au Début du XIX 2 Mascareignes Madagascar Inde Indochine Pacifique Par Alfred Lacroix Pp iv + 259 + 59 plates 150 francs (Paris Gauthier Villars 1938)

IN these two well illustrated volumes the permanent secretary of the Paris Academy of Sciences has collected a very useful and instructive series of short notices of the distinguished French men who promoted the cause of science in the French Empire during the later part of the seventeenth and the eighteenth centuries The Academy itself of which M Lacroix gives a short account had during the seventeenth century no permanent home It received help from Colbert who was always prepared to further French colonial interests and it was finally installed in the Louvre by the King in January 1699

In these volumes the men of science dealt with appear under a geographical arrangement Vol 3 contains notices of those working in the West Indies Guiana the Mascarene Islands Madagascar India and Indo China The last four countries are again represented in vol 4 together with West Africa A separate section in this volume is devoted to the family of Jussieu five of whom were distinguished naturalists The volume ends with a plea for some central organization to deal with research at the present day

It is not possible in a short space to give an adequate idea of the wealth of information which M Lacroix has collected in these four hundred and fifty pages The particular interest of the Academy in astronomy and physics is represented for example by Jean Richer s mission to Guiana in 1666 and by a similar mission of La Condamine in Peru and Guiana Richer s work on gravity was of outstanding importance Similarly we have a picture of Peyssonnel and his work on the polyps begun in the Mediterranean and completed in Guadaloupe He received little recognition at the time in France but his work was published by the Royal Society and he was made a foreign member Bouvet better known as the discoverer of a small island to the south of Africa is shown in these pages as the patron of Poivre who did valuable work on spices Two other notable explorers Kerguélen and Lapérouse appear in a more familiar setting Sir Joseph Banks is mentioned several times His intervention secured the return to France of the botanical collections of La Billardière after their capture by the Dutch Some interesting correspondence on this matter and on the question of Sir Joseph s failure to secure election to the Academy and a similar failure of Jussieu to secure election to the Royal Society is reproduced

The omission to index a reproduction of a letter of Jussieu to the Minister of Police has made the references to the portrait of Banks (Pl xlviii) and a facsimile reproduction of his letter to Delambre (Pl xlix) and of subsequent plates incorrect while the numbering twice over of Plate xxxix in the Explication des Planches has thrown all subsequent references therein wrong But these are trifling inconveniences in a work which is full of illuminating if disjointed appreciations of the great men of science of France J N L B

Stellar Physics

Physik der Sternatmospharen
mit besonderer Berücksichtigung der Sonne Von Prof Dr A Unsold Pp viii + 500 (Berlin Julius Springer 1938) 66 gold marks

IT is clearly recognized how closely the rapid progress in astrophysics has been linked up with the advancement of physics since the beginning of this century Taking into account the fundamental theoretical work of Schwarzschild it would appear that astrophysics became a quantitative science only during the past thirty years The new problems arising during this period have resulted in an extensive literature the material of which has been partly collected in voluminous handbooks But what was badly needed at the present stage (especially for those who wanted to enter the new fields of research and found themselves confronted with this mass of material) was a critical and so far as possible systematic study of the subject

The present book fills this gap most happily The author is a distinguished astrophysicist whose own contributions to science are of fundamental importance His theoretical work shows a rare insight into the conditions of observational astrophysics and into its limitations It is significant also that in his present book Unsold resists all temptations to follow up theoretical developments for their own sake He succeeds very frequently in re presenting theories in a new and simplified form This and the great care he takes to deal with the observational material available make his book readable and useful both for the theoretical and for the practical workers in the field

The volume consists of five parts The first one on more general lines serves as a kind of introduction to the detailed treatment of the later chapters After a brief review of the physical theory of radiation the author deals with general problems of solar and stellar radiation such as the solar constant and the effective temperature of the sun brightness and colour temperature of stars A chapter deals with Saha's formula and its application to stellar atmospheres and gives a survey of its limitations

Turning to the second part of the book we are given a thorough analysis of stellar atmospheres and of their radiation so far as the continuous spectrum is concerned Naturally the theory of radiative equilibrium is treated in all important details The law of darkening towards the limb, and its dependence on wave length, are other topics contained in this chapter the second and main part of which is devoted to the continuous absorption coefficient Introducing Rosseland's mean value κ the author develops the physical theory of the continuous absorption coefficient describes the experimental tests of its validity and applies finally the results obtained to solve the problem of the energy distribution in the continuous spectrum of the stars

From the discussion of the continuous spectrum the author passes to the vast realm of the absorption lines to which naturally the major part of the book is devoted The introductory third part gives an account of all that physics knows about the formation of absorption lines Here we meet the classical theory of representing the atom by damped harmonic oscillators The treatment then follows on the basis of the quantum theory in which for example radiation and collision damping as well as the intermolecular Stark effect are dealt with The quantum mechanics computation of transition probabilities and oscillator strengths is given and on account of the importance of multiplets the Burger Dorgels rule is treated in a special chapter Finally the experimental side of the problem is well represented such items as the measurement of oscillator strengths experiments on the broadening by collision damping or Stark effect etc are clearly discussed

This physical interlude is followed in the fourth part by the treatment of the fundamental problem of the Fraunhofer lines the absorption lines of astrophysics After a brief survey of observational questions which is very useful for the beginner we find here the necessary extension of the theory of radiative equilibrium given in preceding chapters so as to include line radiation The well known Schuster Schwarzschild and Milne Eddington models and their generalizations are dealt with in detail It is shown that the main problem in the theory of the Fraunhofer lines is to find from measurement of the intensity of the line the number of absorbing atoms The author gives the corresponding relations on the basis that the broadening of a line is mainly due to the Doppler effect and to damping The influence of these effects and especially of the second one in stellar atmospheres is shown as well as the importance of the intramolecular Stark effect for the hydrogen lines In this same chapter the theory of central intensity, the role of interlocking and the problems of the blends are treated The study of outside factors causing broadening such as rotation, or expansion of a stellar atmosphere, concludes this most interesting section

The beginning of the fifth and last part of Unsold s book is devoted to the applications of the theory of Fraunhofer lines to the problems of spectral classification and to a quantitative analysis of the solar atmosphere The last two chapters deal with the outer layers of the sun Here we find first of all studies on sunspots faculæ and granulation (an example of the role of convection in stellar atmospheres) and further an account of our physical knowledge of prominences the chromosphere and the corona

The work is concluded by a well arranged bibliography which comprises no fewer than 1 800 entries

A review of this unique book can only give an outline of its contents and its purpose The author has fulfilled his intentions in an admirable way and his work is likely to prove indispensable to all workers in astrophysical and related fields It fills a real gap in astronomical literature in which we were lucky enough to welcome some time ago Rosseland s Theoretical Astrophysics treated on quite different lines (see NATURE 138 628 1936) Prof Unsold has rendered a great service to astronomers as well as to physicists who will be glad to make use of the fundamental problems and their solutions arising from a study of those great physical laboratories the stars A B.

The Liberal Arts Applied to Modern Medicine

The Doctrine of Signatures
a Defence of Theory in Medicine By Scott Buchanan (International Library of Psychology Philosophy and Scientific Method) Pp xv + 205 + 20 (London Kegan Paul and Co Ltd 1938) 7*s* 6*d* net

IN the form of a plea for renewed freedom of speculation in thought Prof Buchanan has written a very interesting book in which he is not concerned with social and political restraints but with the far more stultifying hesitations in the minds of thinkers of the present time He is alarmed to find all around him evidence of the fact that the intellectual process is being called in question and its consequences feared As subject matter for investigation Prof Buchanan has chosen the science and profession of medicine which throughout European history has always fought and won the battle for freedom of thought but which now that it is in possession of victory, stands hesitating at the head of the sciences burning with intellectual energy and imagination but not knowing which way to go In Prof Buchanan s opinion modern medicine is suffering from a lack of balance of the intellectual virtues and while it has a maximum of informatory knowledge has a minimum of understanding

For this unhappy state of affairs Prof Buchanan prescribes two remedies which he maintains are forgotten rather than new These are the use of symbols and of demonstration—or in other words the application of the liberal arts—the trivium and the quadrivium to medical education Here the patient becomes a text to be read and translated according to the rules of medical grammar For according to the doctrine of signatures medical knowledge consists of seeing the connexions between symptoms and remedies and the liberal arts are concerned with signs and symbols and also with the levels of generality and abstraction that appear when symbols are used Prof Buchanan accuses modern scientific medicine of elaborate empiricism and anti intellectualism and thinks that the doctrine of signatures and the liberal arts would be good exercise for our weak symbolic faculties Furthermore he alleges that the disuse of demonstration in the biological and medical sciences has tended to atrophy the understanding and proceeds to show how Plato Aristotle and Galen discovered and established the demonstrative power of form and matter in biological science He thinks that its re discovery and re establishment would both revive and direct our stultified speculative energies

There is no doubt that Aristotle and Galen represent the peak of Greek medical science but Prof Buchanan maintains that to day we are only working out the details of their fundamental insights To support this view he states that students of the history of medicine are repeatedly disclosing the fact that the greatest of original modern discoveries in physiology and anatomy are but the discoveries of ideas and illustrations of principles in the Aristotelian and Galenic works While he would not go so far as to say that there is nothing new in science he assures us that we have yet to recognize the science which has made possible such novelty as there is We should try to recover the doctrines of the tradition from which modern developments have grown in the hope that they may be rendered intelligible enough to absorb modern science within the borders of their ancient wisdom

The subject is certainly a fascinating one and Prof Buchanan's treatment of it although necessarily rather fragmentary in a book of this length is both stimulating and disturbing

Plant Physiology

By Prof Nicolai A Maximov Edited by R B Harvey and A E Murneek (McGraw Hill Publications in the Botanical Sciences) Second English edition, translated and revised from the fifth Russian edition Translated from the Russian by Dr Irene V Krassovsky Pp xxii +473 (New York and London McGraw Hill Book Co Inc 1938) 25s

NICOLAI MAXIMOV is a plant physiologist with a world wide reputation, especially in connexion with the water and soil relations of the plant, and this alone justifies a translation from the Russian of any work of his even if it is only a survey of the subject for the benefit of the student In spite of the fact that there are now several good text books on plant physiology in English written by British and American authors, one by this well known Russian who is an active worker and prolific writer is bound to bring a certain freshness of outlook so that it may be regarded as a valuable supplement to any text book which the student is already using

This second English edition has been translated from the fifth Russian edition, which was so completely rewritten by Prof Maximov as to warrant a new title (The first edition was entitled Textbook of Plant Physiology) It should be pointed out, however that Prof Maximov s researches are biased towards plants of agricultural importance, and thus this book deals as he terms it, more with "agro physiology than with general plant physiology Thus the physiology of saprophytes, parasites, bacteria, fungi and algæ is scarcely considered The book can therefore be strongly recommended as a text book to students of agriculture and as a supplementary book to students of general botany, since its economic outlook will certainly give added interest to their studies

The subject matter is considered in the orthodox manner under such headings as physico chemical organization and chemical composition of the plant, respiration, growth photosynthesis, nitrogen assimilation, absorption of mineral elements, water relations, translocation and so forth Certain subjects such as growth, development and seasonal phenomena receive fuller and better treatment here than in most books on the subject The book deserves unqualified success

A Text-Book of Biochemistry

for Students of Medicine and Science By Prof A T Cameron (Churchill's Empire Series) Fifth edition Pp viii+414 (London J and A Churchill, Ltd , 1938) 15s

THE fourth edition of this very successful text book was reviewed in NATURE of January 6, 1934, p 8 There have been a total of ten editions and reprintings since the original publication of the book ten years ago, so there can be no questioning its utility, especially to medical students, to whom it is primarily addressed

Any text-book dealing with such a progressive subject as biochemistry is naturally bound to become quickly out of date in parts, so the success of this work is of particular value in offering the author opportunity of revision in the light of recent research The author has availed himself of the opportunity with the result that this new edition has been almost completely rewritten The subject matter has also been rearranged As in the previous edition the author has assumed a basic knowledge of organic chemistry but justifiably opens with a résumé of the concepts of physical chemistry Thence the student is brought directly into contact with biochemical agencies —enzymes hormones and vitamins Here the subject matter has been severely curtailed apparently to satisfy the immediate needs of the medical student Phytohormones, as such are dismissed in one sentence though certain of them such as indole acetic acid indole propionic acid, skatole etc , are considered further on in the book in connexion with the action of intestinal bacteria

The chapters on the biochemistry of the foodstuffs leave nothing to be desired We are glad to note that the author has corrected a previous error and here states correctly that strophanthin hydrolyses to glucose, cymarose and strophanthidin

The rest of the book deals with those branches of biochemistry essential to students of medicine, and concludes with a consideration of pharmacology and of immunochemistry and the chemistry of filterable viruses The book is a pattern of compression , in fact to survey such a wide subject in four hundred pages so satisfactorily is a feat of which the author may well be proud

Icones Plantarum Sinicarum

Fascicle 5 Edited by Hsen Hsu Hu and Woon Young Chun Pp iv +50 +plates 201–250 (Peiping Fan Memorial Institute of Biology, 1937)

THE publication of fascicle 5 of the Icones Plantarum Sinicarum brings the total of plates published in this work to two hundred and fifty The illustrations are in black and white, most plates include analyses and many show both flowers and fruits One species is figured on each plate and described in the text in English and Chinese Nearly all the subjects are woody plants (only five herbs have been figured so far), and the large size of the plates (the work is a folio) is a great advantage in that it allows ample material of the plants to be illustrated The value of the work is enhanced by the fact that many of the plants figured, especially in fascicles 3–5 are species described in recent years, whilst another valuable feature is the figuring in successive plates of all or most of the Chinese representatives of one genus, as for example, in *Carpinus*, *Tilia* and *Deutzia* In the first two fascicles the plates are spoilt, to a large extent, by being too heavily inked, but in fascicles 3 5 they are excellently reproduced from drawings (by C R Feng) which are both artistic and botanically accurate The publication forms a valuable work of reference for students of the flora of China, and it is to be hoped that it will be possible for production to continue, despite the unhappy conditions now prevailing in that country

Arctic Eskimo

a Record of Fifty Years Experience and Observation among the Eskimo By C E Whittaker Pp 260+16 plates (London Seeley, Service and Co, Ltd n d) 16s net

IN his fifty years of experience of the Eskimo Mr Whittaker has seen many changes In that period much of their traditional mode of life has passed away while in other respects although superficially there has been little modification conditions have altered fundamentally To mention one instance only though one that is most important for the future of the race the scarcity of game has adversely affected hunting and trapping activities and had not the Canadian Government intervened, the situation would have been parlous indeed

It was however the whaling industry that played the most serious part in breaking down Eskimo culture introducing the commodities, foods and especially drinks and the diseases of civilization When the whaling industry died out some thirty years ago the condition of the Eskimo began to improve and thanks to missions and hospitals as well as in a lesser degree to schools, progress has been continuous

In this volume the author is concerned with the traditional culture of the people rather than their present condition, although he glances at this incidentally His most permanent and valuable contribution to understanding of the Eskimo and the character of their culture lies in his personal observation and contact with individuals of which his memories provide a store His appreciation of their character with all its good qualities as well as its weaknesses is successfully conveyed to the reader

The author deals chiefly with the inhabitants of the Mackenzie Delta and Herschel Island, and the Copper Eskimo of Coronation Gulf who had not been visited by the white man before 1914 but his account of these peoples is made the basis of an account of the Western Eskimo in general

Grass Drying

By S W Cheveley Pp 127+9 plates (London Ivor Nicholson and Watson, Ltd, 1937) 6s net

THIS book fulfils a need in that it deals shortly but concisely with the whole subject of grass drying, tracing its development from the initial experiments at Cambridge to the product now turned out by the modern grass dryer The general principles of grass drying are well set out and some general idea of costs can be ascertained from the figures given It is unfortunate that all figures are taken for one make of dryer only, and that no figures are given for plants suitable for the farmer whose intention primarily is to supply his own requirements

The two chapters dealing with the management of the grass before and after cutting, and the general organization of the work, are well set out

The feeding value of dried grass is given, as are suggested methods of feeding the material to different classes of stock No results are quoted from actual feeding trials though many trials have been carried out Reliable information of this nature, from properly designed and managed trials is, however, still needed especially on the comparative value of spring and autumn dried grass Methods of feeding and amounts to be fed will probably need revising when experimental results relating to these subjects are available

No book dealing with a subject yet in its infancy can be expected to keep abreast of conditions for more than a short time Even now dryers other than those specified are being marketed, but no one contemplating the outlay on a drying plant can fail to benefit from reading this book J R M

The Production of Field Crops

a Textbook of Agronomy By Prof T B Hutcheson T K Wolfe and Prof M S Kipps (McGraw Hill Publications in the Agricultural and Botanical Sciences) Second edition Pp xvii + 445 (New York and London McGraw Hill Book Co Inc 1936) 21s

THIS is essentially a book written to meet the requirements of an American course of agriculture and it deals only with American crops and conditions, it makes no claim to be of direct use to students or teachers in Great Britain The terminology will be strange to English readers and many of the crop varieties mentioned are rarely heard of here

Some of the sections however are of interest to English readers One gives brief results of trials on the placement of fertilizers in relation to seed though with the information available from American sources, much more might have been made of this subject Another relates to the necessity of small quantities of the rarer elements for plant growth but the practical application of this knowledge is not discussed No mention is made of the use of mercurial seed dressings against bunt and smuts in cereals the formaldehyde and copper carbonate treatments being recommended J R M

The Naturalist's Calendar ("With Camera and Note book"), 1939

Edited by Phyllis Barclay Smith and Rudolf Zimmermann Pp 60 (London M C Forrester 1939) 3s 6d net

THIS handsome calendar should be welcomed by all lovers of natural history since it forms an attractive vehicle for some excellent Nature photographs which not only portray the beauties of plants and animals but are also an adequate and ready means of identification Each page on the calendar represents one week, but the letterpress is purely supplementary to the pictures The photographs are of mammals, birds, insects and plants found in Great Britain and have been chosen from among the best works of well known naturalists

The calendar would adorn the wall of a naturalist's study or a biological lecture room or laboratory It would make a very acceptable gift to anyone interested in the natural history of any group of plants or animals

The Physiology of the Plant Cell*

By Prof W. Stiles, F R S

IN spite of its great importance for the life of man the physiology of plants is a subject of comparatively recent development In its earlier phase during the eighteenth and first half of the nineteenth centuries it was very largely a study of plant nutrition from which emerged certain definite information regarding the functions of various plant organs and tissues It is only more recently that the study of the activities common to all living cells has come to the forefront of physiological inquiry These activities can conveniently be considered as of two kinds In the first place all cells respire in the sense that so long as they are alive actions proceed in them which involve the release of energy from certain substances With very few exceptions these actions take the form of a breakdown of carbohydrate or fat by oxidation to carbon dioxide and water The second kind of activity exhibited by all cells is to be found in their capacity for absorbing and excreting water and dissolved substances

It is usually accepted as a fact that every living cell respires and if this is so then we must conclude that respiration is something most inextricably connected with life The general view held regarding the function of respiration put in as precise terms as possible is that it provides energy for certain plant movements and for the building up of substances of higher energy content than the products of photosynthesis which serve as the substrate While perhaps all plant movements do not obtain the necessary energy for their occurrence from respiratory activity no doubt some do and there is every reason for believing that the energy required for the production of various constituents of the plant arises from the same process But having agreed to this can we really be satisfied that we have obtained a complete explanation of the function of respiration ? In the case of germinating seeds growing organs the formation of flowers and fruit this view seems completely adequate but we must remember that storage organs such as potato tubers and carrot roots respire at a by no means negligible rate and that the same is true of senescent organs such as mature fruit Indeed such tissues notably those of the apple have provided some of the most interesting data of plant respiration With what movement or with what synthesis of materials is respiration of the cells of the mature apple concerned ?

Such considerations lead one to wonder whether respiration is not concerned in some much more subtle way with the maintenance of life It looks as if the mere maintenance of the protoplasm in a living condition depends on the continuous occurrence of those processes which manifest themselves in the oxidation of organic material to carbon dioxide and water by means of absorbed oxygen The only exception to this rule is found in certain so called resting organs such as seeds in which the amount of water present is very low and in which presumably the protoplasm is in some very different state from that of active cells

If we cannot answer this question we can at any rate attempt an examination of the functions of respiration of which we feel more certain The most universal of these is the provision of energy for the building up of materials of higher energy content The chief problem which awaits solution here is the mechanism by which the energy released in the oxidation of the substrate is transferred to the actions bringing about the synthesis of proteins and other complex plant constituents A consideration of the relationship between aerobic respiration of apples in air and oxygen and anaerobic respiration in nitrogen led F F Blackman to the view that along with the breakdown of carbohydrate there is in air a process of oxidative anabolism in which some of the intermediate products of the breakdown of carbohydrate are built back into the system Evidence for oxidative anabolism in storage tissues such as potato tuber and carrot root has also been obtained in my laboratory by W Leach J K Choudhury and J K Scott while the investigations of Bennet Clark on the organic acid metabolism of succulents and other plants has led him to the conclusion that not only does oxidative anabolism occur in these plants but also that organic acids may quite generally play an important part in this phenomenon

While then data are accumulating which indicate the linkage of anabolic processes with those of the breakdown of sugar it is important to note that there is no evidence of the formation of products other than carbohydrates Is it not possible however that syntheses of more complex substances are indeed involved and that we have here a dim glimpse of the mechanism for the production of these substances and that along with the formation of sugar or some intermediate there may also be the formation of protein or other complex substances that indeed we have here the mechanism by which the carbohydrate is brought into a suitable form for combination with nitrogenous and other compounds? However this may be before we can hope to present a picture of the relation between respiration and vital syntheses we need not only many more data regarding respiration rates under both aerobic and anaerobic conditions but also a detailed biochemical analysis of the carbohydrate and various nitrogenous materials present in a wide variety of tissues So expressed this may sound a simple enough matter but actually as anyone who has attempted to tackle such problems knows it is one that abounds in difficulties

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* Based on the presidential address read before Section K (Botany) of the British Association at Cambridge on August 18

While it has generally been assumed that respiration is linked in some unknown way with the synthesis of proteins and other substances its connexion with those other processes the absorption and excretion of materials which are characteristic of cells has only come to be appreciated more recently The absorption and excretion of water and dissolved substances was generally more or less tacitly assumed to be determined by the physical laws of osmosis and diffusion Water was supposed to diffuse into or out of the vacuole according to the difference between the osmotic pressure of the cell sap and the sum of the osmotic pressure of the external solution and the inwardly directed pressure of the stretched and elastic cell wall Dissolved substances were supposed to enter the vacuole according to the laws of diffusion expounded by Graham and Fick more than eighty years ago

Although Collander s work on the absorption of a number of non electrolytes indicates that this assumption may in the case of such substances be quite justified it has been known now for thirty years that the entry of electrolytes into cells cannot be explained as the simple diffusion of a substance through a membrane from a region of higher concentration to one of lower concentration During the years 1909 19 two facts militating against this simple view became established In the first place it was shown that the two ions of a salt could be absorbed by plant tissue at different rates while in the second place it was shown that absorption of a salt or its ions takes place towards a condition of equilibrium which is not that of equality of concentration attained inside and outside the cell but which depends on the concentration of the salt With dilute solutions the concentration attained inside the cell may be many times that of the solution outside while in concentrated solutions the reverse is the case and the concentration of the salt inside even after forty eight hours immersion of the tissue in the solution may be very much less than that outside Thus while more salt is actually absorbed from a stronger solution than from a weaker one the absorption relative to the concentration is less both as regards rate and total amount, from a stronger than from a weaker solution

Various possible mechanisms have been suggested to explain this relation between concentration and absorption When this problem was first investigated by F Kidd and myself we found that the relationship between concentration of salt and absorption was much the same as it would have been if the salt were adsorbed by an adsorbent within the cell It is easy to suggest that a first stage in the absorption of salts by plant cells is the adsorption of the ions of the salt by some constituent or constituents of the protoplasm While I have pointed out the similarity of the absorption of salts by plant cells with an adsorption phenomenon I have more than once stressed the point that this similarity is in itself not sufficient to justify the advocacy of an adsorption theory of salt absorption Yet it must be admitted that later work by more exact methods has only served to confirm the approximate similarity of the relationship between salt absorption and adsorption Reference in this connexion may be made to the work of Laine on the absorption of manganese and thallium by roots of *Phaseolus multiflorus* as well as to observations of my own on the absorption of sodium chloride by carrot root

Of course if the similarity between the relationship of salt absorption to concentration and th adsorption equation is more than a coincidence adsorption can only be the first stage in this absorption at any rate by actively growing tissues in which the absorbed ions must be transferred elsewhere Again one would expect the adsorbing material to be present in the protoplasm whereas a number of more recent observations by various investigators indicate that there is actually an increase in concentration of the absorbed ion in the vacuole The adsorption would then have to be followed by elution of the salt at the surface of the vacuole In this connexion it is interesting to note that S C Brooks has obtained some evidence that *Valonia* immersed in sea water containing rubidium chloride accumulates rubidium in the protoplasm for two days after which this cation passes from the protoplasm to both vacuole and external solution The same worker has also found that when cells of *Nitella* are placed in

0·01 *M* solutions of radioactive potassium chloride there is an accumulation of potassium in the protoplasm after six hours before any appreciable amount of potassium appears in the vacuole Previously M M Brooks had found that when *Valonia* is immersed in a solution of methylene blue, the cell wall and protoplasm become deeply stained by the dye before any appreciable coloration of the vacuole is observable

Another mechanism which has been suggested as possibly operative in the absorption of salts is one of interchange of ions within and without the cell under conditions which give rise to the ionic distribution between the cell interior and exterior characteristic of what is called Donnan equilibrium and in this connexion it must be emphasized that just as adsorption must take place if the cell contains adsorbents of ions capable of reaching the adsorbent so if the cell system involves the conditions giving rise to Donnan equilibrium it is inevitable that the movement of ions demanded by these conditions must result

The possibility that respiration has a direct effect in bringing about the absorption of ions has been pointed out by several workers notably by Briggs and S C Brooks The production of carbon dioxide in the cell leads to the appearance of carbonic acid and hence of its ions hydrogen and bicarbonate (H and HCO_3) The interchange of ions required by the Donnan equilibrium will lead to the diffusion out of hydrogen ions which are replaced by cations from the external medium while bicarbonate ions will be exchanged for anions from the external medium As the tissue continually respires the production of hydrogen ions continues to replace those which diffuse into the external solution and so the absorption of ions continues as part of an interchange between tissue and external medium

Against the view of a direct effect of respiration on salt intake by ionic exchange it has been urged by Hoagland and Steward that accumulation of ions is negligible or slight when tissue is deprived of oxygen although there may be a considerable anaerobic production of carbon dioxide But as regards this objection it must be noted that under conditions of anaerobiosis the rate of carbon dioxide production usually falls rapidly with time so that it is doubtful whether a considerable production of carbon dioxide anaerobically generally continues for any length of time The question is obviously one requiring further experimental investigation

That the absorption of salts by tissues is related to a supply of oxygen and probably in some way to respiration there can however be no doubt For more than thirty years it has been known that the growth of plants in water culture is often accelerated by aerating the solutions while more direct evidence of the effect of oxygen on the salt relations of cells has been obtained in work with storage tissues In 1927 I pointed out the importance of maintaining the supply of oxygen to such tissues for the maintenance of their vitality and that in the absence of an adequate oxygen supply exosmosis of electrolytes took place leading to the speedy death of the tissues whereas with maintenance of a supply of oxygen absorption of electrolytes continued in the case of beetroot for example for periods of about three weeks Towards the end of this time a condition of equilibrium was reached or approached in which the content of electrolytes in the external liquid was very low During this period conditions leading to lower oxygen and higher carbon dioxide concentration led to increase in the electrolyte content of the liquid while addition of fresh oxygen led to a decrease

In similar experiments carried out by Briggs and Petrie in 1931 in which a continuous stream of air was passed through the liquid these workers examined the course of respiration along with the changes in electrolyte content of the external solution and established the fact that there is a general parallelism between the rate of respiration of the tissue and the electrolyte concentration of the external liquid If the stream of air was replaced by nitrogen the respiration rate increased and so did the concentration of electrolytes in the solution while replacement of the nitrogen by air brought back the original distribution of electrolytes between tissue and external liquid Steward and collaborators have shown that reduction of the oxygen supply to storage tissue of potato carrot and artichoke below a certain value limits the accumulation of both the ions of potassium bromide by the tissues while Hoagland and Broyer have obtained a similar result with barley root systems

In attempting to explain this effect of oxygen one must bear in mind that the relationship between respiration and salt accumulation may not be a direct one The maintenance of an adequate supply of oxygen is necessary to maintain the vitality of the tissue possibly on account of the deleterious effects of the products of anaerobic respiration Thus the fact that accumulation depends on oxygen supply may be regarded as an expression of the fact that under conditions of partial or complete anaerobiosis the functioning of all or many vital processes dependent on the protoplasm is adversely affected and along with them that of salt accumulation From this point of view the effect of conditions leading to poor oxygen supply may be related not only to oxygen concentration but also to accumulation of carbon dioxide and other products of anaerobic respiration

From a consideration of all the data it seems to me that the following conclusion can be drawn regarding the relationship of respiration to the absorption of salts by plant cells namely that accumulation of salt depends on the vitality of the cells and that the maintenance of this vitality depends as has been long recognized on the presence of oxygen either because aerobic respiration or some other process requiring oxygen is essential for this maintenance of vitality or because in the absence of oxygen the accumulation of carbon dioxide and other products of anaerobic respiration adversely affects the functioning of the protoplasm This dependence of absorption of salts on the vitality or healthiness of the tissue was clearly shown by my experiments of 1927 and by the later ones of Steward in which stress was laid on the effect of aeration of the tissues I think Hoagland s observations on the effect of light on absorption of potassium bromide by *Nitella* fall into line with these It was found that absorption of bromide only took place if the cells were exposed to light or if they had previously been exposed to adequate illumination If for some time previously they had been growing in weak light no accumulation of ions took place *Nitella* kept for some time in low light is probably somewhat unhealthy just as is tissue that is deprived of an adequate supply of oxygen In other words most of the work published on the relationship between respiration and salt accumulation does no more than show that this accumulation is a vital process depending on the normal functioning of the protoplasm Any general relationship between respiration and salt accumulation as regards the linkage of reactions involved or the transfer of the energy required for the entry of a salt against its own diffusion gradient may thus be very indirect

Thirty years ago when the importance of the principles of chemical dynamics in life processes was coming to be fully realized it looked as if the solution of many of the problems of plant physiology in terms of physical chemistry was fairly imminent But with the application of these principles to our investigations into living processes we find that in every one of them the protoplasm introduces a factor which renders these processes not readily explicable in this way Clearly we must seek an explanation in the apparent divergence of vital processes from physical or chemical laws in the constitution of the protoplasmic system and hence a fuller analysis of this system now appears to be a requisite for further advance in our understanding of physiological processes in general There is at present no reason to suppose that with further advance in knowledge of the protoplasmic system we shall not ultimately be able to explain physiological processes in physico chemical terms and I would re affirm what F F Blackman emphasized in his presidential address to Section K thirty years ago namely the inevitableness of physical chemical principles in the cell

It is scarcely necessary to emphasize how the principles of general cell physiology must be of fundamental importance in plant metabolism for inasmuch as this depends on the activity of specialized cells and tissues these wherever they are alive must also exhibit the normal features characteristic of protoplasmic activity But in spheres of botanical science outside the range of pure physiology the general physiology of the cell is just as important This applies in particular to ecology This study in so far as its aim is the determination of the relationship of plants to their environment is indeed nothing else than physiology a fact which was clearly recognized by Clements more than thirty years ago

Of the two groups of factors which determine the distribution of vegetation the climatic and edaphic the mode of action of the latter in particular can only be studied with any hope of success by those with an adequately deep knowledge and appreciation of cell physiology It does not need a knowledge of physiology it is true to determine plant distribution but such knowledge is essential for what Tansley in a paper read to Section K thirty four years ago called the higher branch of ecology i e the detailed investigation of the functional relations of plant associations to their surroundings However desirable and necessary the collation of knowledge of plant distribution may be I am certain that the solution of the fundamental problems of ecology will only be achieved by the use of physiological methods and particularly by the application of our knowledge of the general physiology of the cell For edaphic factors must act through the root and by the absorption of materials from the soil or the exchange of material between the soil and root

Certain aspects of mycology have much in common with physiology indeed that part of mycology which concerns pathogenic organisms is inevitably closely linked with problems of the relation of host and parasite problems which are in their very essence physiological Years ago it was questioned whether the physiology of the plant physiologists was not half pathology Certainly the reverse question can be answered with more assurance, pathology is at least partly physiology and therefore the principles of general cell physiology must here also be of immense importance, and an intimate acquaintance with these principles should be an important part of the equipment of the plant pathologist

Perhaps no branch of botany has made such spectacular advances in recent years as that of cyto genetics At least it has produced a nomenclature which rivals or excels the early efforts of the descriptive ecologists and just as descriptive ecology can do little more than correlate certain types of vegetation with certain environments so cytology can do little more than correlate visible structures in the cell with genetical behaviour I cannot help thinking that a real insight into these problems also will only come with the interpretation of cytological observations in physiological terms and that the greatest advance in the study of cytology will come with the linking up of the knowledge of the cell acquired by these two lines of investigation the cytological and physiological It is surely a rather remarkable fact -one indicating how far away we are at present from the achievement of this end that the physiologist tends to think of the *cytoplasm* as the essential factor in determining vital activities while the cytologist concerns himself almost exclusively with the nucleus Neither the physiologist nor the cytologist appears at present to have anything but the vaguest ideas of the relationship between the two a relationship which however we may feel sure is most intimate and fundamental to life

We all know but it cannot be too strongly emphasized that botany is the pure science of a great part of the most important industry of the world agriculture and that this like every other industry can only be carried on wisely if its practice is based on scientific principles Almost all branches of botany are important for agriculture but mycology, genetics and physiology are particularly so and certainly physiology is not the least of these Absorption of water and nutrients from the soil assimilation of carbon water relations of the plant vegetative development flowering and fruiting are all problems of agriculture and forestry which are essentially physiological

But besides these more obvious economic applications there are numerous industries in which the principles of general cell physiology are no less fundamental There are all those industries ever increasing in number and importance which are based on some particular plant product such as cotton linen jute rubber tea sugar and tobacco to mention only a few of the more important Apart from the growing of the plants themselves which like any other form of agricultural practice should be based on sound physiological principles a knowledge of these principles may be equally important in the subsequent treatment of the plant material In particular a knowledge of cell organization, the action of enzymes contained in the cell its behaviour towards various reagents all aspects of general physiology is essential Finally the great food storage industry depends greatly on the application of knowledge of cell physiology As an example of this I may refer to pioneer work on the scientific principles of cold storage by Jorgensen and myself carried out some twenty years ago From a consideration of what was then known of the constitution of the cell we concluded that the satisfactory preservation of certain tissues in the frozen condition depended on rapidly freezing the tissues a method which was afterwards put into practice in certain branches of the food storage industry This is of course only one instance of the bearing of general cell physiology on the subject of food preservation The effect of the conditions of storage on enzymes and other cell constituents and on the vitality of different kinds of cells tissues and organisms are among the problems which a knowledge of the facts and methods of general cell physiology will help to solve

With the ever increasing mass of knowledge in the various branches of botany an increase which is especially noticeable to day in those aspects of our subject which are undergoing rapid development namely physiology mycology and genetics with cytology it is impossible for anyone to be an active worker in more than a relatively very small field of botanical endeavour We sometimes meet with reference to a mysterious gentleman called the general botanist who is expert in general botany as someone distinct from the morphologist physiologist mycologist or other worker in a defined field But in these days when to make any contribution to knowledge necessitates specialization there can indeed be no such person as the expert in general botany for there is indeed no such subject But in whatever part of our subject our own special interests may lie we can still appreciate the efforts and aims of workers in other fields and realize the bearing of work in these fields on our own problems and in this sense we are all general botanists that is just botanists

For if general botany as something distinct from botany is a myth there is no doubt that the various branches of our subject are related in the whole I have here tried to indicate not only the scope and present position of our knowledge of the general physiology of the cell but also where this particular part of the science of plants comes into contact with other branches of botany and how the application of a knowledge of the facts, principles and methods of cell physiology may be expected to lead to an increase in knowledge not only of the physiology of the plant but also of other aspects of botanical science and of its industrial applications

The Perkin Tradition

DURING the Easter holidays of 1856 a young man of eighteen years of age was experimenting at home in Shadwell in chemistry He followed up the coloured product of the reaction instead of chasing after a more orthodox crystalline substance and strangest of all had the curiosity to try to dye silk with it A mauve skein resulted and the aniline dye industry was born !

Perkin's father was a builder and looking back he must have been a man of remarkable character Not only did the son experiment at a very youthful age as in those halcyon days was customary but also he seems to have been encouraged to try his hand in many directions until finally between twelve and thirteen years of age he came to chemistry and to Thomas Hall at the City of London School He next sought to go to the Royal College of Science this was going a little too fast for the father for chemistry was scarcely a profession in those days but with Hall's assistance the young Perkin had his way and was allowed to study under Hofmann

Mauve was discovered at home and perhaps its properties received more discussion in the family circle than they would have done in a laboratory In any event Perkin there and then started to make his dye while his father risked most of the capital which he had accumulated by a life of great industry to build and start the works There can be no more outstanding example of confidence in a young son and paternal enterprise Such a thing is utterly impossible to day in any country the name of George Fowler Perkin should be highly honoured by posterity

W H Perkin was fortunate in another way there was no school certificate or matriculation examination to dominate his education What is the use of trying to turn out all the boys to day in a common mould when we are really every one of us different the examination system destroys any chance of incipient genius and is the negation of education scientific or otherwise Perkin would have probably passed his examination but the preparation for it would have left him no time to express his individuality Surely this is the chief lesson to be drawn at the time of celebrating the centenary of his birth

The call to invent to prosecute research is strongly hereditary though perhaps latent in the founder of the family Sir William passed it on to all three sons particularly to W H junior and it is a loss to science that there has been no third generation

The story of the Perkin adventure has been often told in the greatest detail and from many aspects particularly in relation to the rise and fall of the industry in England its transference to Germany and its more recent resurrection here The jubilee of the discovery in 1856 gave the chemical world an opportunity to honour Perkin The centenary of his birth was celebrated on November 24 last by a memorial lecture given by Dr Herbert Levinstein in the hall of the Leathersellers Company and arranged by the Society of Chemical Industry and the Chemical Society The selection of speaker was a happy one Levinstein's father maintained a dye industry in Great Britain during the darkest days of its difficulties and father and son supplied a nucleus on which it was possible to condense other efforts when the upswing began No more comprehensive illuminating balanced and graceful address has ever been forthcoming on this subject the simplicity of its language makes it of wide appeal The societies must give it full publicity it should at least be read by every member of Parliament to make them realize the significance of chemical effort for the benefit of man perhaps educationists may be led to ponder also how they are going to preserve further Perkins for us and not destroy them in their teens

Perkin's ability as an applied chemist was remarkable At an age when the young men of to day are still playing games he made discoveries in dyeing practice which Levinstein rightly regards as a more considerable achievement than the laboratory discovery of mauve The new mauve dyed silk direct but very irregularly he found it dyed level shades if applied to silk in a soap bath a novel method which has never since gone out of practice Mauve would not dye cotton far and away the most important textile fibre without a mordant Perkin in 1857 when he was nineteen years of age discovered the tannin method since found of general application to basic colours He did much also to make calico printing with the new dyes possible

Perkin only remained seventeen years in industry selling out when he was thirty five years old he had amassed what was for him in those days a competence In so doing he displayed great shrewdness as after events disclosed in leaving the industry when it was in a very flourishing condition In later life he showed relatively little interest in the industry and some have blamed him for cutting himself so soon adrift from his own offspring. The business side of the factory was looked after by his brother Thomas.

The rest of Perkin's life was devoted to pure research. He has himself told us that he determined not to let the manufacturing career check his scientific life. It is not at first glance easy to understand why he could be happy in the study of such subjects as magnetic rotation. To quote Levinstein: 'this physicochemical work is of great difficulty but I should have thought of quite exceptional dullness for a man who had created vast industries'.

I saw a good deal of Perkin in this last phase of his life, when it was hard to believe he had been so active as a young man. Most of us, like my own father, carry on such activity until incapacitated: the contrast between Perkin and Duisberg of the I.G. at the same advanced age was a remarkable one. Perkin followed a rigid and austere vegetarian diet and it may be that it contributed in some way yet to be discovered to this change of outlook. But he was by disposition a man of most retiring nature.

It is the duty of the chemical societies to keep the memory of Perkin from fading from the public mind. His achievements were startling and will be remembered when the names of the statesmen of to day are long forgotten. There is a great tradition to be kept alive.

> "A crown of fame! Fulfilment of thy work
> well done
> And knowledge of a people's gratefulness."

E. F. A.

Obituary Notices

Sir Henry Fowler, K.B.E.

HENRY FOWLER, who died on October 16, at the age of sixty eight years, was born at Evesham on July 29, 1870. His technical education started at the Mason Science College, Birmingham, and was continued at the Railway Mechanic's Institute at Horwich during his apprenticeship in the locomotive works of the Lancashire and Yorkshire Railway. Whilst at Horwich, Fowler gained the first Whitworth Exhibition to be awarded to a student of the Institute. After service under Sir John Aspinall, with whom he was associated in a series of classic experiments on train resistance, Fowler left Horwich to become gas engineer of the Midland Railway at Derby, where, a few years later, he became works manager of the locomotive works, under R. M. Deeley, whom he eventually succeeded as chief mechanical engineer in 1909. During the Great War, Fowler successively held the positions of director of production, Ministry of Munitions; superintendent of the Royal Aircraft Factory, Farnborough; and assistant director general of aircraft production, Ministry of Munitions; for these services he was created C.B.E. in 1917 and K.B.E. in 1918.

Consequent upon the amalgamation of the railways of Great Britain in 1923, Fowler was appointed deputy chief mechanical engineer, and two years later he succeeded George Hughes as chief mechanical engineer of the L.M.S. Railway. From January 1931 until December 1932 he was assistant to the vice president, and during these two years he was able to devote the whole of his energies to research and development, unhampered by the large volume of administrative work inseparable from his earlier appointments.

Although responsible for the design of several new locomotive types including the well known "Royal Scot" class, perhaps Fowler's greatest flair was for works' organization. He also realized the vast economies that could be attained by the standardization of locomotive parts, and he was an early and successful exponent of the policy of reducing the number of different types of locomotive to a minimum.

Fowler was always an enthusiastic participator in the activities of the various institutions to which he belonged, and he ultimately became president of the Institution of Mechanical Engineers, the Institute of Locomotive Engineers, the Institution of Automobile Engineers and the Institute of Metals. His keenness in furthering the interests of such bodies was coupled with a deep sense of the importance of technical education and scientific research to industry. He did a great deal to facilitate the higher technical education of the many apprentices and pupils who passed through the Derby works during his time, and he was always ready to give up his leisure to address educational and scientific bodies, and to give freely of his accumulated experience.

Of Fowler's scientific work it is difficult to speak fairly. He had no time for carrying out personally many of the investigations which he, often before his colleagues, saw were necessary; but he had an extraordinary gift of encouraging others, both within and without the railway service, to follow the lines he had indicated, and he was always most generous in providing facilities for trying out other people's ideas. In all this work he maintained an almost boyish enthusiasm, and was never happier than when he was able to spare the time to discuss the progress of some particular research with those who were actually conducting it. He was also skilful in securing the interest of eminent scientific workers in his locomotive and metallurgical problems, and he undoubtedly established for the former Midland Railway a reputation for sympathy towards scientific methods.

Fowler would probably have agreed that crank axles and boilers were the subjects that fascinated him most and his investigation into the life of the former was an almost classic example of the statistical use of a vast mass of metallurgical evidence The many problems connected with the locomotive boiler also held a great appeal and he could never resist the temptation to inspect personally any boiler that had developed some peculiar defect in service Even on his many visits abroad he invariably took his boiler suit with him and excited the admiration of his hosts (and of the writer) by his skill in negotiating the not always easy entrance to the barrel or firebox of a locomotive Therein he showed how thoroughly he understood the value of personal observation which is so essential in engineering and metallurgical research F M H

Prof P A Murphy

PAUL ALOYSIUS MURPHY whose death at the age of fifty one years occurred on September 27, was born in Co Kilkenny After courses at the Albert Agricultural College, Glasnevin, and the Royal College of Science, Dublin, extending over five years, he was appointed to a temporary post under the Irish Department of Agriculture and started research in plant pathology Later, with a Development Commission scholarship, he proceeded to the Imperial College of Science and Technology, London and to the K Biologische Reichsanstalt, in Berlin Dahlem Leaving Germany in 1914, and being rejected on medical grounds for active service, he completed his scholarship period at Cornell University He was then appointed plant pathologist in Prince Edward Island by the Canadian Government He returned to Ireland in 1921 to similar work in the Department of Agriculture there and six years later was appointed to the newly created chair of plant pathology in University College, Dublin, which he held until his death

Murphy's scientific work was very largely concerned with research on potato diseases After having helped to show the bacterial nature of the so called black leg' disease and to prove that the blight fungus (*Phytophthora infestans*) was capable of producing sexual spores—a much vexed problem up to that time—he worked out the cytology of the peculiar mode of sexual reproduction in the newly discovered allied species *P erythroseptica* Later, he considerably extended his work on the bionomics of *P infestans*, but devoted much attention to virus diseases such as leaf roll, mosaic, crinkle and streak His contributions to a scientific knowledge of these obscure diseases were particularly extensive and important, and received world wide recognition As a result of his investigations and those of a few other pioneers, the production of healthy stocks of potatoes has been placed on a sound scientific basis and important advantages to practical agriculture have already accrued To mark his eminent work in the sphere of potato husbandry, Murphy was awarded the John Snell Memorial Medal by the National Institute of Agricultural Botany in 1927

At his old college at Glasnevin (now incorporated with University College, Dublin) Murphy developed a vigorous school of plant pathology, and the sound work of himself and his colleagues there not only on virus diseases but also on others such as onion mildew swede dry rot, sugar beet crown rot and American gooseberry mildew, is a testimony to its wide scope and to Murphy's inspiring and untiring devotion to research in plant pathology

Murphy graduated at the University of Dublin (Trinity College) in his student days and was awarded the Sc D degree in 1922 He was a member of the Royal Dublin Society and a valued member of its Science Committee For his published researches, the Society awarded him the Boyle Medal in 1933, and at the time of his death these were approaching fifty in number He was also a member of the Royal Irish Academy of the Phytopathological Society of America and of the Agricultural Research Council's Committee on Virus Diseases of Plants

Murphy's loss will be deplored in wide circles, for he was always ready to help other workers Many of them, both at home and abroad, will gratefully remember his generosity in the distribution of strictly dependable material—the product of his own careful and protracted work—which greatly facilitated their own investigations He leaves a widow and two sons, for whom the deepest sympathy is felt

G H P

MR ROSSE BUTTERFIELD, of High Cote, Riddlesden, Yorkshire curator of the Keighley (Yorkshire) Corporation Museum who died recently at the age of sixty four years was a well known naturalist of the West Riding He came of a Wilsden family of naturalists and his father was a well known authority, another member of the family was the late Mr Ruskin Butterfield, formerly curator of the Hastings Museum Mr Rosse Butterfield did much valuable work in connexion with organizations of naturalists, and he was himself known for his work in entomology He had been the curator at Keighley Museum since 1910 and was due to retire next year Under his guidance the development of the Museum collections and of education in natural history has made rapid strides He was a member of the executive of the Yorkshire Naturalists' Union and was secretary of the Keighley Naturalist Society He was a member of the committee of the Bradford Natural History and Microscopical Society and was recorder for Hymenoptera Formerly, Mr Butterfield was curator of the Bronte Museum at Haworth

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WE regret to announce the following deaths

Sir James Barr, C B E , consulting physician to the Liverpool Royal Infirmary, known for his work on the diseases of the blood vascular system, on November 16, aged eighty nine years

Prof J W Bews, principal of Natal University College and professor of botany in the College, aged fifty three years

Prof William McDougall, F R S , professor of psychology in Duke University, North Carolina, aged sixty-seven years

News and Views

Dr. G S. Whitby

As announced in NATURE of November 5, p 828, Dr George Stafford Whitby, for the past nine years director of the Division of Chemistry, National Research Council of Canada, has been appointed director of the Chemical Research Laboratory of the Department of Scientific and Industrial Research, London In Canada, Dr Whitby has organized and directed chemical research in many lines, not a few leading to industrial applications and developments At the age of sixteen years, he entered the Imperial College of Science and Technology, London, where he worked under Sir William Tilden Following graduation, he spent four years on the staff of the Imperial College in teaching and research under Sir Edward Thorpe He then spent seven years in the East Indies as chief chemist to a group of British French and Belgian rubber companies His work there had a marked influence on the development of the rubber industry, and established him as one of the leading rubber chemists of the world He was appointed assistant professor of organic chemistry in McGill University in 1918, and eventually associate professor and full professor Dr Whitby has published seventy seven scientific papers chiefly in the realms of organic and colloid chemistry In 1929 he was selected to take charge of the Division of Chemistry of the National Research Laboratories, Canada Many of the research programmes initiated by him have yielded results of commercial value, notable examples being the development of refractories, improvement of testing methods and means for the utilization of asbestos, the application of research to the problems of laundering, the development of processes for the utilization of waste natural gas, studies in wool, leather, rubber and other materials of commerce

Prof. J. Plotnikow

PROF J PLOTNIKOW, director of the Physico-Chemical Institute in the technical faculty of the University of Zagreb (Jugoslavia), will celebrate his sixtieth birthday on December 4 Prof Plotnikow is very well known for his numerous investigations in photochemistry and photography, and for various books, amongst which may be mentioned "Photochemische Versuchstechnik" (2nd edition, 1928, Akademische Verlagsgesellschaft, Leipzig), "Grundriss der Photochemie' (1923, W de Gruyter, Berlin); "Photochemie fur Mediziner" (1928, G Thieme, Leipzig); and "Lehrbuch der allgemeinen Photochemie" (2nd edition, 1936, W de Gruyter, Berlin) He was born at Tambow, Russia, was a student of physics and mathematics at the University of Moscow until 1901, and from 1901 until 1908 worked in Ostwald's Institute at Leipzig, in which he was appointed assistant in 1906 Returning to Moscow, he became professor in 1916, but lost his position, his property, and very nearly his life in the Russian revolution After a year as director of the scientific laboratory of the 'Agfa" Company (Berlin), he became in 1920 a professor at Zagreb For his discovery of 'infra red shadow photography' he received the 'Goldene Verdienstsmedaille of the Vienna Photographic Society

Prof A Sommerfeld

PROF ARNOLD SOMMERFELD professor of theoretical physics in the University of Munich, will celebrate his seventieth birthday on December 5 He is able to look back on a long and successful career in mathematical physics, both in research and in teaching. During the time of his tenure of the chair in Munich, where he succeeded Boltzmann in 1905, his modest institute became the centre for students of physical theory many of whom went there from abroad for a period under his inspired guidance Among his numerous pupils who now occupy high positions in the academic world, Debye, Pauli and Heisenberg may be mentioned

Social and International Relations of Science

THE British Association has now constituted a committee to work the Division for the Social and International Relations of Science which was established at the recent meeting of the Association in Cambridge The committee, under the chairmanship of Sir Richard Gregory, includes the president and general officers of the Association *ex officio*, Sir Daniel Hall, Sir Frederick Gowland Hopkins, Sir John Russell, and Lord Stamp as vice chairmen, and as other members Prof F C Bartlett, Prof J D Bernal, Prof P M S Blackett, Mr Ritchie Calder, Mr A M Carr Saunders, Prof S Chapman, Dr C H Desch, Prof A C G Egerton, Prof H J Fleure, Mr E W Gilbert, Prof N F Hall, Mr R F Harrod, Prof A V Hill, Sir Clement Hindley, Prof L Hogben, Dr L E C Hughes, Dr J S Huxley, Mr D Caradog Jones, Prof H Levy, Dr C S Myers, Mr Max Nicholson, Sir John Orr, Prof J C Philip, Prof J G Smith, Prof R G Stapledon, Prof F J M Stratton, Prof F E Weiss, Mr H G Wells, Mr J S Wilson, Dr S Zuckerman The main purposes of the Division are stated to be "the objective study of the effects of advances in science on communities, and reciprocally the effects of social conditions upon the progress of science, and the encouragement of the application of science to promote the well being of society"

THE committee is empowered to arrange meetings of the Division to co-ordinate work dealing with the social relations of science, both at home and abroad, to be prepared to act in a consultative capacity and to supply information to organizations, individuals and the public, to initiate and carry out inquiries and research, and to secure their publication. An executive sub-committee has prepared an extensive programme of work for the full committee, which at a meeting on November 28, appointed a number of other sub-committees to deal with specific matters. These include such topics as the economic requirements of nations, the influence of scientific and technical developments on the relative importance of different industries and on the total volume of employment, the question of supplementing existing national research organizations whether in normal circumstances or at time of emergency, and the co-ordination and subsequent public presentation of work on nutrition and agriculture. Contact has already been established with organizations at work on such subjects as a survey of research in Great Britain, the prospective effects of changes in the population structure on economics, society, and occupations, and the incidence of taxation on scientific research. It is hoped to co-operate with the International Council of Scientific Unions, which has already set up a Committee on Science and its Social Relations with the view of preparing a report of world-wide scope.

Jundhi Shapur

AT a meeting of the Section of the History of Medicine of the Royal Society of Medicine on November 2, Dr. Cyril Elgood gave an interesting account of Jundhi Shapur, which was famous as the site of a university in south-west Persia, probably founded about A.D. 340. The Arab invasion of Persia took place when Jundhi Shapur was at the height of its fame. The city surrendered in A.D. 636, but was left undisturbed, and the University remained the greatest centre of medical learning in the Islamic world until the foundation of the school of medicine in Bagdad. The system of medicine taught at Jundhi Shapur was predominantly Greek, but indigenous medicine, Indian medicine and possibly Chinese medicine were also studied there. The teachers of Hippocratic medicine were reinforced by the exodus of the Nestorian professors from Edessa in 489 and of the Neo-Platonists from Athens in 529. There was also a constant flow of individual Greek physicians to the Persian royal service. The importance of Jundhi Shapur lay in its being a store-house of Greek tradition when Rome was no longer the capital of the Empire and when Constantinople was more interested in theology than in science. It was the cradle of the great Arabian school of medicine and provided most of the translators who rescued Greek texts from oblivion, thus forming the source of the renaissance of medicine in Europe. Owing, however, to the constant transfer of physicians to Bagdad, the school of Jundhi Shapur declined, and by the twelfth century ceased to function.

Awards of the Mary Kingsley Medal

PRESENTATIONS of the Mary Kingsley Medal to five recipients were made on November 23 at a reception at the Liverpool School of Tropical Medicine by its chairman, Viscount Leverhulme. This medal, struck in commemoration of the late Miss Mary Kingsley, niece of Charles Kingsley, distinguished for her work in promoting the welfare of the natives of West Africa, is awarded in recognition of services in the cause of fighting and preventing disease in the tropics. After the chairman had welcomed the guests, Prof. Warrington Yorke introduced the recipients of the medals, briefly outlining the grounds for the awards. They were: Lady Danson, honorary recipient, widow of the late Sir Francis Danson, who was Chairman of the Liverpool School over a lengthy period, and was largely responsible for the establishment of the School's research laboratory at Freetown, West Africa, and herself undertaking the duties of chairman during her husband's absences; Dr. Marshall A. Barber, with a long and distinguished association with the International Health Division of the Rockefeller Foundation, and recognized for his researches on malaria and for his work on the hookworm, and inventor of the micromanipulator; Prof. Emile Brumpt, of the University of Paris, distinguished for his researches on tropical parasitology; Prof. W. Scott Patton, emeritus professor of entomology in the School, formerly in the Indian Medical Service and director of the King Institute, Madras, well known for his researches on kala azar and oriental sore; and finally Werner Schulemann, professor of pharmacology, University of Bonn, the discoverer of the anti-malarial drug plasmoquine, which gave a great impetus to chemotherapy.

Early Anatolian Civilizations

MISS WINIFRED LAMB'S account of her third season of excavation at Kusuru, south-west of Afyon Karahissar in Anatolia, which was given before the Society of Antiquaries of London on November 17, emphasized the importance of this little-explored region for knowledge of the cultural distributions of Asia Minor in the third millennium B.C. Miss Lamb was able to demonstrate that at this early period the distinction which has been drawn between the cultures of eastern and western Anatolia is by no means so clearly defined as has been thought. The culture of the community of Kusuru in the third millennium, she finds, had much in common with that of the western Anatolian group; and she would regard the two, not indeed as dissociated, but rather as independent developments of the culture of peoples of a common stock. A relatively advanced stage of civic development is indicated by the disposition of the houses on either side of a street. These architectural remains are well preserved, and in some instances still rise to a height of more than three metres. A period of disturbances and the partial destruction of the settlement at about 2000 B.C. was followed by the appearance of a new race. The town was rebuilt and its citadel enclosed by a double wall with a gateway on the west. On the evidence of the pottery, implements and cult objects it is possible to conclude that this new people was identical with that which formed the bulk of the population of the chief Hittite centres at Boghazkoi, Alishar and Alaga. This is the first occasion on which this culture has been found so far to the south-west. Its presence here may be expected to throw light on the difficult ethnological and historical problems of the second millennium B.C.

Prehistoric Pottery in Kent

THE results of further excavations in the Bean Valley, Kent, upon which Mr. J. P. T. Burchell made a report before the Society of Antiquaries of London on November 24, have failed to support the suggestion that the pottery discovered here in a previous investigation was of palæolithic age (see NATURE, 140, 800; 1937). The evidence upon which Mr. Burchell relied in making such a suggestion was in part the absence of a mesolithic culture in the lower beds of the series in which the pottery occurred, in part the presence in the deposits of shells of the extinct *Helicella striata*, not previously recognized later than the Upper Palæolithic. Mr. Burchell's further examination of the site leads him to agree with the dissentient opinion previously expressed that this pottery is to be assigned to the early bronze age. It has been shown by this season's excavation that *Helicella striata* outlived the last glacial phase and survived into the mesolithic period. What was thought to be collateral evidence from Springhead in the Ebbsfleet valley in the form of striated implements showing the effect of glacial action has now proved to be later in date than two mesolithic floors in the valley, and consequently some other explanation of their condition must be sought. The excavations in the Ebbsfleet valley in the course of this further investigation have been pursued in exceptionally favourable conditions owing to pumping operations. It was found possible to excavate the bed of the stream to a depth of ten feet, and remains of cooking pots, decorated within and without, of a type not previously found in Britain, with flint flakes and fragments of worked wood of late mesolithic dating, were found in a grey silt below ten feet of peat.

Electricity in Coal Mines

IN a paper read by Mr. R. Nelson to the Institution of Electrical Engineers on December 1, a retrospect is given of the use of electricity in coal mines during the last thirty years and also a forecast of what still remains to be done before the mines of Great Britain are fully electrified. In the year 1883, the first electric motor pump was used to pump water from a coal mine; it was only 1½ h.p., but there was then only very little mechanical power used for any purpose below ground. Twenty-five years ago the most disastrous explosion in the history of British mining, namely, that at Senghennydd Colliery, South Wales, had the effect of causing the miners to call for the removal of electricity from the pits. Happily, by the application of systematic stone dusting a means was found of preventing the spread of an explosion of gas or coal-dust, and thereafter the miners' opposition lessened at any rate in degree, but it has not yet disappeared. During the last ten years, the coal industry has been greatly assisted by mechanized mining and mechanical methods of coal sorting. These, with normal development in other directions, have resulted in a total of more than two million horse-power of motors installed in 1937, half of them being below ground. Accident statistics are touched upon. It is recorded that taken over ten years, 1927–1936 inclusive, electricity has been responsible for 224 out of 8 656 deaths, or 2½ per cent of the total loss of life in the pits. Electricity and compressed air are rival sources of power for the machine cutting of coal. In 1937 seventy per cent of the machine-cut coal was cut by electricity. It is satisfactory to learn that in some of the recently developed South Yorkshire and Nottinghamshire coalfields, their transmission mains are interconnected, a very desirable example of co-operative working. The wider provision of cheap and unlimited current by the grid, for example, would facilitate the use of electricity for all colliery purposes, and would improve the economics of the coal industry by materially assisting mechanical mining. The author concludes with an appeal to electrical engineers to capture the confidence of the miners.

British Museum (Natural History): Acquisitions

MRS. MARY V. WALKER has presented to the Department of Zoology a set of photographs which were taken by her husband, the late Dr. William D. Walker, depicting the early life-history of kangaroos. The photographs show the kangaroo in all its stages from the newly born young on to the adult and mature individual. The first of the series shows the newly born kangaroo having just made its way into the pouch and it is seen adhering to one of the nipples. At this stage the animal is very embryonic and bears but little resemblance to the massive creature into which it will grow, being scarcely more than an inch in length and looking more like a fragment of raw flesh than the young of any animal. A skin and seven skulls of a rare species of otter (*Paraonyx microdon*) have been presented by Mr. M. D. W. Jeffreys. Mr. J. E. Perkins, assistant keeper in the Department of Entomology, spent six months from April until September 1938 in Sweden partly in the study of the important Thomson Collection of Ichneumonidæ (Hymenopterous insects the larvæ of which are parasitic on the larvæ of other insects), and partly in collecting insects, chiefly Ichneumonidæ, from the localities in Sweden where most of Thomson's specimens were obtained. More than 40 000 specimens of Hymenoptera were collected, of which 12 000 were Ichneumonidæ. A large quantity of the material obtained was identified and compared with the Thomson Collection before leaving Sweden, and the specimens so dealt with were found to represent 540 different species of which 260 were not previously to be found in the British Museum (Natural History). The collections obtained by Mr. Perkins constitute an important addition to the Entomological Department, and for the large number of specimens acquired and for the work done upon them in Sweden the Museum is indebted not only to Mr Perkins but also to his wife, who accompanied and assisted him Recent acquisitions in the Geological Department include nearly 300 invertebrate fossils from the Tertiary of the West Indies collected and presented by Dr C T Trechmann

THE Department of Botany has received the first consignment (2 800 specimens) of Dr Carl Christensen's fern herbarium Dr Christensen is the chief authority on the taxonomy of ferns and is the author of Index Filicum It is estimated that the collection comprises more than 14 000 specimens with more than 800 types and 800 co types and in addition fragments of 900 types and co types, also more than 4 000 drawings, photographs and figures The herbarium is without doubt the most important collection of ferns in private hands and will add enormously to the value of the important fern section in the Department The original drawings (426) illustrating the late E D Heathcote's Flowers of the Engadine have been presented to the Department by his daughter, Mrs D Lee A further 600 specimens of flowering plants collected by Dr H Smith in Western China have been purchased These are well collected and preserved and contain several co types A collection of 984 lichens from northern Norway and from Baffin Land made by Dr N Polunin has been purchased Although these are rather fragmentary owing to the difficulties of transport, the collections are important because they have been examined by experts and are the token specimens for several distribution records

Wild-Life of North-West England

IN a lecture to the Blackburn Naturalists Field Club on November 26 Mr Eric Hardy mentioned that oyster catchers curlew woodcock redshank tawny owls and spotted woodpeckers are all increasing their nesting range in Lancashire and Cheshire, but the terns are becoming fewer at the well known Ainsdale sea bird sanctuary His subject of On My Rounds Notes From a Naturalist's Notebook described his field studies in Knowsley Park where great crested grebes, sandpipers, kingfishers and goldcrests are all common nesters and winter wildfowl visiting the great lake are more numerous and varied than at any other Lancashire water, he also showed a series of Dufay natural colour photographs taken at London Zoo this year and some scenes from Whipsnade Zoo, while the small herd of Chartley wild cattle there was compared with photographs of the original herd at Chartley Park, Staffordshire, now extinct, but of which Mr Hardy has two valuable photographs taken by a Liverpool naturalist in 1891 when the historic herd totalled 52 and tuberculosis had not then broken out At the Liverpool Cathedral Wild Birds' Sanctuary, said Mr Hardy, there is a resident population of a few blackbirds, greenfinches, song thrushes and wrens, but in winter chaffinches, great tits, cole tits and goldcrests visit it and during migration willow warblers are frequently heard, despite the sanctuary being in an old cemetery in the midst of city slums From this position inside the city valuable migration and other observations have been made as a refuting of the old belief of great migrations of city sparrows to distant harvest fields, but owing to the position of a new masons shed directly above the sanctuary, it has not been possible to attract many birds this year although the sanctuary is to be reconditioned and improved

Industrial Research in India

THE report of the Industrial Research Bureau, Government of India, for the year 1937–38 (Delhi Manager of Publications), covers the activities of the Industrial Research Council, the Industrial Research Bureau, which has been placed on a permanent basis as from March 1, 1938, and of the Research Branch of the Government Test House in the third year of its working Special attention has been devoted to the improvement of glass products and, in addition to the work in this field described in a separate chapter of the report, including the improvement of glass furnaces and a survey of glass making materials, the Council has authorized further work with an improved type of pot furnace The Research Branch of the Government Test House has been responsible for a considerable amount of work on paints, natural weathering and accelerated weathering tests and also on the construction and performance of dry cells Work has also been carried out on the use of vegetable oils as fuels and as lubricants for internal combustion engines, and promising results have been obtained with β naphthol diphenylamine, acetylphenylhydrazine and tin naphthenate as antioxidants in blends of castor oil with mineral oils Information on the manufacture of casein and casein plastics in India is being collected, and a number of investigations on oils and soaps have been allocated The report includes particulars of publications of the Bureau and of inquiries received

Research in Education in the United States

As a step toward canalizing research activities in the field of secondary education, much of which might otherwise run to waste, the United States Office of Education has published a bulletin on Needed Research in Secondary Education' (Washington, D C Supt of Documents Pp 70 Price 10 c) The bulletin is largely based on the monographs of the National Survey of Secondary Education, a collection of important research studies (more than 4,400 pages in all) relating to organization of schools, the pupil, administrative and supervisory problems and personnel, the curriculum and 'the extra curriculum Before proceeding to indicate specific problems needing investigation, the author discusses some general characteristics of contemporary methods of educational research, distinguishing, for the purpose of evaluating results three levels of quality the study of the results of practices (1) in any and all schools as found, (2) in schools selected for their outstanding merit, and (3) in experimental conditions set up especially for the purpose of testing theory He emphasizes the need for more co-ordinated and co operative research enterprises such as the college entrance inquiry, undertaken by the Progressive Education Association, into college entrance problems, in which three hundred colleges and thirty schools are participating Indications of specific problems needing investigation are given under twenty-five headings, corresponding with the several survey monographs already referred to; for example, individual differences, guidance, interpreting the secondary school to the public, and the library

Co operative educational research on an un precedented scale was undertaken in 1936–37 by sixty universities in the United States under what was known as the Project in Research in Universities of the Office of Education An important feature of the project was the widespread and co ordinated attack on each of forty selected problems by a number of universities at the same time The results of the investigations have been reported in a series of bulletins issued by the Office of Education An interesting example of these is Bulletin No 17 on Opportunities for the Preparation of Teachers of Exceptional Children (Washington, D C Super intendent of Documents Pp 58 Price 10 c) This gives a conspectus of courses concerning the education of eight different groups of exceptional children blind, deaf, crippled, delicate, speech defectives, mentally retarded, mentally gifted, and socially or emotionally maladjusted In recent years such courses have been characterized by an increasing breadth of the pre requisites for qualifying as a teacher of any one of these groups, candidates being required to have a general knowledge of the teaching methods appropriate for use with normal children and of the needs and problems of exceptional groups other than that chosen for special study Of the courses concerning the education of exceptionally gifted children, the report notes that "so little is known to day as to how gifted children should be educated that it is not surprising to find so few teacher education institutions presuming to tell their students in any intensive way how to do it"

Suggested New Peace Conference

The petition for the holding of a New Peace Conference open to all nations and directed towards remedying the economic and political conditions likely to lead to war, and urging the Government to take, in consultation with the President of the United States of America, the necessary steps to secure the holding of such a Conference, which has been sponsored by the National Peace Council, has received an excellent response Requests for more than 100,000 petition forms have been received from national organizations, most of which will go to local organizations The National Peace Council has also issued an appeal for the sum of £2,000 to liquidate an accumulated deficit and provide the expansion of income required for its growing work in mobilizing public opinion in Great Britain in support of efforts to lay the foundations of a general and durable peace

Activity of the Leonids

Mohd A R Khan Begumpet, Deccan, observed the Leonid shower this year on November 14–17, and found that it was more active than it has been for several years On the night of November 15, in spite of the fact that the radiant was close to the moon, between $21^h\ 30^m$ and $22^h\ 30^m$ U T , out of 31 meteors observed 14 were Leonids Several of them were bright, the magnitudes in some cases being 0 or even brighter, and most of them were followed by expanding streaks During the next half hour the numbers fell off, only two out of eleven meteors observed being Leonids On the following night, between $21^h\ 5^m$ and $22^h\ 35^m$ U T , out of 48 meteors observed, 12 were Leonids but on November 17, only two Leonids were observed out of a total of eight meteors between $23^h\ 30^m$ and 24^h U T The Leonid shower has been rather feeble for some years but this year it returned with surprising activity

Another Large Sunspot

Sunspot frequency remains high, and large spots within the range of naked eye vision have averaged, so far this year, one new group in about every ten days Very large spots, say of area greater than 1,000 millionths of the sun's hemisphere have been well represented, no fewer than thirteen having been recorded during the eleven months of 1938 A group of spots, first seen near the sun s east limb on Novem ber 23 in solar latitude 14° north grew rapidly in the next few days from 150 millionths to 1,950 millionths by November 27 The date of central meridian passage of this large group was November 28 8, and the west limb will be reached on December 5 On December 6, a region of the sun containing another large spot, which was developing during its approach to the west limb, will come into view again at the east limb

Announcements

The Buchan Prize for 1939 of the Royal Meteoro logical Society has been awarded to Dr E W Hewson, for papers contributed to the *Quarterly Journal* of the Society during the years 1933–37 dealing with The Application of Wet Bulb Potential Temperature to Air Mass Analysis"

The following officers for the session 1938–39 of the University of Durham Philosophical Society have recently been elected *President*, Very Rev C A Alington , *Hon General Secretary* Dr W A Clark *Hon Treasurer*, Mr J W Bullerwell , *Editor*, Prof G W Todd

An exhibition of optical aids will be held in Barnsley Grammar School on December 10 During the after noon, Mr H S Magnay, director of education, Barnsley, will speak on ' The Work of the British Film Institute ' Further information can be obtained from the Exhibition Secretary at the Grammar School

Dr Eugen Korschelt, emeritus professor of zoology and comparative anatomy in the University of Marburg, has been awarded the Goethe medal for art and science

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1000.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Further Evidence for the Radioactive Decay of Mesotrons

IT has been shown recently by Euler and Heisenberg[1,2] that the postulate that heavy electrons (or mesotrons as they seem to be finally named) are radioactively unstable, with a mean time of decay when at rest of about 2×10^{-6} seconds, is capable of explaining quantitatively the greater apparent absorption of penetrating cosmic rays in air than in dense materials.

Exactly the same considerations serve to explain the observations of Auger, Ehrenfest, Freon and Fournier[3], who measured the zenith angle distribution of the penetrating rays at different altitudes above sea level and found that the absorption of the inclined rays was greater than that of vertical rays under the same thickness of absorber.

Assume an isothermal atmosphere, so that the pressure will vary with the height z as $\exp(-z/z_0)$ where z_0 defines the rate of decrease of pressure with height. Let I_0 be the vertical intensity at sea level, and let I_1 be the intensity at a height z_1, in such a direction θ_1 from the zenith that the total mass of absorber is the same, so that θ_1 is given by $\cos\theta_1 = \exp(-z_1/z_0)$.

Following Euler and Heisenberg, we suppose that the mesotrons are produced by the incident primary rays after the latter have traversed a thickness of absorber equivalent to a fraction $f \approx 1/10$ of the vertical thickness of the atmosphere. Then the rays coming vertically downwards will be produced at a height z_m given by $f = \exp(-z_m/z_0)$ and those inclined at an angle θ_1 will be produced at a height z^1_m given by $f \cos\theta_1 = \exp(-z^1_m/z_0)$. Since the vertical rays traverse a path of length z_m to reach sea level, and the inclined rays a path $(z^1_m - z_1) \sec\theta_1$, to reach the height z_1, the excess path traversed by the latter is $l = (z^1_m - z_1)\sec\theta - z_m$. The relative intensity of the inclined rays to the vertical rays is then $I_1/I_0 = \exp(-l/L)$ where L is the mean range of the mesotrons before decay. Using the expressions given above for l, z_m, z_m^1 and θ_1, we obtain

$$\frac{I_1}{I_0} = \exp\left\{\frac{z_0}{L}\left(e^{z_1/z_0} - 1\right)\log f\right\}$$

From the meteorological data[7], we have $z_0 = 7.0$ km., and assuming $f = 1/10$ corresponding to a height of formation of mesotrons of 16 km., we obtain, using the observed ratios of I_1/I_0 taken from the data of Johnson[4] and of Auger and others, the values of L given below.

Height	(I_1/I_0) obs.	L calc.	Observer
1.9 km.	0.78	20 km.	Johnson
3.4 km.	0.69	25	Auger and others
		mean 23	

It has been further shown by Blackett[5] that the observed temperature coefficient α of cosmic rays can be explained as due to the greater vertical extension of a warm atmosphere, and should be given by the expression $\alpha = (dz/d\theta)/L$, where $dz/d\theta$ is the rate of increase with temperature of the layer of the atmosphere where the mesotrons are formed. Cosmic ray observations[6] give $\alpha = -0.18$ per cent per °C. and the meteorological data[7] give $dz/d\theta = 45$ m. per °C. for a height of about 16 km. Thus we get $L = 25$ km., in close agreement with the value of 24 km. found above for rays of about the same energy.

Consider now the observations of the mass absorption anomaly between air and water. The observed intensity under 60 m. water is one half that at sea level under the same mass of air, that is at an angle θ_1 such that $\sec\theta_1 = 6.0$. The height of formation of the rays, calculated as above, is 28.6 km. and so the difference of path between the inclined and the vertical rays is $28.6 \times 6 - 16 = 156$ km. This is the *half value* range, giving a *mean* range $L = 156/0.693 = 225$ km. The mean energy of the rays which penetrate 60 m. water can be estimated from the measured energy spectrum to be 3×10^{10} e. volts, while the mean energy of the rays at sea level is about 4×10^{9} e. volts.

We thus have two rough determinations of L for two different roughly estimated mean energies, E.

Experiment	L		E	L/E
Mass absorption anomaly	[illegible] km.		3 × 10^{10} e. volts	km. (e. volts)$^{-1}$ [illegible] 5 × $10^{[illegible]}$
Inclination anomaly	23	24 km.	4 × 10^{9} e. volts	mean	6 × $10^{[illegible]}$
Temperature effect	25			6.8 × $10^{[illegible]}$ km. (e. volts)$^{-1}$

If τ and τ_0 are the decay times of a particle of mass μ when at rest and when moving with energy $E \gg \mu c^2$, we have, from relativity considerations,

$$L = c\tau = \tau_0 E/\mu c$$

whence $L/E = \tau_0/\mu c$ = constant. This is seen to be approximately the case, thus verifying approximately the change of time scale of a moving particle.

The mean observed value of the constant gives $\tau_0/\mu = 1.29 \times 10^{19}$ sec./gm.$^{-1}$. It is thus the ratio τ_0/μ that is given directly by such experiments. To get τ_0, the mass must be assumed. Taking $\mu = 150\ m_e$, we get $\tau_0 = 1.7 \times 10^{-6}$ sec.

P. M. S. BLACKETT.

The University,
Manchester.
Nov. 7.

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[1] Euler and Heisenberg, *Ergeb. exak. Naturwiss.*, **17**, 1 (1938).

[2] See also Blackett, NATURE, **142**, 169 (1938).

[3] Auger, Ehrenfest, Freon and Fournier, *C.R.*, **204**, 257 (1937). See also *Rossi*, NATURE, in the Press.

[4] Johnson, *Phys. Rev.*, **43**, 307 (1933).

[5] Blackett, *Phys. Rev.*, in the Press.

[6] Compton and Turner, *Phys. Rev.*, **52**, 799 (1937).

[7] Humphreys, "Physics of the Air" (Philadelphia, 1930), Fig. 16 and Table 3.

[8] Blackett, *Proc. Roy. Soc.*, A, **159**, 1 (1937).

IN a recent paper, Euler and Heisenberg[1] have thoroughly discussed the hypothesis that the hard component of the cosmic rays consists of 'mesotrons' produced in the upper layers of the atmosphere by primary electrons or photons and then disintegrating as predicted by Yukawa's theory of nuclear forces with a life time τ of the order of 10^{-6} sec. (τ is relative to a system in which the particle is at rest; whilst in a system in which the particle is moving with a velocity $v = \beta c$ the life time becomes[2] $\tau^1 = \tau/(\sqrt{1-\beta^2})$.)

In practice, the particles may disintegrate before they are brought to rest by ordinary loss of energy only in a gas, since in a liquid or solid absorber a 'mesotron' of a given velocity βc is stopped within a time which is very small in comparison with $\tau/(\sqrt{1-\beta^2})$. By traversing a gas absorber, the intensity of the hard component would therefore be more reduced than by traversing a liquid or a solid absorber of the same stopping power.

It has been pointed out that this theoretical result is confirmed by Ehmert's experiments, which give a difference of the kind expected between the absorption curves of cosmic rays in air and water[3].

In connexion with this, it is perhaps worth while to direct attention to some similar results previously obtained by De Benedetti and myself in Eritrea (geom. lat. 11° 30' N., 2,370 m. above sea-level)[4]. In these experiments the absorption of the cosmic particles was measured (*a*) in lead by interposing lead screens between two counters placed one above the other; (*b*) in air by inclining the counter system, thus increasing the thickness of the air layer traversed by the particles. In a first experiment each counter was surrounded by a cylindrical lead shield of 1.7 cm. thickness. Full absorption curves were taken; the lead curve begins with a steep decline (owing to the absorption of the soft component which is not completely cut off by the lead cylinders) but it then becomes nearly horizontal. The air curve on the contrary, descends smoothly, cutting the lead curve at about 120 gm./cm.^{2}.

In a further experiment, 4 cm. of lead was placed permanently between the counters (in addition to the lead cylinders) in order to avoid the disturbing effect of the soft component. One point only of each absorption curve was measured; namely, at 136 gm./cm.^{2} (12 cm.) lead and at 121 gm./cm.^{2} air (counter system inclined by 30°). The results were as follows:

		coin./min.
Counter system vertical	lead cylinders + 4 cm. lead	0.626 ± 0.009
	+ 4 + 12 cm. lead	0.575 ± 0.009
inclined	+ 4 cm. lead	0.516 ± 0.008

Both experiments show very definitely that the hard component is much more reduced by air than by lead. The difference would have been still greater in absence of the earth's magnetic field, which acts in the sense of diminishing the observed air absorption, as the counter system was inclined in a *westerly* direction. We may correct for the magnetic influence approximately by taking the average of the intensities in the western and in the eastern direction, which differ, under the actual experimental conditions, by a factor of about 1.2. We shall use, therefore, instead of the measured value 0.516, the corrected value $\frac{1.1}{1.2} \times 0.516 = 0.473$ for the frequency of the coincidences at 30°.

The difference between the air and the lead absorption, for which no satisfactory explanation had been found at that time, can now easily be accounted for on the disintegration hypothesis. The inclined rays have of course to travel a greater distance than the vertical ones before they reach the counters.

We assume that all the observed mesotrons are produced at a given depth R below the top of the atmosphere where R, as pointed out by Blackett[5], has to be measured in the actual direction of the incoming particles. The difference Δl between the paths of the particles which at an altitude of h km. above sea-level, are observed at a zenithal angle φ and in the vertical direction respectively, is then given by the formula

$$10^{-5}\,\Delta l = \left(\frac{10.33}{1.29}\log\frac{1033}{R} - h\right)\left(\frac{1}{\cos\varphi} - 1\right) - \frac{10.33}{1.29}\log\frac{\cos\varphi}{\cos\varphi}$$

Putting $h = 2.37$, $\varphi = 30°$ and taking for R the value corresponding to the maximum of the Regener–Pfotzer curve, namely, 100 gm./cm.^{2}, we get $\Delta l \sim 4 \times 10^5$ cm.

On the other hand, since the loss of energy by ionization is about the same in 121 gm./cm.^{2} of air and in 136 gm./cm.^{2} of lead, we may assume that the relative number $\Delta n/n$ of mesotrons which disintegrate by travelling the distance Δl is given by

$$\frac{\Delta n}{n} = \frac{0.575 - 0.473}{0.626} = 0.163$$

This result enables us to calculate the life time of the mesotrons. If we suppose, for reasons of simplicity, that they all have the same energy, say ε times the rest energy μc^2, with $\varepsilon \sim 40$, we have

$$\tau = \frac{\Delta l}{\beta c}\,\frac{n}{\Delta n}\sqrt{1-\beta^2} \sim \frac{\Delta l}{c}\,\frac{n}{\Delta n}\,\frac{1}{\varepsilon} \sim 2 \times 10^{-6}\ \text{sec.}$$

We obtain, therefore, a life time just of the order of magnitude previously given. Chiefly owing to the uncertainty in the value to be introduced for ε, the above estimate may be too low or too high by a factor 2.

BRUNO ROSSI

Universitetets Institut for teoretisk Fysik,
København.
Nov. 4.

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[1] Euler, H., and Heisenberg, W., *Ergeb. exakt. Naturwiss.*, **17**, 1 (1938). The same point of view has been developed in a discussion at the Physical Institut in Rome. I am indebted to Prof. Bernardini for telling me of this. See also Blackett, P. M. S., NATURE, **142**, 692 (1938).

[2] Bhabha, H. J., NATURE, **141**, 117 (1938).

[3] Ehmert, A., *Z. Phys.*, **106**, 751 (1937).

[4] Rossi, B., *Ricerca Scient.*, **51**, 79 (1934); *Phys. Rev.*, **45**, 212 (1934). De Benedetti, S., *Ricerca Scient.*, **51**, 590 (1934); *Phys. Rev.*, **45**, 214 (1934).

[5] Blackett, P. M. S., see letter above. I am indebted to Prof. Blackett for a discussion on this point at the conference on cosmic rays held in Copenhagen on Oct. 25–29.

Range of Nuclear Forces in Yukawa's Theory

FOUR years ago, Yukawa, in an attempt to develop a relativistic theory of the interaction of heavy particles in nuclei, was led to predict the existence of charged particles of mass intermediate between those of the electron and the proton[1].

In view of the great interest and hope raised by the striking discovery in cosmic rays of particles having just the desired mass, which one is naturally tempted to identify with Yukawa's particles, it may be desirable to have a derivation as elementary as possible of the fundamental relation

$$\rho = \frac{h}{mc}, \qquad (1)$$

where ρ is range of the nuclear forces, h is Planck's constant, m is the mass of the heavy electron'[1], c is the velocity of light, which led Yukawa to his remarkable prediction

It may perhaps be of interest therefore, to point out that the meaning of relation (1) may be simply illustrated by an argument based on Heisenberg's Uncertainty Principle, in close analogy to Bohr's discussion of Gamow's formula and other related problems

The argument runs as follows in Yukawa's theory the interaction between heavy particles is carried by the semi heavy particles, by means of simple emission and absorption processes (much in the same way as the relativistic interaction between two electrons can be described in terms of emission and absorption of light quanta), these are not, of course, actual emission and absorption processes, which would be contrary to the energy principle, they are called, therefore, virtual transitions Let us see, however, a little closer how it comes about that the energy principle is respected One might try to show that this is not so by setting up some device which could see the heavy electron whilst it is travelling from one heavy particle to the other In this case the energy principle can only be saved, as usual, if the uncontrollable energy exchange involved in the operation of the device is so large as to cover the energy excess actually observed, which is at least mc^2 Now the time t employed by the Yukawa particle in travelling from one heavy particle to the other is at least r/c, where r is the distance between the heavy particles The time of operation of the device must on the other hand be smaller than t (otherwise the system will react as a whole, and the device will not be able to detect the presence of the individual Yukawa particle), but it need not be essentially smaller than this We see, therefore, that the energy uncertainty will be, at most

$$\Delta E \sim hc/r$$

The condition

$$\Delta E > mc^2$$

actually gives the distance (1) as the limit up to which virtual transitions can make themselves felt without contradiction of the energy principle It may be remarked that by assuming a velocity of the intermediate particle smaller than c, it is only possible to reduce the energy uncertainty further, so that the consideration of relativistic velocities actually gives the optimum conditions or the upper limit to which the interaction may extend

I am very glad to express my thanks to Prof N Bohr for his kind interest and the Fondazione Volta of the C d R for a grant enabling me to stay in Copenhagen

G C WICK

Istituto Fisico,
Palermo
Oct 31.

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[1] Yukawa H *Proc Phys Math Soc Japan* 17 48 (1935) see also Fröhlich, H Heitler W Kemmer N, *Proc Roy Soc* A 166 154 (1938) and several papers quoted there

Vector Maps as Positive Evidence in Crystal Analysis

THE principle of crystal analysis by means of vector maps may be indicated briefly as follows If the electron density throughout a crystal is expressed by a triple Fourier series ρ whose typical coefficient is the complex number a, the triple Fourier series V whose typical coefficient is the real number $|a|^2$ has two properties (1) the coefficients in V are determinable from and collectively resume all the information given by observations of intensities of reflected X rays, (2) a maximum value of V corresponds in position to a step between positions for which ρ is a maximum Since the points at which maximum values of ρ occur are the individual atoms, we can say that the observed data are made to furnish directly the vector map of the atomic structure The ultimate usefulness of the method depends, therefore, theoretically on the extent to which a vector map S_2 determines, or at least characterizes, the nuclear structure from which it is derived, practically on the efficiency of a mathematical technique for achieving such deduction as is theoretically within reach Until recently, it was thought that the direct value of the vector map was small and that the map was in effect only a test to be applied to structures suggested independently, and by showing that the main features of the atomic structure can be read from the map and that in many cases every detail of the atomic structure is implicit in the details of the map, Dr Wrinch has opened a new chapter in crystal analysis[1]

An argument has been used which purports to demonstrate without the trouble of examining specific instances that substantial reconstruction is theoretically impossible Since the vector series V is unaffected by a change in the angle of any coefficient a provided that the modulus $|a|$ is unchanged one series V is common to a multiply continuous infinity of density series ρ Therefore runs the argument every vector series must be common to an infinity of atomic structures, and we must accept the depressing conclusion that although an immense amount of toil has been devoted to collecting intensity observations and constructing vector diagrams for actual substances, this toil and the ingenuity and patience which have been needed for the discovery of structures compatible with the diagrams have alike been wasted since the probability that a particular structure found in this way is the correct one remains in any event negligibly small

When, however, we set to work actually to infer an atomic structure S_1 from a given vector map S_2 nothing is clearer than that the possibilities are finite and the probabilities far from zero A trivial example is in this respect typical the map which consists of the origin O, a single point A, and the image of A in O, is the map of a point pair congruent with OA, and cannot conceivably be the map of any other configuration Dr Wrinch is undoubtedly right the Patterson diagrams contain far more information than was suspected before she began to study the published insulin diagrams for herself In fact, reconstruction of a discrete point set from its vector map is a systematic process At various stages alternatives must be examined, but the analysis is exhaustive Sometimes it happens that a problem has two or more solutions, but geometrically this would seem to be a rare accident There are no parameters in the solutions The notion that the atomic structure remains hopelessly indeterminate however thoroughly the vector analysis is carried out is quite untenable; it is obviously absurd in the simplest cases, and gains nothing in plausibility when the map is complicated, for the number of conditions to be satisfied by the interatomic measurements rapidly outstrips the number of measurements available.

The explanation of the discrepancy is not hard to find. An arbitrary density series ρ does not represent even approximately the state of high concentration near isolated nuclei that we translate as an atomic structure. *Stringent conditions must be satisfied if* ρ is to correspond to a point set. If then the coefficients in ρ vary while the derived vector series V is unchanged this does not imply continuous variation of an atomic structure: it is only that the sharpness with which ρ represents such a structure is lost usually beyond discovery.

Experiment cannot furnish all the coefficients of an infinite series. In utilizing the observational data we have to be content with a vector series which is reduced to a small number of leading terms and with a density series which accounts for these leading terms. On any view we must regard a curtailed density series as nothing more than a useful approximation, and a point structure that would imply a discrete vector map is nothing less than another approximation which has an equal claim to consideration. But we must not think of the two approximations as exclusive alternatives. We can change from one form of approximation to the other halfway through a single investigation, and when we have been shown that discrete maps are decipherable we realize that this is just what we must do. Intensity measurements provide a V series; the V series provides a family of surfaces the nuclei of which constitute a set which from its physical origin must, within the observational limits of accuracy, be the vector map S_2 of some point structure S_1. The problem is now one for the mathematician, whose verdict on the evidence is final. If there is only one S_1 from which the S_2 is derivable, that S_1 is as perfect a picture of the atomic structure as the observations justify. Should there be more than one S_1, the problem remains open until reasons for discrimination are found, but such reasons must lie elsewhere than in the X-ray measurements. It should be added that while multiplicity of solutions is possible, the more elaborate the vector map the less is the likelihood of multiplicity. In other words, as the labour of proving the uniqueness of a solution becomes prohibitive, the probability that a structure which has the right map is the correct structure increases, and in the case of a megamolecule, if one atomic structure is shown to fit the facts exhibited in the vector diagrams, criticism which does not begin by providing another structure which also fits these facts need not be taken too seriously.

E. H. NEVILLE

University, Reading
Nov. 15

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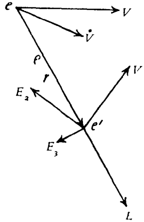
[1] See for example NATURE 142, 955 (1938).

A Comprehensive Fundamental Electrical Formula

IN a letter on "Fundamental Physical Concepts" which appeared in NATURE of August 13, I suggested that it should be possible to dispense with magnetic considerations in fundamental physical theory, and to express the forces acting on elementary electric charges at rest and in uniform or accelerated motion by a single comprehensive formula; and I was very glad to learn from Mr. Rollo Appleyard's letter in NATURE of September 17 that Sir Horace Lamb had expressed the desirability of dispensing with the duality of electricity and magnetism. Such a formula has now been worked out and may be expressed most conveniently in the form

$$f = m\dot{V}' = Ee' = \frac{ee'}{r^3}\left\{\rho + ([V'[V\rho]] + [\rho[\rho\dot{V}]])/c^2\right\},$$

where f is the force on a charge e' moving with vector velocity V', due to a charge e moving with vector velocity V and acceleration $\dot{V}$, ρ is the vector distance ee' of length r, and c is the velocity of electric wave propagation in space. The charges e and e' and the electric force E are in C.G.S. electrostatic units, m is the total mass of e', including its 'electromagnetic mass', and the square brackets imply vector products.



The electric force E has three components $E_1 = \frac{e}{r^2}\frac{\rho}{r}$, which is obviously the electrostatic force in the direction of ρ; $E_2 = \frac{e}{c^2r^3}[V'[V\rho]]$ perpendicular to V' and in the plane $V\rho$, which represents the force on a current element $i\,ds = e'V'/c$ due to a current element $i\,ds = eV/c$ and is derivable from Ampère's experiments; and $E_3 = \frac{e}{c^2r^3}[\rho[\rho\dot{V}]]$ perpendicular to ρ and in the plane $\dot{V}\rho$ which is due to the electric wave excited by the acceleration of e. This last term covers current induction and leads directly to Neumann's inductance formula $M = \iint ds\,ds' \cos\epsilon/r$, but it has the advantage of giving the electric force E itself instead of its line integral round a closed circuit, and hence of being applicable to unclosed conductors. The accompanying diagram shows the three electric forces E_1, E_2 and E_3, when V, V', $\dot{V}$ and ρ are coplanar.

It will be noticed that no magnetic quantities whatever appear in the formula, as the permeability of space is implicitly included in the velocity $c = 1/\sqrt{\varkappa_0\mu_0}$, which is determinable by purely electrical measurements. If the charges e and e' are in a medium of relative permittivity $\varkappa$ and permeability μ, the formula becomes

$$f = Ee' = \frac{ee'}{\varkappa r^3}\left\{\rho + ([V'[V\rho]] + [\rho[\rho\dot{V}]])/v^2\right\},$$

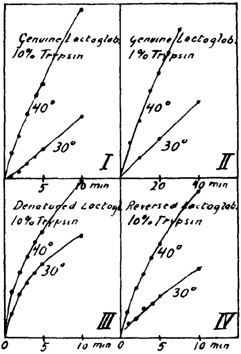
where $v^2 = c^2/\varkappa\mu$, which introduces the permeability μ explicitly, as Mr. Appleyard suggested, but it need not be considered as a magnetic quantity as it is determinable by search coil methods which do not involve magnetic measurements It must be borne in mind, however, that all material media are aggregations of ions, each of which exercises its individual influence, so that this latter formula is only a convenient one for practical applications

C V DRYSDALE

The Athenæum,
London, S W 1
Oct 19

Peptide Bonds in Globular Proteins

IT is well known that genuine proteins (at pH 7) are attacked by crystalline trypsin which, on the other hand is able to split synthetic peptides This has been taken as support for the view that these proteins contain peptide bonds in their molecules[1]



We wish, however to point out that in the light of the following consideration, this support loses a great deal, if not all, its importance If, according to Anson and Mirsky denaturation is reversible, then in a solution of a given globular protein there is an equilibrium between genuine and denatured protein,

$$G \rightleftarrows D$$

Hence it is sufficient that D and only D should contain peptide bonds open to fission by trypsin, because by removal of D by hydrolysis this process is forced in the direction from left to right and G will gradually disappear as well The problem is open to experimental test in two different ways

(1) When the protein is hydrolysed with so much trypsin that the rate of the above process becomes the limiting factor in the total reaction, then we must expect the temperature coefficient for the hydrolysis to approach that of the reversible denaturation, which is presumably very high

(2) If a protein solution is heated for a short time to a temperature at which the process is proceeding rapidly and completely from left to right and then quickly cooled down to a temperature where it is a slow process a protein solution is obtained which contains initially more D than corresponds to the equilibrium at that (low) temperature Hence we may expect to find a more normal (that is, a lower) temperature coefficient for the hydrolysis of the protein in this solution Upon standing the equilibrium will slowly be reached and the temperature coefficient of the hydrolysis by much trypsin will tend to rise correspondingly

Some preliminary results are shown in the accompanying figure

(1) Equal volumes of 2 per cent lactoglobulin and 10 per cent trypsin (Merck) were mixed The reaction was followed by precipitation with trichloroacetic acid and the ordinates are the values for the nitrogen soluble in this acid The reaction temperatures chosen were 30° and 40°, pH was 7

(2) As (1) but with 1 per cent trypsin

(3) As (1), but the lactoglobulin solution was heated for 1 minute to 100° and rapidly cooled down again Trypsin was added immediately

(4) As (3), but the trypsin was added 20 hours later

(Commercial trypsin was used because it contained very little substance precipitable by trichloroacetic acid under the conditions applied In addition, it contained large quantities of enzymes which break down further the split products from the trypsin hydrolysis This is rather an advantage, since it is possible that these split products give precipitates with trichloroacetic acid)

(1) and (2) show that there is a small but distinct rise in the temperature coefficient of the initial hydrolysis rate, K with increasing trypsin concentration (1 per cent trypsin K_{40}/K_{30} 3 3, 10 per cent trypsin K_{40}/K_{30} – 4 3)

(1) and (3) show a pronounced fall in the temperature coefficient after the protein solution has been heated (K_{40}/K_{30} – 1 9) and cooled again

(3) and (4) show that this effect is partly reversible

These experiments provide sufficient basis for giving a warning against the conclusion that genuine proteins contain peptide bonds because they are split by proteinases like trypsin They give a certain indication that peptide bonds are formed or 'appear' (like SH groups) upon denaturation, but they are not conclusive enough to decide whether or not some hydrolysable peptide bonds are pre formed in the molecules of the genuine globular proteins

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[1] Linderstrøm Lang K *Collegium* 10 501 (1937)

New Derivatives of the Silyl Radical

THE compound monochlorosilane, SiH_3Cl, prepared in 1919 by Stock, was shown by him to yield volatile monomeric derivatives in its reactions with water and ammonia With water it forms the compound $(SiH_3)_2O$, which is a gas, b p – 15 2°, and with ammonia the product is an amine-like body of the formula $N(SiH_3)_3$, b p + 52° This field appeared to us to be one which was capable of great extension and we have already made a number of interesting observations Thus we find that monochlorosilane reacts spontaneously and quantitatively with methyl amine according to the equation

$$3CH_3NH_2 + 2SiH_3Cl = CH_3N(SiH_3)_2 + 2CH_3NH_2HCl$$

The product, methyldisilylamine, is a liquid b p + 32 3°, which is stable in air, but is quantitatively hydrolysed by alkali its formula has been established by analysis and by vapour density determinations It differs from aliphatic amines in being quantitatively decomposed by hydrogen chloride

$$CH_3N(SiH_3)_2 + 3HCl = 2SiH_3Cl + CH_3NH_2HCl$$

Ethyldisilylamine, prepared by identical methods is a liquid of very similar properties boiling at + 65 9°

Trimethylamine and monochlorosilane have been found to combine in the cold in strictly equal volumes giving a stable solid quaternary compound $N(CH_3)_3SiH_3Cl$ This differs from the organic quaternary compounds in being instantaneously decomposed by water to form trimethylamine hydrochloride and disiloxane, $(SiH_3)_2O$ It is also decomposed on standing in moist air The ultimate products in this case are silicic acid and trimethylamine hydrochloride, but the intermediate products are soluble in water, giving solutions with strong reducing properties It is hydrolysed by alkali according to the equation

$$N(CH_3)_3SiH_3Cl + 3NaOH = Na_2SiO_3 + NaCl + N(CH_3)_3 + 3H_2$$

The dissociation pressure of the salt is 9 mm at 20° and this increases to one atmosphere at 91° The dissociation, however, is not reversible due to the disproportionation of the SiH_3Cl formed, thus

$$N(CH_3)_3SiH_3Cl \rightleftharpoons N(CH_3)_3 + SiH_3Cl$$
$$2SiH_3Cl \rightleftharpoons SiH_4 + SiH_2Cl_2$$

Trimethylsilylammonium chloride is a convenient silylating agent as the trimethylamine present will fix quantitatively any hydrogen chloride formed in a reaction Thus we have shown that it will react with alcohols to form volatile silyl alkyl ethers, which may be isolated with ease, for example

$$C_2H_5OH + N(SiH_3)(CH_3)_3Cl = SiH_3\,O\,C_2H_5 + N(CH_3)_3HCl$$

Monochlorosilane and dimethylamine react at room temperature with the production of the compound $N(SiH_3)(CH_3)_2$ This amine appears to form an unstable quaternary salt with excess of monochlorosilane There is thus a gradual decrease in the stability of these quaternary salts and we may formulate the following series

I	$N(CH_3)_4Cl$	Stable
II	$N(SiH_3)(CH_3)_3Cl$	Moderately stable
III	$N(SiH_3)_2(CH_3)_2Cl$	Unstable
IV	$N(SiH_3)_3(CH_3)Cl$	Not formed
V	$N(SiH_3)_4Cl$	Not formed

The members IV and V had they been formed, would have been detected in the preparation of the amines $N(SiH_3)_2(CH_3)$ and $N(SiH_3)_3$, since both of these preparations were carried out in the presence of an excess of monochlorosilane

We are at present extending these observations, and attempting to prepare compounds of the silyl radical with other elements, such as phosphorus, arsenic and lead

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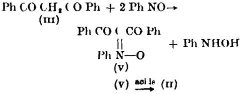
A Degradation Reaction in Organic Chemistry

THE method described below by means of examples enables the group CO CO CO or CO CH₂ CO to be converted into the dicarbonyl group CO CO which is virtually the degradation of a propane derivative into an ethane derivative

For example diphenyltriketone (I) is changed by warming with acids (for example, sulphuric acid acetic acid) into benzil (II)

$$\underset{(I)}{\mathrm{Ph\,CO\,CO\,CO\,Ph}} \xrightarrow{\text{acids}} \underset{(II)}{\mathrm{Ph\,CO\,CO\,Ph}}$$

The conversion of dibenzoylmethane (III) into benzil involves first the change of the group $\mathrm{CO\,CH_2\,CO}$ into $\mathrm{CO\,\underset{\overset{\|}{N}}{C}\,CO}$ (IV) and then warming the resulting product with acids (for example sulphuric acid acetic acid) The nitrogen containing intermediate compound with the group (IV) may be (V) which is readily obtained in half an hour by the action of (III) on nitrosobenzene in alcohol Diphenyltriketone 2 anil oxide (V)[1] forms yellow crystals m p 144°



$$\underset{(III)}{\mathrm{Ph\,CO\,CH_2\,CO\,Ph}} + 2\,\mathrm{Ph\,NO} \rightarrow \underset{(V)}{\mathrm{Ph\,CO\,\underset{\overset{\|}{Ph\,N—O}}{C}\,CO\,Ph}} + \mathrm{Ph\,NHOH}$$

$$(V) \xrightarrow{\text{acids}} (II)$$

Robert Michaelis and Cezar Azzam participated in this investigation

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[1] Compar Schönberg A and Michaelis R *J Chem Soc* 627 (193)

Kinetics of Exchange Reactions

THE shape of the curve obtained by plotting the concentration of a reactant or product against the time can in general be used to yield information about the way the rate of the reaction depends on concentration in particular about its order In the case of isotopic exchange reactions this is not possible even in principle supposing the isotopes to have identical chemical properties This rather amusing result does not appear to have been placed on record hitherto

Suppose the reaction is

$$AX^* + BX = AX + BX^*,$$

where X^* represents a labelled (for example, radioactive) X atom. Let the concentrations be AX, a BX b, AX^*, x and BX^*, y, if the compounds contain several similarly situated X atoms, these concentrations must be expressed in equivalents of X We will assume that $a \gg x$ and $b \gg y$ Let the exchange proceed at a rate

$$R = k\,f(a)\,\varphi(b),$$

where f and φ are *any* functions and k is a constant Then

$$\frac{dx}{dt} = -\frac{dy}{dt} = -\frac{x}{a}R + \frac{y}{b}R,$$

where t is the time If $x = 0$ when $t = 0$, and $x = x_\infty$

when $t \rightarrow \infty$, these equations can be integrated to give

$$-\ln\left(1-\frac{x}{x_{\infty}}\right)=R\left(\frac{a+b}{ab}\right)t$$

Thus the shape of the x t – curve is given *exactly* by simple theory, and is independent of the form of R, whether the reaction is uni , bi or termolecular, or something more complicated, the x t – curve is that for a reversible unimolecular reaction

The reason for this particularly simple result is, of course, that the composition of the reacting mixture remains chemically unchanged throughout the reaction, so that we get $k\frac{x}{a}f(a)\varphi(b)$ instead of $k f\left(\frac{x}{a}\right)\varphi(b)$ for the rate of the forward reaction and a similar expression for the rate of the backward reaction By changing a and b we can of course, determine $f(a)$ and $\varphi(b)$, that is determine the order of the reaction

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Manifold Effects of Male and Female Sex Hormones in both Sexes

IN our previous experiments[1] the hormones were usually injected into gonadectomized rats for a period of 21 23 days This comparatively short treatment produced definite effects on the non sexual organs (except spleen) of males, but the effects were less evident or absent in most of these organs in females

In the present experiments, 91 castrated and 88 ovariectomized rats have been injected for a period of 2½ to 4 months with the following hormones and doses (per week) androsterone 7 5 mgm , trans dehydroandrosterone 7 5 mgm testosterone propionate 0 75–7 5 mgm , and (in males only) testosterone 0 75 7 5 mgm , alone or simultaneously with œstradiol dipropionate, 0 018 0 200 mgm , our usual experimental technique being used[1]

The effects obtained on the organs investigated were very similar in males and females, varying as a rule only in degree The accompanying table containing, for the sake of economy of space, the average weights of some organs only, gives examples of the changes observed in females

Hormone injected		Actual weights of organs			
Male hormone (mgm per week)	Œstradiol dipropionate (mgm) per wk	Hypophysis (mgm)	Liver (gm)	Heart (mgm)	Gain in body wt (gm)
None (control rats)	none	11 9	8 31	737	165
None	0 090	98 0	7 61	623	73
None	0 200	132 2	6 77	596	13
Androsterone 7 5	none	10 8	11 39	928	199
Androsterone 7 5	0 090	48 0	8 96	723	112
Testosterone prop 2 25	none	10 9	10 42	935	139
Testosterone prop 2 25	0 200	00 2	7 91	621	64

Some important conclusions are obvious from the data given in this table and from the other results (not given here) obtained with females and males

(1) While œstrogens produce *stunted growth* and decreased *fat deposition*, with the male hormones this depressing effect is absent or (with large doses of testosterone propionate) slight

(2) Moreover, this depressing effect of œstrogens is to some extent neutralized by the simultaneous injections of male hormones (except dehydroandrosterone), thus indicating some antagonistic relation between œstrogens and male hormones (see table)

(3) Both male and female hormones accelerate the physiological involution of the *thymus*, having a co operative effect on this organ, when injected simultaneously

(4) The male hormones have a definite effect on *adrenals* in males causing the hypertrophied castration glands to return to or towards normal The histological changes which occur have been discussed elsewhere (Hall and Korenchevsky[2]) Simultaneous injections with œstrogens in most cases prevent this restorative effect on size and weight of adrenals In females, similar results have been obtained with androsterone, but the effects of the other hormones and of ovariectomy were indefinite

(5) While male hormones do not produce any considerable change in weight of the *hypophysis*, certain doses of œstrogens cause a tumour like hyperplasia of the gland (see table) When injected simultaneously, male hormones neutralize to a considerable extent (in one male rat almost to normal—14 mgm) this hyperplastic effect of œstrogens both in males and (see table) in females This is another important case of antagonistic relations between male and female hormones

(6) Slight hypertrophy of *liver*, *kidneys*, *heart* and *spleen* in gonadectomized animals is produced by male hormones, while œstrogens cause either a decrease in their actual weight or no change (kidneys), This effect of œstrogens is in some organs partly dependent on the body weight, which relation, suggesting a possible stimulating effect on the kidneys, will be discussed elsewhere When injected simultaneously the effect of male hormones on the actual weights of these organs is antagonistic to, and to some extent neutralizes, that of œstrogens in both sexes (see table)

The data presented (1) confirm a definition, previously given[3], of gonadal hormones as not merely sex hormones, but as hormones also possessing manifold important effects on non sexual organs , (2) show the co operative and antagonistic interrelations between male and female hormones, supplementing similar results previously obtained[1] on sexual organs

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[1] See references Korenchevsky V Brit Med J ii 896 (1937)
[2] Hall K and Korenchevsky V J Physiol 91 365 (1938)
[3] Korenchevsky V and Dennison M J Path and Bact, 38 231 (1934)

Antarctica and Glacial Ages

IN NATURE of September 17 there is an interesting discussion between Rev W S Fleming and Prof E W MacBride in regard to the Gondwana flora and glaciation in Antarctica in Permo-carboniferous times which requires some comment Referring to the Permo carboniferous ice age, Prof MacBride suggests that a vast Gondwana continent in temperate parts of the southern hemisphere drifted south across the south pole, Australia and Antarctica, which lay at its north edge, being left behind in temperate latitudes The rest of the continent underwent severe glaciation and finally broke up into South America, South Africa and the Deccan of India

Why Australia, which was heavily glaciated, was left behind is difficult to understand unless it was because the Australian geologists interpret their tillites as due to the work of floating ice It Australia in temperate latitudes was severely glaciated, why was it necessary for the other glaciated regions to be bundled together and drifted across the pole ?

In reality, all the heavily glaciated regions were close to the sea and a compact Gondwanaland certainly did not exist while glaciation was going on The Indian tillites are associated with marine beds at two points hundreds of miles apart The South American tillites are found with marine deposits both in Brazil and on the western side, and in South Africa on its south western side its ice sheet reached the sea (See Ice Ages Recent and Ancient pp 102 3, 134, 146–9, 168) This of course is what one should expect since the building of an ice sheet demands an immense amount of evaporation from some nearby body of warm water In the Pleistocene north western Europe and north eastern America near the Atlantic with its Gulf Stream were heavily glaciated while Siberia one of the coldest parts of the earth had no important ice sheet A huge land mass, such as the supposed Gondwanaland, even at the south pole, would lack precipitation in its central parts, and so would be unglaciated

Late Palæozoic glaciation in Australia deserves some further mention The geologists of the Commonwealth have proved that there were two important glaciations, one in the Carboniferous the other much later, separated by a very long interglacial time when great coal seams were laid down Are we to suppose that Australia was pushed towards the south pole in the Carboniferous and then pulled up to a temperate latitude for coal plants to grow, and then pushed down again for the second glaciation?

Also what about the Permo carboniferous tillites at Squantum near Boston and on the Alaskan boundary in North America and the glacial deposits described in France and Germany ? Surely Gondwanaland had nothing to do with these deposits in the northern hemisphere

In a great ice age like the Pleistocene and the Permo carboniferous, the whole world is chilled, though great ice sheets are formed only in regions favourably placed for moisture laden winds to deposit snow

May an old fashioned geologist ask the advocates of drifting continents how they account for the extraordinary performances they so readily assume ? On the Labrador coast one may see icebergs pushing southward, thrusting aside the ice floes, or sometimes ridging them up in front, but one knows that the greater part of the berg is sunk in the arctic current, so that the motion is accounted for

Our iceberg like continents are solidly frozen into the sea bottom crust, supposedly miles in thickness of strong basalt Are there currents in the supposedly plastic basic substratum in which the bulbs of the continents are enclosed ? Or what forces push them in one direction rather than another ? To say they 'drift' is, of course, begging the whole question Permanently enclosed rock masses cannot drift— they must be pulled or pushed What power do the advocates of the 'drift of continents' suppose dragged India from the antarctic regions thousands of miles north, over the bulge of the equator, to leave it in the northern hemisphere ? Where are the heaped up ridges of rock which it thrust up on each side, and where is the scar it left after its passage ? Again, why did Gondwanaland explode and send South America in one direction and South Africa in another and leave Antarctica where it is ?

These casual driftings of massive blocks of the earth s solid crust should have some reasonable explanation before being used to account for the distribution of plants or animals The Gondwana plants are mainly ferns equisetums and club mosses especially ferns all cryptogams the spores of which could easily be transported by the wind A gale would quickly carry them hundreds of miles Why send continents crashing through the solid earth s crust to effect their distribution ?

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Formation of Widmanstatten Figures in Meteorites

Investigations have been conducted in this laboratory during the last few years on the structure of artificially prepared iron nickel alloys in the iron end of the equilibrium diagram, and during the last year the structure of iron nickel meteorites has also been examined An interesting point in connexion with meteorites is the formation of etched patterns known as Widmanstatten figures Several attempts have been made to explain these figures, but no satisfactory theory seems, so far, to have been advanced

I wish to mention here certain conclusions reached in the course of the investigations referred to, which may be helpful in arriving at a satisfactory explanation of the existence of these figures

(1) An iron nickel alloy containing say between 6 and 25 per cent of nickel, when quenched from high temperature, consists solely of a distorted body centred lattice which is in metastable equilibrium at ordinary temperatures It is suggested that this is the condition of meteoric iron nickel after the sudden drop in temperature which occurs when the meteorite comes to rest in the earth, and that afterwards prolonged annealing at a comparatively low temperature has taken place

(2) The alloy possessing as it does a distorted lattice, is supersaturated with nickel The result of this is that internal stresses exist in the material This condition is favourable to the growth of single crystals when the material is annealed and this growth may take place at moderately low temperatures

(3) The growth of the crystals occurs in sheets parallel to the octahedral planes of the distorted lattice, the growth being much more rapid in the direction of the octahedral plane than at right angles to it These crystals are the stable kamacite or undistorted α lattice the composition of which corresponds with that at the pure α phase boundary at the temperature of annealing

(4) During the process of crystal growth, the surplus nickel in the lattice is gradually displaced and collects on the surfaces of the kamacite sheets When the concentration of nickel reaches a certain value, tænite is formed Thus tænite appears in the form of very thin sheets bordering crystals of kamacite It may be expected also, that as the result of this process, a definite relation exists between the orientation of kamacite and tænite crystals Different observers have found this to be the case

(5) The lower the nickel content of the alloy as a whole, the greater is the width of the kamacite plate, because more volume of kamacite will have to be formed in order to expel a sufficient number of nickel atoms to produce tænite at the boundary This explains the different degrees of 'coarseness' found in meteorites (octahedrites)

(6) Meteorites within a certain range of composition generally contain plessite, which may consist of a microscopic octahedral arrangement of kamacite and tænite, or may be of a granular structure similar to that of the metastable distorted α alloy When the plessite is in the latter form the meteorite has not reached its final state of equilibrium a conclusion which may appear strange when, to quote one writer, meteorites have presumably had geological ages in which to reach equilibrium But according to the views expressed here, any equilibrium which might have been established would be upset by the final heating of the meteorite in passing through the atmosphere and in penetrating the earth's crust, followed by sudden cooling

(7) If plessite may be regarded as consisting only of the metastable distorted α lattice, it should not exist in an alloy which has reached its final and true state of equilibrium, this state consisting only of stable kamacite and tænite

The above general statements will be amplified and supplemented by experimental data in a series of papers which will shortly be published

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A Visual Phenomenon

ON starting an electric fan with the observer so placed that he can see the sky (or other bright background) through the vanes of the fan, then at a certain speed of rotation a hazy violet patch of colour can be seen in the plane of the fan At higher rates of rotation the effect disappears, but can again be observed on decreasing the speed to the critical value The speed in question appears to correspond with the frequency of flicker The effect was actually observed in the case of a fume cupboard extractor fan

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Points from Foregoing Letters

PROF P M S BLACKETT calculates the mean range of the mesotrons (particles of mass intermediate between that of the electron and that of the proton) from the relative intensity of the inclined cosmic rays to the vertical rays, and also from the absorption anomaly between air and water He arrives at a value of $1\,7 \times 10^{-6}$ sec for the decay time of a fast moving mesotron, assuming its mass to be 150 times that of the electron Prof B Rossi obtains a value of the same order of magnitude for the life of the mesotron from calculations based upon the anomaly of absorption of cosmic rays by air and by lead when vertical and inclined counters were used

A simple demonstration of Yukawa's relation $\rho = h/mc$, from which the existence of particles of intermediate mass (mesotrons) was inferred, is given by Prof G C Wick, based upon Heisenberg's Uncertainty Principle

When inferring crystal stucture from X ray vector maps possibilities are finite, according to Prof E H Neville It is rare that two or more solutions are possible, especially in the case of a megamolecule If one structure is shown to fit the facts exhibited in the vector diagrams, any serious criticism must begin by providing an alternative structure that fits the diagram

A fundamental electrical formula which expresses the forces acting on elementary electric charges at rest and in uniform or accelerated motion, without introducing magnetic quantities (thus dispensing with the duality of electricity and magnetism), has been worked out by Dr C V Drysdale

The fact that genuine proteins are split by proteinases (such as trypsin) does not prove that they contain peptide bonds, according to Dr K Linderstrøm-Lang, R D Hotchkiss and G Johansen A small but distinct rise in the temperature coefficient of the initial hydrolysis rate with increasing trypsin concentration and a pronounced fall in the coefficient when the protein has been first heated to 100° C and then cooled, indicate that peptide bonds appear upon denaturation, but may not have existed in the original protein

The preparation of certain monomeric compounds of silicon of a new type, containing both silyl and alkyl radicals, is announced by Dr H J Emeléus and N Miller A quaternary salt, trimethylsilyl ammonium chloride, containing such radicals, is also described , and its behaviour is compared with that of its analogues

Prof A Schonberg describes a method by means of which the group CO CO CO· or CO CH_2 CO may be converted into the dicarbonyl group CO CO , which is virtually the degradation of a propane derivative into an ethane derivative

H A C McKay points out that in the case of isotopic exchange reactions, where the isotopes have identical chemical properties, it would not be possible, even in principle, to determine the order of the reaction from a single concentration time curve

The effect of male and female sex hormones upon various organs (liver, heart, adrenals) of castrated or ovariectomized rats, is described by Dr V Korenchevsky and K Hall They show that the hormones produce manifold important results upon the non sexual organs and that the male and female hormones have sometimes co operative, and in other circumstances antagonistic, effects

Prof A P Coleman doubts Prof MacBride's hypothesis of a Gondwana continent having drifted across the South Pole in Permo Carboniferous times, and supplies alternative explanations for the glaciation effects observed in some of the Permo Carboniferous rocks of the southern hemisphere

Research Items

Canoes of the Pacific

IN the third and final volume of their study of the canoes of Oceania (Bernice P Bishop Museum, Honolulu, *Special Publication* 29), Dr A C Haddon and Mr James B Hornell deal with definitions of terms, a general survey and conclusions It appears likely that the Papuans originally were acquainted only with the raft or simple dugout, possibly with a makeshift sail of palm leaves The first wave of Indonesian migration into Melanesia may have brought the canoe with double outrigger with parallel, or stick connexions It was possibly square sail rigged, with mast yard, or boom Later immigrants came with large double sailing canoes and sailing canoes with small outrigger with stick connexions for the booms Probably they were rigged with some form of the Oceanic sprit sail These are the proto Samoans of Churchill, the most ancient stratum of central and western Polynesia—the first Kava people The later Kava peoples also had large sailing double canoes and large single outrigger canoes with stick and stanchion connexions Their dugouts doubtless had strakes, which led to the plank built boat The true plank built boat was employed only sporadically in western Oceania and is not a local development It belongs to one of the later spreads from the West into Polynesia The later Kava peoples, or some of them, the so called Tangaroans, were instrumental in raising Polynesian culture to its highest level The Tangaroans were also great navigators, and it may be under them that New Zealand was colonized by the Fleet" in A D 1350 The migration of the betel people into Melanesia was probably the last of these great movements, and to them the introduction of the various types of plank canoe, without outrigger, was due The abandonment of the outrigger by the Maori was probably a local development The colonizers of Hawaii, who brought a double canoe and a single outrigger probably came direct through Micronesia about A D 400 450

The Dionne Quintuplets

THE unique Dionne quintuplets are being studied genetically Dr John W MacArthur presents the evidence (*J Heredity*, 29, No 9) that they represent a monozygotic set The methods in use for twins have been applied to them Employing the diagnostic criteria for distinguishing between identical and fraternal twins, each method, as well as the new quantitative method from dermatoglyphics, leads to the conclusion that they are monozygotic There was evidently a single placenta and chorion, and probably five separate amnia and five cords attached in a ring There may have been a sixth embryo which aborted very early The children themselves and their nurses can recognize each of the five, but their facial features are very similar The other sibs vary widely in hair colour, hair shape, eye colour, features, ears, etc The finger prints of the quintuplets are as like as in most identical twins, the palm and sole prints repeating some rare features, all ten feet have a mild syndactyly of the second and third toes and a peculiar thenar pattern complex They are of the same blood group and very similar in eyes, hair and ears When compared in pairs, no one stands apart from the rest, nor is any pair exceptional It appears that forty five cases of quintuplet births have been recorded in the literature, and at least two or three sets were monozygotic but in this case alone have all survived

Kinetics of Choline Esterase

THE kinetics of the enzyme which splits acetyl choline in the body, choline esterase, have up to the present only been studied on relatively high concentrations of acetylcholine In the organism acetylcholine is active in very minute amounts, and for this reason, some knowledge of the effects of esterase on low concentrations was desirable Clark, Raventos Stedman and Stedman (*Quart J Exp Physiol* 28 77, 1938) find that, in general, the hydrolysis of acetylcholine by choline esterase follows the usual course of an enzymic reaction When high concentrations of the substrate are present, the amount hydrolysed per second is constant, but when the concentration falls below 5×10^{-5} molar, the amount of acetylcholine hydrolysed is approximately proportionate to the concentration Estimations of the effect on the hydrolysis of variations in the concentration of esterase show that, in all probability, the amount destroyed in unit time varies as the esterase concentration, and that there is no reason to suppose that the rate of hydrolysis increases as some power of the enzyme concentration Taking these points into consideration, the authors believe that in the animal organism the hydrolysis of even minute amounts of acetylcholine is likely to take at least as long as 0 1 sec

Fossil Penguin in South Australia

FROM Miocene beds in the cliffs on the east shore of St Vincent's Bay, South Australia, H H Finlayson describes a single bone of a penguin (*Trans Roy Soc S Australia*, 62, 14, 1938) The bone, a left humerus complete except for the tuberculum externum, was accompanied by several fractured laminæ probably derived from a radius Among the thirty five species of fossil penguins now known the Australian humerus corresponds most closely in dimensions and structural detail with that of *Palæeudyptes antarcticus* which was found in beds of similar age in New Zealand But the author considers that the variation shown in the humeral characters of penguins and the uncertainty of conclusions as to relationship to be drawn from geographical distribution, until such time as the original centre of distribution is known, precludes the application of a new name to the Australian fossil The fact that the Tertiary penguins of the Antarctic region show structures which seem to indicate superior terrestrial and inferior aquatic adaptations, according to Lowe, suggests that these forms were comparatively sedentary and coast frequenting, and this would preclude colonization over long stretches of open sea

Moisture Conditions within Termite Mounds

IN Pamphlet No 82 of the Council for Scientific and Industrial Research in Australia, Messrs R V Fyfe and F J Gray give an account of the humidity of the atmosphere and the moisture conditions within mounds of the termite, *Eutermes exitiosus* After a study of the structure of different mounds, and of the composition of the different walls comprising these mounds it is shown that the termites have developed an extraordinary construction whereby they maintain particular moisture conditions These conditions prevail in the interior of the mounds and are necessary for the maintenance of the termite colony They are, furthermore maintained throughout all conditions of temperature and rainfall which may occur outside the mounds The structure and composition of the walls of the mounds are stated to be such as to retain the moisture produced as the result of the respiration of the termites The temperature maintained by the living insects, and the special properties of the mound material, prevent the deposition of this free water where the termites generally live The mound is, it seems, so constructed as to allow the amount of water production by breathing and that lost by diffusion and evaporation to be closely balanced

Cereal Synonyms

THE Cereal Synonym Committee regards two cereals as synonymous when they present precisely similar morphological characters, and when they also possess identical physiological characters in so far as they can be determined Even then, by this term they do not necessarily imply that these two varieties are of identical origin, though doubtless in the majority of cases they are The possibility of two cereals of different parentage presenting such a close, if not complete similarity as to mask their individuality has not been lost sight of But the Committee has to deal with facts as they are, therefore, it regards as synonymous all cereals which are identical in the sense used above even when it is known that the origins are different It should be noted, however that before the Committee comes to a conclusion concerning the synonymity of any variety, the breeder and/or the introducer is given an opportunity of demonstrating to the Committee such differences as he may claim to exist between his variety and the type variety On the basis of this definition, the Committee has reached certain decisions on the stocks examined in 1937 *Westerfield White* is considered a synonym for *Setter*, and two wheats of continental origin introduced as Hybrid 40 and Desprez 80, but which have since been renamed in other countries, will be known as Hybrid 40 (Benoist) and Desprez 80 (Jonequois) The latter is a very early ripening short strawed variety among those recommended for good soils by the National Institute of Agricultural Botany, in Farmer s Leaflet No 1 *Holdfast*, however, is worthy of special attention in the early ripening group as baking quality is likely to assume greater importance than heretofore, and tests have shown it to be superior to the *Yeoman* in this respect Early sowing is stressed in the case of the later ripening varieties As regards oats, the new Aberystwyth *White Winter Oat S* 147 is suitable for fertile soils, where *Grey Winter* is likely to lodge *Plumage archer* and *Spratt archer* are still the most favoured barleys Particulars of other good varieties of autumn sown cereals and the special purposes for which they are adapted, can be obtained on application from the Institute at Cambridge or from any county agricultural organizer

Hybrid Vigour in Wheat

A STUDY of heterosis or hybrid vigour in wheat has been made by Dr B P Pal and Mr N Alam (*Proc Ind Acad Sci*, 7, No 3, Sec B) They crossed a bearded with a beardless variety of *T vulgare* from Pusa and compared the F_1 with the parents as regards amount of germination, rate of formation of first leaves, height, tillering, number of leaves, length of ear, number of fertile spikelets, number of grains per ear, weight of grain and yield A new feature of these experiments was that these comparisons were made when the three crops were grown under different sets of conditions Heterosis was found, less striking than in maize, and its amount was shown to vary according to the conditions Thus by sowing at different depths it was found that the F_1 germination was superior only at depths of 4–6 in The time of sowing (morning, noon or evening) also affected the germination rate The difference in tillering between the F_1 and the better parent was greater in sowings made early in the season than later, the percentage in favour of the F_1 ranging from 46 per cent to nil In ear characters the F_1 exceeded the mean of the parents under all conditions but were not significantly better than the better parent The results indicate that the expression of heterosis is much influenced by various external factors, and that the optimum conditions for its expression in any particular cross therefore need to be sought

Fertility of Amphidiploid Hybrids

H W HOWARD has made a study of the fertility of amphidiploid hybrids between the radish and cabbage in F_3 and F_4 generations (*J Genetics*, 36, No 2) Earlier studies of this cross have been made by Karpechenko and Richharia Fresh F_1 hybrids were also studied and were found to be of two types One type had short meiotic chromosomes like the parents, the other had long chromosomes A variable number of bivalents and occasional trivalents were formed The chiasmata gave evidence of a reduplication in one chromosome Some secondary pairing of univalents was observed, as well as bridges and restitution nuclei The theory of fertility in amphidiploids is considered, and it is pointed out that the types of F_1 pairing may lead to the formation of gametes which have some chromosome segments reduplicated and others deficient Some of the resulting offspring may not be true amphidiploids and these will show reduced fertility Some F_4 plants had a much higher fertility, others equal or lower fertility than the F_3 The increased fertility is attributed to the elimination of irregular chromosome pairing Certain F_3 plants had less than 36 chromosomes

A New Species of Fungus

Tremella translucens is the name suggested for a new fungus species described by H D Gordon (*Trans Brit Mycol Soc*, 22, Pts 1 and 2, Aug 1938) The fructification is a small cushion, not usually more than 2 mm in diameter, upon dead pine needles Basidia are quite characteristic of the genus, being divided longitudinally to the base Dry fructifications have basidia without spores, but on wetting, they form epibasidia and basidiospores The new species belongs to the section Tuberculiformes of the genus *Tremella* Only three species of the section are European, and differ sharply from *T translucens*, which therefore seems to have a good title to specific rank

The Violent Earthquake of November 10

Very large amplitudes were registered on the seismograms for this shock at Hamburg and Stuttgart, described in Nature of November 19 p 909 At Hamburg a small primary pulse was discernible at 20h 30m 0s a dilatational *P* wave at 30m 8s and *S* at 39m 41s At Stuttgart a compressional *P* wave was registered at 20h 30m 29s, *S* at 40m 17s, *PS* at 41m 5s and *L* at 52m From Hamburg the epicentral distance was thus 8 400 km and from Stuttgart 8,500 km The azimuth from Stuttgart was N 5° E All this evidence supports the hypothesis of an epicentre in the North Pacific Ocean in the neighbourhood of the Bering Sea and the Aleutian Islands

Determination of Nicotinic Acid and its Amide

Recent work on vitamins has shown that nicotinic acid and nicotinamide cure pellagra in human beings and thus act as anti pellagra vitamins It is therefore of importance to discover a method of determining and detecting those pyridine derivatives when they occur in traces Karrer and Keller (*Helv chim Acta*, 21, 463, 1938) worked out a colorimetric method based on the reaction between 2 4-dinitrochloro benzene and pyridine discovered by Vongerichte in 1899 In alkaline solution a deep red colour is produced The method has been used by Karrer and Keller for the determination of nicotinamide in the liver of various warm blooded animals König, in 1904, described a colour reaction of pyridine and its derivatives which depended on the fission of the pyridine ring by cyanogen bromide On addition of aromatic amine, a yellow to yellowish green colour is produced Swaminathan has recently used this reaction (Nature, 141, 830, 1938) to determine nicotinic acid in foodstuffs H Kringstad and T Naess (*Naturwiss*, 26, 709, 1938) have now reported further investigations on this reaction They find the intensity of colour is considerably affected by hydrogen ion concentration By buffering the solution at *p*H 6 1 by a phosphate buffer, and determining the colour intensity when it has reached its maximum (after 7 min in the case of nicotinic acid) by the extinction method, it is found that the extinction coefficient is directly proportional to the concentration of the pyridine derivative It is possible by this method to determine nicotinamide in concentration so low as 1 γ per c c The shade and intensity of the colour vary with the pyridine derivative used, but the proportionality referred to above holds in all cases

Free Radicals from Toluene

There are three possible modes of decomposition of the toluene molecule on heating (900–1,100°, 0 1–0 5 mm)

(1) $C_6H_5\,CH_3 \rightarrow C_6H_5CH_2- \; + H$

(2) $C_6H_5\,CH_3 \rightarrow o$ and p $CH_3C_6H_4- \; + H$

(3) $C_6H_5\,CH_3 \rightarrow C_6H_5- \; + CH_3-$

F Hein and H I Mesée (*Naturwiss*, 26, 710, 1938) have investigated this thermolysis by a method similar to that used by Rice, the free radicals formed being removed by combination with mercury vapour It has been found that the reaction gives rise entirely to benzyl radicals The compound $(C_6H_5\text{-}CH_2)_2Hg_2$ is formed by the combination of the benzyl radicals with the mercury vapour followed by polymerization This compound is stable at liquid air temperatures, but is decomposed on warming to room temperature giving mercury dibenzyl $C_6H_5CH_2HgCH_2C_6H_5$ and mercury It therefore appears that the thermal decomposition of toluene at about 1 000° and at low pressure takes place entirely according to the first reaction mentioned above

Sound Insulation

In a communication to the Physical Society on October 28 Dr J L R Constable of the National Physical Laboratory gave the results of his measurements of the sound insulating powers of various walls and floors of buildings In one case a set of six rooms in two stories, rooms 1 2 and 3 in the upper, 4, 5 and 6 in the lower, about 14 ft wide 27, 16 and 18 ft long respectively were used Rooms 1 and 2, and 4 and 5 were separated by a plastered 9 inch brick wall, and 2 and 3, and 5 and 6 by a 3 inch plastered clinker concrete wall The side walls were on one side a 2 inch cavity single brick wall and on the other a plastered 3 inch hollow tile wall The floors were all 5 5 inch reinforced concrete A warbling note of frequency 200, 700 or 2 000 was generated in room 2 and the intensity of the sound in the other rooms measured The reduction of intensity was greater for the high than for the low pitched note The average reductions were in room 1, 45 decibels, 3 40 db 5, 47 db 4 and 6, 52 db The brick wall between rooms 1 and 2 would produce a reduction of 55 db and the clinker wall between rooms 2 and 3, 43 db The difference between these results and those found in the rooms is due to the transmission through the side walls the floors and ceilings of the rooms In average buildings there is therefore little to gain by partitions producing greater reductions than 55 or 60 db unless the side walls are improved to a corresponding extent

Distance Geometries

One of the best known geometrical theorems is that any two sides of a triangle are together greater than the third From this simple basis an extensive set of distance geometries has been developed. Prof L M Blumenthal (*Univ Missouri Studies*, 13, No 2, 1938) gives an account of these They are based on abstract postulates, with a single completely undefined element *point* and a single numerical relation *distance* between every two points The theory involves considerable difficulties, and theorems which are true in one kind of distance geometry are not necessarily true in another To the thorough going pure mathematician, such studies need no justification by reference to anything outside them, but to those of weaker faith it may be comforting to notice that the abstract theory can be applied to determinants, curves and surfaces, and the calculus of variations There is, at present, no mention of any application to physics However, in these days, when new attempts to bring physics under the domination of geometry are liable to be made at any time, the physicist must not be surprised if he is suddenly confronted with an alarming horde of such new geometries, armed with mysterious terms and terrifying symbols

Messrs H H Lester, R L Sandford and N L Mochel, at the request of the American Society for Testing Materials jointly undertook to write an account of non destructive testing as practised in the United States Radiographic methods are widely used in the States Pressure vessel manufacturers use fifty seven installations, and there are thirty one installations for various other applications The American Society of Mechanical Engineers has greatly helped boiler makers by constructing the A S M E Boiler Construction Code of definite standards of soundness to which manufacturers have to build Porosity conditions are defined by pictures Rejectable defects such as cracks and unfused regions are specifically designated and limits of toleration are established for slag inclusions In the paper emphasis has been given to practical applications and to technological research of direct bearing on industrial practice In conclusion methods and regulations for testing porcelain and glass are given All high voltage porcelain parts designed for service above 6 6 kilovolts are given a routine flash over test In addition routine mechanical tests are made on all suspension insulators The Polaroid Corporation has recently developed a glass strain detector built for the routine inspection of glass articles during the process of manufacture

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Rothamsted Experimental Station

THE Rothamsted Report for 1937* contains the results of experiments carried out at that Station during the year, and of crop trials undertaken at Woburn and at a number of commercial farms, extending over a large area Short accounts of the work of some of the departments of the Station are included and also an extended summary of the research carried out in the Plant Pathology Department since its formation twenty years ago

The experiments with chalk, discussed in this report, are of great interest because of the Government subsidy for the use of various forms of lime Although liming is such an old practice and although a large number of field trials have been carried out on the subject there is a lack of precise knowledge on many aspects of the problem Thus it is often said that magnesium limestones are detrimental but experiments planned at Rothamsted and carried out in various parts of Britain have given no evidence of this The residual value of chalk has also been investigated and distinct improvements were obvious in crops some years after application on an acid sandy soil for example there is little sign of the effect of the dressing of lime disappearing after six seasons of cropping

In a country with large numbers of live stock, as in Great Britain the conservation and utilization of farmyard manure is an important consideration and many aspects of these problems have been under investigation at Rothamsted from its early days In the 1937 report, the results of the early trials, which started in 1852, are dealt with briefly as a preliminary to the consideration of the more modern work The earlier, long period experiments showed that farmyard manure could give yields as high as those given by the best combination of artificial manures, and that it had considerable cumulative effects , in one instance, the increases in yield were considerable sixty five years after the last application of dung A number of modern, replicated experiments show that the response in potatoes averaged 2 1 tons per acre, and, in sugar beet, 1 3 tons per acre at Rothamsted The increase resulting from 10 tons of farmyard manure was about equivalent to that from 2 cwt of sulphate of ammonia Experiments were also carried out to investigate the effects on the yields of potatoes and of sugar beet, of different methods and times of application of farmyard manure With both crops, late application was superior to the earlier dressing With potatoes the application of the manure in the rows at planting time in the spring, gave an increase of between one and two tons per acre more than when it was ploughed in in autumn Finally, a number of experiments were undertaken to find whether artificials may be profitably applied on land that is also being dunged The responses to sulphate of ammonia were increased in the presence of dung while, with sulphate of potash there was a small decrease

An important aspect of the organized schemes of manuring experiments consists in the accumulation by the Chemistry Department of data which may make it possible to predict the fertilizer requirements of soils from their chemical analyses and textures In 1936 and 1937 sugar beet gave much larger responses than in the three preceding dry seasons and there was an opportunity of testing laboratory methods in this respect The amount of inorganic nitrogen, obtained in the soil after incubation, gave a good degree of correlation with responses to sulphate of ammonia, while, with phosphoric acid the fraction soluble in acetic acid corresponded to responses from superphosphate It is unnecessary to emphasize the importance of this line of work at Rothamsted, as it will not only assist the individual agricultural adviser, but will also greatly increase the amount of useful information that can be obtained from soil surveys

A note of this brevity cannot do more than mention the work of the Plant Pathology Department summarized in this report Among the important contributions from this laboratory must be cited the discovery of the green wart' method of infecting potatoes with wart disease , this enables susceptibility or immunity to be determined within as many weeks as had hitherto required years The investigations in this laboratory into the fundamental nature of virus diseases were extended after the Imperial Agricultural Conference of 1927, and the problem of the ultimate nature of these diseases is tackled from many angles In one study, for example, it has been found possible to arrive at estimates of the size of certain of the plant viruses. The relationship between the insect carrier and the virus is also under investigation, and some striking results have been obtained already in regard to the connexion between degree of infection, season and length of feeding times on the infected plant.

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* Rothamsted Experimental Station Lawes Agricultural Trust Report for 1937 Pp 225 (Harpenden Rothamsted Experimental Station 1937) 2s 6d

In addition to discussions of the various investigations in progress, the report contains a wealth of other material, such as the farm report, also notes on the insect pests and fungus diseases at Rothamsted and Woburn. Many branches of agricultural science gain from the information given in this report; the close connexion between laboratory and farm, together with the carefully planned field trials, give a high value to all the data supplied.

Precision Methods of Measuring Stellar Radiation

IN a communication dated October 17, from the Smithsonian Institution, Washington, an account is given of experiments made by Dr Charles G Abbot, secretary of the Institution and Mr W H Hoover, of the Smithsonian staff, at the Mount Wilson Observatory of the Carnegie Institution at Washington, on the total energy radiated by distant stars in narrow wave length bands. For the measurement of electric current they used a galvanometer which was twenty times as sensitive as any instrument of this sort used in the past. A magnetic shield for this very sensitive galvanometer was made for the Institution by the late Dr Elihu Thomson, of the General Electric Company, one of the world's foremost inventors of electrical devices. The galvanometer itself was made at the Institution and will detect a current variation of $1/10^{13}$ of an ampere.

The galvanometer is attached to a thermocouple, the standard astronomical instrument for measuring extremely minute amounts of heat energy. The thermocouple used by Dr Abbot and Mr Hoover is a more sensitive, and at the same time a more robust instrument, than any hitherto used.

The efficiency of the new devices has just been tested in California, using the Carnegie Institution's 100 inch telescope, with encouraging results. Dr Abbot and Mr Hoover measured with a high degree of precision the relative energies in narrow bands of the spectra of a number of the brighter stars. The total heat which reaches the earth from all the thousands of millions of stars of the Milky Way is extremely small. If the earth depended on this heat alone, the temperature would be approximately −270° C. Many individual stars in the galaxy are many times hotter than the sun, but their radiation is soon dissipated in the immensity of space.

Astronomers have had for many years instruments sufficiently delicate to measure the total radiation of several of the planets of the solar system. It has also been possible within the past few years to measure the total radiation of selected single stars. The aggregate light of such a star is focused on the thermocouple, essentially a junction of two wires made of different kinds of metal, through which an electric current is caused to flow by the minute rise of temperature produced by the stellar radiation; any variation in the temperature of the junction produces an alteration in the current measured by the galvanometer. The amount of the radiation energy necessary to produce a change in the current, the distance of the star and the rate of dissipation of stellar radiation in space being known, it is possible to calculate the actual heat from the star itself.

Dr Abbot and Mr Hoover have gone a step farther. In the radiation of almost every star are to be found all the elements of the spectrum from the infra red to the ultra violet. Actually the proportions of infra red, visible light and ultra violet differ enormously in the radiation of different classes of stars. It was the problem of measuring the approximate amount of radiation from a star in different narrow bands of wave lengths that the Smithsonian astronomers set themselves. This task required the most precise measurements ever attempted.

Experience for the task was drawn from two sources. A division of the Institution has been engaged for years in measuring the precise effects on plants of illumination from different wave lengths of light. This required further development of an instrument known as the Christiansen filter to segregate narrow bands of wave lengths from the light and heat of an arc lamp and also of improvement of the thermocouple. There seems little connexion between oat seedlings growing in boxes and giant stars a 1000 light years away, but all Nature seems tied together so inextricably that the development of this technique connects the one inextricably with the other. The other source was the work of the Smithsonian Institution's observatories set up on distant mountain tops in various parts of the world, the work of which is to make very precise measurements daily of minute variations in the radiation of the sun. This has called for more and more responsive heat measuring instruments.

Dr Abbot began the present work in 1923 using an instrument called the radiometer prepared for him by the late Dr L F Nichols. In 1928 he returned to the task using a fly vane radiometer of his own construction in which the sensitive element was a small piece cut from the wing of a house fly. He has hoped to continue the experiments ever since with instrumental improvements giving greater sensitiveness. A point has now been reached where the measurement of the energy in narrow stellar wave bands can be made with high accuracy.

It is possible, however, that much greater responsiveness will be attained within the next two years before the 200 inch telescope, with which it is planned to carry out the main programme of measurements, is set up at Mount Palomar in California. It may be possible to improve the thermocouple, to eliminate the element of drift due to the sensitivity of the two joined elements.

The last measurements made by Dr Abbot were at Mount Wilson ten years ago. At that time the greatest swing of the recording light spot that could be attained was only about one millimetre. This year

Mr Hoover easily obtained swings of twenty millimetres, which is equivalent to a twentyfold preciseness in his measurements.

Far reaching results may be attained with the new technique. A means is now at hand of determining with considerable accuracy temperatures depths and compositions of the atmospheres of stars and this will make possible more accurate estimates of the size and nature of stellar bodies.

Economics of Industry

ARISING out of the Conference held in 1937 by the International Industrial Relations Institute, when the theme was productivity and standards of living as influenced by industrial relations, the Institute has arranged a series of publications, the I R I Social Economic Series, to present the results of its studies. Two of these have now appeared, the first by A Carrillo on *Mexico's Resources for Livelihood* including a general introduction to the series on the world's natural resources and standards of living (Mexico's Resources for Livelihood: a Study of the Influence of Foreign Ownership. By Alejandro Carrillo. Pp 34. The Hague and New York: International Industrial Relations Inst, 1938. 25 cents).

This introduction outlines the field opened up including an analysis of the distribution of the world's raw materials and a survey of the hitherto abortive efforts to deal with the problem through international action. The implications of power production for economic organization are also considered, and in addition to summaries of the main arguments in the papers submitted to the 1937 Conference a number of suggestions for immediate action are outlined. Mr Carrillo's special study gains further interest in view of the expropriation of oil by the Mexican Government since the paper was written and it facilitates appreciation of the situation in Mexico and the important moral achievements of the revolution.

The second paper by M Yergan on gold and poverty in South Africa, is a study of economic organization and standards of living, it is yet another indictment of the labour policy pursued in South Africa with its deliberate exploitation of native labour as part of the natural resources of the country (Gold and Poverty in South Africa: a Study of Economic Organisation and Standards of Living. By Max Yergan. Pp 24. The Hague and New York: International Industrial Relations Inst, 1938. 15 cents). The importance of workers' living standards as an element in the problem of raw materials is again emphasized, and while the report recognizes that the errors and dangers of the policy hitherto pursued are now perceived by an increasing body of European opinion, the material it presents overthrows a conception of trusteeship under the conditions which prevail in South Africa. The importance of encouraging and co-operating with all those in South Africa, whether African or European, who are aware of the dangers and real needs, and striving to meet them, is emphasized, as well as the need for strenuous efforts to eradicate the hates and prejudices which repression and exploitation have developed within the ranks of both Africans and Europeans.

Science News a Century Ago

Temperature of the Crust of the Earth

WITH the assistance of the British Association J D Forbes in 1837–38 made determinations of the temperature of the soil in the neighbourhood of Edinburgh, the results of his experiments being given in a paper read to the Royal Society of Edinburgh on December 3, 1838, entitled Discussion of One Year's Observations of Thermometers sunk to different Depths in different localities in the Neighbourhood of Edinburgh.

The principal purpose of the experiments undertaken by Forbes was to ascertain the progress of solar heat in the crust of the earth, and had no immediate reference to the question of central heat. With the view of rendering the observations comparable with those at Paris and Brussels the lowest thermometers had their bulbs 24 French feet (25 6 English) below the surface. Other thermometers were placed at depths of 12, 6 and 3 French feet. The observations were begun in February 1837 and were continued weekly.

The three stations for the experiments were at the Observatory, Calton Hill, in the sand in the Experimental Garden and in the compact coal formation sandstone of Craigleith Quarry. Among other results obtained Forbes found that at the greatest depths the annual range temperature was 1 45 F at the Observatory, 2 1 F at the Garden and 4 1 F at the Quarry.

Footprints of the *Chirotherium*

AT a meeting of the Geological Society on December 1838, one of the communications was An Account of the Footsteps of the *Chirotherium* and five or six other unknown animals lately discovered in the quarries of Storeton Hill between the Mersey and the Dee. The communication was made by the Natural History Society of Liverpool and was accompanied by drawings by J Cunningham. In 1834 there were discovered in several quarries at the village of Hessburg near Hildberghausen casts in a grey quartzose sandstone, resembling to some extent a human hand, and for which Prof J J Kaup proposed the provisional name of *Chirotherium*. In June 1838, similar casts were discovered in the Storeton Hill quarries. The Natural History Society of Liverpool appointed a committee to report on those.

The red sandstone of the peninsula of Wirral may be divided into three layers: a lower consisting of a red or variegated sandstone and conglomerate, a middle of white and yellow sandstone, and an upper or red or variegated marl and sandstone containing pebbles of quartz. It is the middle division which was worked at the quarry. The strata there are of unequal thickness, and are separated by thin seams of whitish clay. The casts appear to have been moulded in impressions made by the *Chirotherium* and other animals walking over the clay.

The animal had been tracked by its marks 16 ft on one stone. Although the footsteps of the *Chirotherium* are the most prominent there are slabs covered by raised casts apparently made by tortoises and saurian reptiles.

Societies and Academies

Paris

Academy of Sciences (*C R* 207 753 812 Nov 2, 1938)

H Deslandres Application of the new analysis of molecular spectra to some molecules of particular interest Applications to the chlorides of phosphorus

L Roy Electric effects in a system of isotropic bodies

S Mazur Some characteristic properties of Euclidean space

A Kolmogoroff A generalization of the inequality of J Hadamard between upper limits of successive derivatives of a function

V G Avakumović Inversion of a process of summation, with application

E Szpilrajn Independent ensembles and non separable measures

G Godefroy *Stability of rows of eddies*

J K de Fériet, A Martinot Lagarde and C Rollin An apparatus for determining the modulus and direction of velocity in a fluid

H Mineur Statistical equilibrium of the masses of stars with three unequal axes

A Marcelin New observations on the increase of viscosity in a mineral oil at rest

B Kwal and M Lesage A method of utilizing ordinary counting mechanisms for counting a rapid succession of phenomena

J Cathala and J Cluzel Spectrophotometric study of the slow hydrolysis of ferric salts

C Jausseran Absorption spectrum of the developed photographic image

V Dolejšek and M Rozival A method of focalization utilizing the Seemann *couteau*

J Orcel and Mlle S Caillère New observations on the transformations of magnesium prochlorites under the action of heat X ray crystal analysis of the minerals

J Jung, R Pécoil and J Richard Stratigraphy and facies of the Stampien of the central Limagne

C Arambourg and J Fromaget The quaternary bed of Tam Nang (North Annamese Range), its stratigraphy and faunas

R Jacquot and R Raveux Influence of the food concentration on the development of isolated seedlings cultivated in the dark Dry weight increases and water content decreases with increase of concentration of glucose

M M Janot and F Cionca Catuabol from the bark of catuabach (*Trichilia* sp)

M Paget and R Berger Researches on the Schryver Fosse reaction and on its analytical applications

A Boutaric Study of colloidal solutions by combined measurements of viscosity and optical density

M Doladilhe Researches on irreversible coagulation

P Grabar Action of pepsin on anti pneumococcic antibodies

L Parrot and A Catanei Factors in the occurrence of epidemics of paludism in Algeria A study of the three types of infection, under conditions exceptionally favourable to infection and re infection, in 1878 Berbers by regular blood examinations extending over fourteen months A form of resistance is established at about ten years of age.

(*C R*, 207, 813 880 Nov 7, 1938)

M Brillouin Inevitable instability of a heavy liquid which rotates, without relative movement, with a solid nucleus which it surrounds oceanographic and geodetic consequences Contrary to views held since the time of Newton and Laplace no permanent configuration of the liquid stationary with regard to axes of the revolving solid is stable under these conditions

A Cotton Optical measurement of very intense continuous currents

A Blondel Application of Maxwell's equations for transformers to circuits imperfectly coupled by iron cores tuning to low frequency resonance

L Roy Electrostatic effects in a system of isotropic bodies

P Lejay Gravity measurements in the Philippines

E J Gumbel The deficiency of increase median over a period of years *Application to the statistics* of river floods

L Pasqualini Extension of a property to the whole of an ensemble

M Brelot Potential and series of sub harmonic functions

R Duchêne and A Martinot Lagarde Mean speed associated with motion in a fluid in turbulent flow

G García General problem of exterior ballistics third and fourth approximations

G Badarau Passage of corpuscles across Coulomb potential barriers

P Van Rysselberghe Generalization of thermodynamic potentials deduced from affinity

J Bethenod Maintenance of the movement of a pendulum by means of an alternating current of frequency higher than its own frequency

B Tsaï New method for the measurement of heavy currents The magnetic flux in a flexible solenoid surrounding the conductor is measured

J Thibaud and P Comparat Discrete groups of particles emitted in the course of the disintegration of nitrogen by fast neutrons

P Ehrenfest jun and A Freon Spontaneous disintegration of mesotrons, the particles constituting the penetrating cosmic rays

B Pontecorvo A soft radiation emitted at the time of the capture of neutrons by nuclei

C Magnan Measurement of γ radiation of high frequency by the method of pair formation

P Lacombe and G Chaudron Study by X rays of the recovery of the solid solution aluminium magnesium

C Duval and G Mazars Identification [by qualitative micro analysis] of the halogens

H Clément *Magnesium bromopentamethyl benzene*

V Mironovitch and A Viaut Complex structure of the lower stratosphere

H Marcelet Presence of free and combined glycerol in the watery juice of the olive

R Souèges Embryogeny of the Boraginaceæ, development of the embryo in *Echium vulgare* L

P Chabanaud Correction of a special point concerning the morphology of the hypopharyngeal musculature of the Achiridæ

G Sandulesco and A Girard A new method for the quantitative separation of alcoholic compounds

Cracow

Polish Academy of Sciences and Letters (*C R*, Nos 6–7, June 17, 1938)

S **Szczeniowski**, St **Zifmecki** and K **Narkiewicz-Jodko** Specific ionization characterizing cosmic rays Measurements made during a free balloon ascent on May 14, 1938, indicate that ionization at heights of 5 5–10 km is proportional to the density of the gas in the ionization chamber

T **Banachiewicz** Problem of the variations of the solution in the method of least squares

W **Świętosławski** Contribution to the study of phenomena at the critical point

L **Marchlewski** and W **Bednarczyk** Absorption of ultra violet radiation by organic substances (48) Azines and analogous compounds

L **Marchlewski** and J **Cholewinski** Absorption of ultra violet radiation by organic substances (49) Indirubine and indigotine

B **Skarżynski** Spectrographic studies of compounds of the flavone type

K **Dziewonski** and **Mlle** M **Marusinska** Studies of 1 methyl 4 aceto naphthalene

K **Dziewonski**, K **Sřeo** and P **Zagała** Ketones derived from 2 6 dimethylnaphthalene

K **Dziewonski** **Mlle** M **Marusinska** and J **Moszew** Syntheses and transformations of compounds of the type of the 2 naphthyl 4 arylamino quinolines

St **Pawłowski** Morphology of the southern edge of the plateau of Lublin

J **Nowak** Problem of the limits of the Polish oil basin in the Carpathic flysch

B **Krygowski** Studies of elastic materials of quaternary origin with the aid of geological and petrographical methods

J **Kovats** Influence of the presence of iron and of molybdenum on one hand, and of the soil humus or humus ash on the other hand, on the fixation of nitrogen by *Azotobacter*

J **Biborski** Histological structure of the veins of *Gadus morrhua*

Mlle J **Janiszewska** Researches on the life and development of internal parasitic worms of *Pleuronectes flesus* L

F **Pautsch** Role of the medullary tube and of the dorsal cord in the development of the tail of tadpoles of *Rana temporaria*

J **Makólski** and St **Smreczynski** New researches on the Pleistocene Coleoptera of Łeki Dolne near Pilzno

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Lecturer in Electrical and Mechanical Engineering in the Stockport College for Further Education—The Director of Education Town Hall Stockport (December 5)

Teacher of Chemistry in the Northern Polytechnic Holloway London N 7—The Secretary (December 6)

Lecturer in Mechanical Engineering in the Burnley Municipal College—The Director of Education Education Offices Burnley (December 8)

Head of the Engineering Department of the Hendon Technical Institute—The Secretary Education Offices 10 Great George Street S W 1 (December 9)

Lecturer in Education and Psychology in Rhodes University College—The Secretary High Commissioner for South Africa Trafalgar Square London W C 2 (December 10)

Lecturer in Chemistry in Rhodes University College Grahamstown—The Secretary, High Commissioner for South Africa, Trafalgar Square London W C 2 (December 17)

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, December 5

Royal Geographical Society at 5 F F Fergusson Famine and Water Supply in Western Rajputana

University of Leeds, at 5 15—Dr L Dudley Stamp The Utilisation of Land in Britain *

Tuesday, December 6

Norman Lockyer Lecture (in the Goldsmiths Hall Foster Lane Cheapside London E C 2) at 4—Dr H Spencer Jones F R S The Atmospheres of the Planets

Wednesday, December 7

Society for the Study of Alchemy and Early Chemistry (at Queen Mary College London), at 8 J C Gregory From Magic to Science' *

Thursday, December 8

Royal Society, at 4 30—Dr Irving Langmuir For Mem R S 'Molecular Films (Pilgrim Trust Lecture)

Royal College of Surgeons of England, at 5 H A T Fairbank Increased and Decreased Density of Bone with Special Reference to Fibrosis of the Marrow (Robert Jones Memorial Lecture)

Friday, December 9

Physical Society and Meter and Instrument Section of the Institution of Electrical Engineers (at the Institution of Electrical Engineers) at 7—Discussion on Electro acoustics' to be opened by Dr C V Drysdale

Royal Institution at 9—Dr Irving Langmuir For Mem R S The Properties and Structure of Protein Films

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London Series A Mathematical and Physical Sciences No 781 Vol 237 Propagation of Wave packets incident obliquely upon a Stratified Ionosphere By Dr H G Booker Pp 411 451 5s Series B Biological Sciences No 559 Vol 229 The Potato Virus X, its Strains and Reactions By R N Salaman Pp 137 217+plates 18 25 15s (London Cambridge University Press) [811

Report of Committee on Evacuation With a Covering Memorandum by the Secretary of State for the Home Department (Cmd 583) Pp iv+39 (London H M Stationery Office) 9*d* net [811

Board of Control (England and Wales) Report on Cardiazol Treatment and on the Present Application of Hypoglycaemic Shock Treatment in Schizophrenia By Dr W Rees Thomas and Dr Isabel G H Wilson Pp 70 (London H M Stationery Office) 1*s* net [911

Royal Meteorological Society Bibliography of Meteorological Literature Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office Vol 4 No 5 (January June 1938) Pp 235 294 (London Royal Meteorological Society) 2*s* 6*d* net [1011

Gas Works Effluents and Ammonia By Dr Arthur Key Pp 1 (London Institution of Gas Engineers) 5*s* net [1111

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute Report on the Work of the School for the Year 1937 38 Pp xiv+118 (London London School of Hygiene and Tropical Medicine) [1111

University of Cambridge Solar Physics Observatory Twenty sixth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee 1937 August 1–1938 July 31 Pp 4 (Cambridge Solar Physics Observatory) [1211

Other Countries

Bulletin of the Bingham Oceanographic Collection Vol 6 Art 5 A Contribution to the Life Histories of Atlantic Ocean Flying fishes By C M Breder Jr Pp 126 (New Haven, Conn Yale University) [1011

Annuario del Reale Istituto Lombardo di Scienze e Lettere 1938 Pp 220+51 plates (Milano Reale Istituto Lombardo) [1211

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The Victoria History of the Counties of England

WHEN in the early months of the present year the one hundredth volume* of the Victoria History of the Counties of England issued from the press it marked a memorable achievement in which all who have been associated with the work may feel a legitimate pride Inevitably this feeling is mingled with regret that so many among the promoters and the collaborators of earlier days cannot now enjoy the credit that is their due not least among them the one man the late Dr William Page to whose courage tenacity of purpose and organizing ability we owe it that this great undertaking is still in existence to pursue its way towards completion

The Victoria History of the Counties of England was conceived on a generous scale and when the original promoters came to work out their plan in detail the magnitude of the task they had undertaken might well have daunted the boldest Something of its stupendous character the organization involved and the difficulties to be overcome of which not the least has been finance may be gauged from the fact that in just under forty years less than one half of the work has been completed

The conception of a new history and survey of the counties of England to supersede the partial out of date and often unsatisfactory records existing in the closing years of the last century was due to Mr (afterwards Sir) Laurence Gomme whose genius as a research worker in the remoter fields of the social history of the English people was equalled only by his vision in the co ordination of learning in the study of the past and his power of inspiring others with an enthusiasm like his own The survey was planned to cover the natural features the geology natural history the archaeology and social history in the broadest sense of each county But its essential feature and as it were its mainspring was to be the topographical record a detailed descriptive and historical account of town village and hamlet not only including important historic buildings but also omitting no feature of historic antiquarian or architectural interest For example the record covers those important factors in the development of English social life the manors tracing their history in the various families that have held them not omitting to give consideration to the heraldry of these as well as of the other important families of the county The most casual glance through the pages of the hundredth volume covering the topography of a division of Sussex will serve to indicate how faithfully and with what competent completeness the original scheme in this department of the work has been respected and carried out Not only has care been lavished on preparation to ensure accuracy of detail but also every effort has been made to ensure that no least item of interest or significance should escape notice Needless to say county records have been ransacked for rare and usually inaccessible documents plans maps and illustrative material which might serve to illuminate past history The scale of the work and the labour involved in its preparation may be estimated from the fact that the record of no county will be completed in less than three volumes several run to nine while one Norfolk will require ten volumes One volume is to be given to Roman England

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* The Victoria History of the County of Sussex Edited by L F Salzman Vol 9 The Rape of Hastings (The Victoria History of the Counties of England) Pp xv + 279 + 63 plates (London Oxford University Press 1937) 42s net

It is of interest to note the origin of the title of the History When permission was sought to dedicate the project of providing a history of every county of England to Her Majesty Queen Victoria its importance was at once recognized by her Not only did she graciously accept the dedication but she also commanded that the history should bear her name A like patronage has been extended to the work by her successors Each in turn has expressed sympathetic interest in its progress and on the occasion of the celebration of the publication of the one hundredth volume Lord Athlone as Chancellor of the University of London read the following message from H M the King

> The King has learned with much satisfaction of the publication of the hundredth volume of the Victoria County History which you are celebrating His Majesty cordially congratulates all concerned in this notable achievement and desires to assure you that he fully shares the interest evinced by his predecessors in the progress of the work

The scheme for this boldly conceived county survey was successfully launched by the publication of the first volume of Hampshire in 1900 Mr H A Doubleday being the editor Two years later Mr W Page was joined with him and in 1904 became sole editor continuing to act in that capacity until his death in 1934 This long period of office was one of many vicissitudes and anxieties In the first four years of his editorship between 1904 and 1908 Mr Page accomplished the remarkable feat of publishing no fewer than thirty nine volumes of the History to which professional and lay workers extended a cordial welcome for its accuracy scholarship and technique of production At this point however financial difficulties began to press and the rate of publication slackened until with the outbreak of war in 1914 the work came to a standstill

At the close of hostilities the position of the History offered little prospect for the future The efficient staff which Mr Page had collected and trained had been dispersed and the affairs of the History lay in Chancery until the late Lord Hambleden came to the rescue purchasing all assets and rights which he handed over to the editor in 1922 Nothing daunted by the difficulties which confronted him Mr Page set to work, and in the next ten years published eighteen volumes relying for his financial resources on what could be raised for the production of each volume in turn In 1932, however feeling the burden of his years and anxious to secure the continuance of the work he offered the History to the University of London The gift was accepted and since then publication has been carried on by the University the work of administration being entrusted to the Institute of Historical Research

Although the continued existence of the History is assured by its transfer to the University of London it by no means follows that all difficulties standing in the way of that steady and rapid progress towards completion which is essential to its value as a record have been smoothed away As chairman of the University Court Lord Macmillan pointed out on the occasion of the celebration to which reference has already been made while the University holds itself responsible for general expenses including a too exiguous staff it is not in a position to bear the burden of payments to contributors and costs of production which up to the present have exceeded the income from sales by on the average a sum of £700 for each volume At present the University does not feel justified in commissioning a new volume until it is assured that such a sum will be made good by public and private benefaction It is however to some extent reassuring to note that at the time this statement was made the authorities had put in hand the preparation of seven new volumes For these volumes adequate financial assistance has been secured but continued publication depends upon further support

For a work of the character and scope of the Victoria County History it is obvious that the ordinary channels are of little avail No doubt as the value of the work is more widely recognized larger sums will accrue from its sale The present tendency towards an increased interest in local antiquities and history among the public justifies such an assumption and the appearance of the County History on the reference shelves of public libraries in the more important centres of population will be expected as a matter of course Nor doubtless will the private benefactor ever be entirely lacking But it cannot be anticipated that these sources will be adequate to meet the needs of publication without substantial backing from the public purse That a more liberal flow of funds from this source is to be anticipated is indicated by recent action of the Minister of Health He has announced his willingness to sanction application from local governments for leave to make grants for the completion of histories of areas within their jurisdiction Substantial help under the provisions of this announcement has already been received from several local government bodies including the County Council of Warwickshire and the City Councils of Birmingham, Coventry and Oxford. This example might and no doubt will be followed liberally by other local councils in due course.

There are, however, a number of reasons for urging that a publication doing work such as that which the County History might carry out, given a more rapid rate of publication, is of national and not merely of local interest, and should be subsidized from national funds, just as in the instance of an ancient monument it has not infrequently occurred that its importance as a piece of historic evidence of national interest has justified a nation-wide appeal for funds for its preservation. There can be no two opinions that it was a calamity that publication of the Victoria County History had not been completed before the outbreak of hostilities in 1914. If the contemplated county survey had been complete then, it would present a unique summation of the development of English culture at a time when, had we but known, it was about to suffer a fundamental transformation. Although we have it now but in part, it is no less important that we should have as its pendant a record at the present time when the character of the English countryside is changing before our eyes. Time is the essence of the contract, and it is desirable in the extreme that the record should be made before these changes have gone too far on their way. No doubt local interest in the long run will ensure that in due course each county history will attain completion; but as a national undertaking—and the Victoria History as a whole is no less—the value of the survey resides to a great degree in the extent to which it can present a series of contemporary pictures giving in sum a record of the cultural development of England as a whole. This is a work of educational value to the entire nation both now and future generations, and as such is one which national resources might be asked to subsidize apart from the contribution of local funds. It is true that it may be urged that in respect of evidence of antiquity still standing the obligation of national funds is met by the work of the Historical Monuments Commission. However valuable the work of that Commission may be as a record, it cannot give the facts their natural and cultural setting. It is this setting which eventually, when the Victoria County History is complete, will endow it with abiding value.

The Botanical Gardens, Leyden

1587–1937 Hortus Academicus Lugduno Batavus: The Development of the Gardens of Leyden University. By H. Veendorp and L. G. M. Baas Becking. Pp. 218. (Haarlem: Typographia Enschedaiana, 1938.)

A CERTAIN amount of confusion exists in the minds of some botanists concerning botanical gardens, especially with reference to their origin and history. This is probably due in no small measure to a misunderstanding of the term. Botanical gardens may be considered to be gardens in which the plants are deliberately arranged according to botanical classification and where plants are grown and studied from the point of view of their botanical and economic importance. In this way such a garden differs widely from a park. The former has as its primary objective botanical research and education; the latter that of beauty and recreation. The fact that the objectives in nearly all cases overlap is immaterial.

Failure to recognize the distinction between a botanical garden and a park probably explains the difference of opinion concerning the Vatican Gardens. Some claim that these gardens are the oldest existing botanical gardens in the world, since they were established by Pope Nicolas III in 1277. Since that date their location has been changed several times, the present-day Gardens being founded in 1883 at the foot of Janiculus. They are twenty-seven acres in extent. Botanists who claim these Gardens as the oldest botanical gardens do so on the grounds that a small portion of them was used for pharmaceutical and experimental purposes. Others point out that the Gardens were founded by Nicolas essentially as a recreative park. Thus the experimental side was merely a side issue.

One of the first botanical gardens of which there are authentic records was the Royal Garden founded by Thothmes III at Karnak in Egypt more than three thousand years ago. The plants cultivated there were probably of utilitarian value. Another early garden established with the express purpose of aiding the study of plant life was that founded by Aristotle in the fourth century B.C.

and placed under the direction of his pupil, Theophrastus.

The immediate precursors of the present-day botanical gardens of the world were the physic gardens of the monasteries and convents. Their contents were determined chiefly by therapeutic and culinary value. Herb-lore was the prerogative of the layman, but the more systematic study and cultivation of plants of proved medicinal value remained with the cloister gardens.

Later, plant drugs and even living plants began to seep into Europe from the Near East, and in the early sixteenth century the science of pharmacognosy became established in Pisa (1543), and Padua (1545), where medicinal gardens attached to the Universities were established. The founder of the Pisa garden was Prof. L. Ghini, but the gardens achieved greater fame under their second director, Andrea Cæsalpini, whose work marked the beginnings of present-day systematic botany. In Italy, other botanical gardens followed Padua, among the best-known of which were Florence (1556), Bologna (1657) and Rome (1660).

The Jardin Royal des Plantes Medicinales was founded in Paris by Guy de la Brosse, the king's physician in 1635. Its present name, Musee d'Histoire Naturelle, was given to it in 1790.

The Chelsea Physic Garden was established in London by the Society of Apothecaries in 1673. It was established for the study and teaching of botany and for providing material to that end, and was extended by Sir Hans Sloane in 1722. It was handed over to a committee of management for botanical research in 1902.

Schöneberg, near Berlin, was the scene of the foundation of the Staatliche Botanische Garten und Museum in 1679; but during 1897–1907 the garden was transferred to its present site in Berlin-Dahlem. It is now about 100 acres in extent.

The world-famous Royal Botanic Gardens at Kew, Surrey, of an area of 288 acres, are a much younger institution. Plants grown by Lord Capel of Kew House formed the nucleus of the Gardens, and in 1757, William Aiton, a former student in the Chelsea Physic Garden, was appointed to extend this nucleus also as a physic garden. But the Gardens were not established as a national garden until 1841, under the direction of Sir William Hooker.

Last year, the Botanical Gardens of the University of Leyden celebrated their three hundred and fiftieth anniversary, which is of special interest since Dutch botanists and Dutch botanical gardens have had an exceptionally important role in the development of botanical science throughout the centuries. The names of Leeuwenhoek, Swammerdam, Ingenhousz, van Marum and Hugo de Vries are sufficient to establish claim to pre-eminence in this field. Furthermore, apart from the Gardens at Leyden, there are several others of first importance, such as those at Amsterdam, where de Vries carried out his epoch-making genetical experiments on *Œnothera*. Furthermore, the wonderful collections in the Gardens at Buitenzorg in the Dutch East Indies are known to all present-day botanists. These Gardens were founded by C. G. C. Reinwardt, who was director of the Leyden Gardens in the early eighteenth century.

Even to-day, botanists are much indebted to Holland, and especially Amsterdam, The Hague and Leyden, for the advancement of their science. Botanical research is very healthy in that country; its present botanical publications include *Chronica Botanica*, under the editorship of Dr. Verdoorn, which is international in its scope, and many other journals and also books of more specialized interest. Now comes the commemoration volume of the Botanical Gardens at Leyden, which is of interest not to botanists alone but also to other men of science.

The University of Leyden was founded in a monastery in 1575, but owing to lack of space the establishment of a medicinal garden was deferred. Later, the municipal council granted an extension of land and the Gardens were established in 1587. The professor of medicine, Geraerdt de Bont, was offered an increase in salary of fifty guilders "if willing to continue as well in winter time to explain and administer anatomy, as in summer to explain the herbs to students of medicine".

In 1589, de Bont was succeeded by Pieter Pauw as professor extraordinarius of medicine. Owing to internal dissension, however, little was done for the Gardens, and in 1592, Clusius (Charles de l'Escluse) was appointed. It was Clusius who foresaw the great importance of plant bulbs.

The first inventory and plan of the Gardens were made in 1594. The Gardens were divided into four quadrangles by intersecting paths and contained more than a thousand different species. Though no particularly systematic plan was followed at that time, the "Index" of 1594 was that of a *hortus botanicus* rather than a *hortus medicus*, showing that the Gardens were an expression of Clusius's purely botanical point of view.

The first printed catalogue of the Gardens appeared in 1601. In 1685, there were three thousand species in the Gardens; in 1740, seven thousand; and at the present time there are between eight and nine thousand.

The 1628 catalogue owed its existence to the fact that the then director, Adolf de Vorst, was asked to show "more activity and application". The catalogue of 1633 showed the appearance of several North American species, the centre of distribution of which was Paris. It is characteristic that the most common specific name applied to these plants by the French was *canadensis*, by the British, *virginicus*, and by the Italians, *indicus* Among other introductions were the Virginian creeper and the Jerusalem artichoke

Herman Boerhaave was appointed director of the Gardens in 1709 He has been described as "a Physician and plant-lover by the Grace of God, Professor of Chemistry and of Botany by the Grace of the Board of Curatores" Among his botanical correspondents were William Sherard and Hans Sloane It is interesting to note that when considering his successor in 1729, Boerhaave had in mind Scheuchzer of Zurich and Dillenius of Oxford, but since neither was a chemist both were rejected, and A van Royen was appointed

Linnæus visited the Botanical Gardens at Leyden for the first time in 1735 He formed a close connexion with the Gardens, and dedicated his "Genera Plantarum" to Boerhaave, who wrote of the work, "centuries shall praise it, the good will follow it, all will derive profit from it" The human element comes in when we read that in order to coax Linnæus, Boerhaave offered him a two-year plant-collecting trip to the Cape, but Linnæus declined it since he had a bride waiting for him in Sweden

With a further succession of directors, the Gardens continued in prosperity, and many more species, especially of Japanese origin, were acquired In 1891, Jacobus Janse was appointed to the chair, where he did forty years of splendid work He retired in 1930 and has only recently died

The Gardens are now under the directorship of Prof L G M Baas Becking, co-author of the work under review His is a splendid heritage In the Gardens of to-day, periods of architecture and centuries of endeavour are reflected But there is no fear for the future of the Gardens They are in good hands, as reflected in Prof Baas Becking's concluding words in this monumental book 'We have cause to be contented, *but we should take care lest we be satisfied*'

The authors of this book, H Veendorp, *hortulanus*, and L G M Baas Becking, *praefectus horti*, are to be congratulated on a work of inestimable value to botanists, for apart from an absorbing history of one of the most important of botanical gardens, we are offered a wealth of botanical information of more general appeal

The text is beautifully illustrated with sketches by J Spier, D A Bueno de Mesquita, J Raphael and Miss M L E van Weydom Claterbos

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Data of Ferromagnetism

Magnetische und elektrische Eigenschaften des Eisens und seiner Legierungen

Von Dr O v. Auwers (Aus "Gmelins Handbuch der anorganischen Chemie", herausgegeben von der Deutschen Chemischen Gesellschaft) Pp lxii + 1421–1634 +466 +148 (Berlin Verlag Chemie, G m b H , 1938) 84 gold marks

TWO parts of "Gmelins Handbuch" dealing with the magnetic and electric properties of iron and its alloys have previously been published, the first dealing with 'pure' iron and the iron-carbon system (1934), and the second with alloy steels (1936) These are brought together in the present volume, with a supplement covering the literature up to September, 1937

Magnetic and electric properties are surveyed in separate sections in each part, the magnetic sections accounting for about three quarters of the whole The first part opens with an introductory section dealing with definitions and units, and in a general way with theories of ferromagnetic phenomena Most of the experimental material is presented under the main headings of intensity, susceptibility, and hysteresis The effects of form grain size, thermal and mechanical treatments, temperature, strain, and alternating fields are reviewed under each heading Further sections deal with the Barkhausen effect, magnetostriction, and galvanomagnetic effects The survey of electric properties includes sections on resistance, contact potentials, and thermo electric effects In the second part, some six hundred alloy systems are treated in turn in the Gmelin system order at a length ranging from that of a treatise, as for the magnetic properties of the iron-silicon and iron-nickel systems, to that of a bare reference

Apart from a number of general literature lists, the references are incorporated in the text, to the number of tens of thousands The text is largely a guide to the literature, either without comment, or with brief abstracts, supplemented by general surveys introducing many of the sections In spite of the necessity for conformity with a rather rigid plan, the author of the text has succeeded remarkably well in infusing a measure of spontaneity into the presentation, and a profound familiarity with the subject-matter is shown by the easy conciseness and clearness, and by the appositeness of cross-reference and footnote

Extensive numerical data and numerous diagrams are given these forming one of the most valuable features of the work

With the general scheme of arrangement of the Handbuch based on the subdivision of subject matter by substances reference to the work done on any particular alloy is very straightforward Reference for other purposes is facilitated by summaries at the ends of the second and third parts indicating under which alloys the more important phenomena are discussed and by extensive tables in which the alloys are arranged in accordance with their properties There are also lists of patented alloys similarly arranged and of the compositions of alloys having special trade names

It is for the unprecedented comprehensiveness of the survey of ferromagnetic properties that this volume is particularly valuable As a treatise on ferromagnetism it inevitably suffers from the fact that nickel and cobalt cannot be considered except as constituents of alloys and that the theoretical side can be considered only incidentally As a record of experimental data and as a guide to the literature however it is in a class by itself It will be invaluable not only to chemists but also to physicists concerned with magnetism to metallurgists and to electrotechnologists

Examination of this volume focuses attention on the overwhelming mass of experimental work which has been carried out on ferromagnetism against which understanding of ferromagnetic phenomena is revealed as still pitifully meagre It is difficult to avoid the feeling that if even a small fraction of the energy devoted to the accumulation of experimental data had been diverted to serious theoretical investigation a much more satisfying state would have been reached not only in the science of magnetism but also in the associated practical art

F C S

Castelnuovo's Collected Works

Memorie scelte
Per Guido Castelnuovo Pp x + 588 (Bologna Nicola Zanichelli 1937) 125 lire

PROF CASTELNUOVO'S scientific jubilee occurred in the year 1935 and in the same year he retired from the professorship of geometry at the University of Rome a post which he had held for nearly forty five years To mark the occasion his friends and pupils urged him to publish a book of memoirs and decided to found in his name a scholarship at the University to which the proceeds from the sale of the book should be devoted After some delay the book has now appeared Containing as it does most of Castelnuovo's major works it needs no introduction to students of algebraic geometry who at one time or another find it necessary to consult all of them Its value is enhanced by the fact that here and there the author has added brief commentaries of great interest showing the relations between the various papers and giving some account of their inception

The present book opens with a series of papers representative of the author's work during the early Turin period (1887–91) when he was in daily contact with Corrado Segre It has been said that the modern geometry of curves was born under the arcades of Via Po Turin the fruit of conversations between the two young mathematicians In proof of this the second paper of the series contains the celebrated result concerning the maximum genus of a curve in a given space These researches culminate in a long memoir on plane curves which may be said to initiate the modern study of linear systems from the invariantive point of view To Castelnuovo we owe the introduction of those *virtual* characters which play a leading part in all later developments

The second period which begins with Castelnuovo's appointment to the chair of geometry at Rome is remarkable for the wealth of results and for the unity of aim displayed throughout The years 1892 97 saw the creation in the theory of algebraic surfaces of a vast new branch of geometry which is almost entirely the work of two men Castelnuovo and Enriques Castelnuovo's own contribution to it was a long chain of memoirs which dispose of an array of important problems many of them landmarks in the theory The whole of this work is characterized by the utmost originality and resourcefulness the author has had to forge his own technique for each special problem

First comes a number of preparatory notes which discuss various simple types of rational surfaces and criteria of rationality These it now appears were almost prophetic for they were destined to be invaluable in the general discussion which almost always reduces in the last analysis to the examination of particular cases Then follows a group of famous memoirs on the rationality of plane involutions, the conditions of rationality of a surface and an exhaustive study of linear systems of curves on a surface, with all the remarkable inferences which can be drawn from it So intense was this period of research that few fundamental questions remained to be settled afterwards One of them however was disposed of only a year ago by Beniamino Segre

In the ensuing period the author's interest turns from the methods of algebraic geometry proper to the consideration of transcendental questions The most celebrated paper of this group contains the theorem that the number of simple everywhere finite integrals attached to an algebraic surface is equal to the so called irregularity of the surface This third series concludes with some interesting researches on Abelian functions The final paper is devoted to a very different topic—the statistical problem of moments

To anyone with a knowledge of Italian though not necessarily of geometry these papers will have an extra mathematical interest they are written in a style which for sheer lucidity and directness has never been surpassed Castelnuovo has that rare capacity for going straight to the heart of a difficult problem of seeing where the difficulty lies and resolving it in successive stages all apparently of the utmost simplicity Altogether this book is the most fitting memorial to the great period of Italian mathematics which now it seems is drawing to a close

Laboratory Experiments in Biochemistry

Fundamentals of Biochemistry, with Laboratory Experiments
By Prof Carl L A Schmidt and Dr Frank Worthington Allen (International Chemical Series) Pp xv + 388 (New York and London McGraw Hill Book Co Inc 1938) 18s

THIS is a book for the beginner in America It starts with a definition of the purpose of laboratory training which every old stager in science will applaud The incalculable gift of the laboratory is its discipline in scientific method and its training in the importance of logical reasoning and the use of exact language in speaking and in writing The student is enjoined to supply himself with a laboratory coat a box of matches a set of weights a note book and a slide rule So equipped the scientific world lies open before him

The standard of biochemistry and chemical physiology is so high in the United States to day that one may justly infer that the subject is being well taught, particularly in the laboratory The object of the special experiments here described is defined as "to teach the student the sources of the facts of biochemistry to integrate information to carry out a well controlled experiment and to present the facts in a co ordinated and logical manner".

There is no doubt that the object is the same in Great Britain also but any time when half a dozen employers are gathered together they will tell you that the normal product of the British university definitely fails to meet such criteria The question may justifiably be asked whether our present training is not too theoretical ? As has been aptly written by Dr S Miall We should not regard the young as carboys into which you can put pints or litres of knowledge For the moment the fight against examinations as the one test of education appears lost or in abeyance there are but few reformers left to combat in this field The fact remains however that in many respects the Americans are better trained more practical to day than British graduates it is evidenced by the way the United States is going ahead in scientific work and what is more important in its practical application

It is opportune to sound this warning note and to express the hope that teachers in Great Britain will examine with care books such as this one so that they may ascertain the differences between British and American methods

This is not the place for its detailed examination there is no novelty in the experiments or in the facts presented in its text which is crisp and contains a great deal of information in a small compass Its perusal leaves us with the feeling rightly or wrongly that it would inspire a young man to dig further into the subject and try to keep abreast of its progress The essential facts are clearly presented whether the substance is simple or complex in structure

> Further deeper may you read,
> Have you sight for things afield '

says Meredith Surely it is in this spirit that the training of men whose work takes them near to Nature should be conducted

E F A

(1) Experimental Cookery:

from the Chemical and Physical Standpoint, with a Laboratory Outline By Prof Belle Lowe Second edition Pp xi+600 (New York John Wiley and Sons, Inc, London Chapman and Hall Ltd, 1937) 22*s* 6*d* net

(2) Food Technology

By Dr Samuel C Prescott and Prof Bernard E Proctor Pp ix+630 (New York and London McGraw Hill Book Co, Inc 1937) 30*s*

(1) THE object of this book is to present the knowledge of food preparation and cookery processes from a chemical and physical point of view, particularly from that of colloid chemistry A citation from Ostwald is appropriate Much as every one would like to obtain better food for less money the study of such questions is regarded as menial and best left to the cook A scientific study of the preparation of food is considered as only amusing in scientific circles

The book is intended for students of home economics and for food preparation courses in colleges It is highly informative and in advance of most other books on the subject

(2) This book of American origin, is designed for students who hope to find a place in the food industries it seeks to bring into a single volume the laws and processes of biology, physics chemistry and engineering used in the preparation and preservation of food products It is certainly a mine of information brought together in a congested form but written with a light touch so as to make interesting reading

The staple foods are dealt with in turn cereals, sugar, vegetables and fruits, of plant origin, meats, dairy products and fish, of animal origin Half the book is devoted to the processes of food manufacture It may be claimed that full knowledge is available how to prepare first class foods of all types under hygienic conditions so that there is no excuse for delinquents, who should be severely dealt with It is for the public to select a proper diet in relation to their means and for the dieticians to explain why we must have fresh food also

Mœurs et histoire des Peuls

1 Origines, 2 Les Peuls de l Issa Ber et du Macina, 3 Les Peuls du Fouta Djallon Par Louis Tauxier (Bibliothèque scientifique) Pp 422+16 plates (Paris Payot et Cie 1937) 75 francs

THE Peuls, as they are known to the French authorities who have adopted the Wolof name, but more commonly known in English as the Foula or Fulani, are a pastoral people, widely scattered as a dominant caste over that part of northern Africa extending from Nigeria to Senegal and from the Atlantic to Lake Chad They were known to Arab writers of the fifteenth century, but they appear to have reached northern Nigeria as an immigrant nomad people at the end of the thirteenth century, their conquest of that country, however, dating from 1804 when the Moslems declared a Holy War against the pagan rulers In French territory their principal groups are Peuls of Fouta Toro (Ferlo), of Nioro, of Macina and Fouta Djallon, their numbers being estimated at 1,790,000, while in Nigeria there are said to be some two millions

Various theories have been put forward as to their origin, some of a fantastic character It is now generally accepted that they are of southern Hamitic origin, while their language is an archaic Hamitic tongue

M Tauxier whose opportunity of observation in the field among the Peuls extended over many years, here presents a critical survey of the information relating to them, and discusses critically the literature dealing with their origins, social organization and history, which he analyses in the light of his personal studies His work, more especially in regard to the people bordering on the Niger and of Fouta Djallon, is the most complete study which has yet been made

Analytic Geometry and Calculus

By Prof Max Morris and Prof Orley E Brown Pp x+507 (New York and London McGraw Hill Book Co Inc, 1937) 21*s*

THE authors of this volume have taken for their aim the axiom that the best preparation for the calculus is a suitable course in co ordinate geometry The text is thus divided into two sections the first, consisting of six chapters is devoted to analytic geometry, and the second to the calculus The former embraces both plane and solid geometry and deals not only with the conics but also with cycloids, exponential and logarithmic curves together with several curves of historical interest like the Cassinian Ovals The section on calculus begins with a discussion of limits, continuity and derivatives Then follows a sound exposition of integration partial differentiation, multiple and line integrals infinite series and finally a chapter on differential equations

The book abounds in exercises for the student, both of the academic drill type and of the more practical problematic kind The text is also excellently illustrated with clearly drawn diagrams Although the book is adapted to the needs of American students, it should be of much value in Great Britain

Ixodoidés

Par Prof G Senevet (Faune de France 32 Fédération française des Sociétés de Sciences naturelles Office central de Faunistique) Pp 101 (Paris Paul Lechevalier, 1937) 50 francs

THIS useful synopsis deals not only with the French species but also with those found in countries bordering on the Republic Since the various species found in Great Britain are also included, this work provides a handy and ready means for their identification In addition to the descriptions of each of the species enumerated, an account is given of its range of distribution, its hosts and its pathological relations At the end of the work a list of hosts is appended, arranged in taxonomic order, together with the various Ixodidæ known to parasitize them Prof Senevet has written a memoir which may be recommended as being well up to the high standard attained by others in the series to which it belongs

The Atmospheres of the Planets*

By Dr. H. Spencer Jones, F.R.S., Astronomer Royal

DURING the last few decades the main interests of astronomical research have shifted rapidly from the solar system outwards. Nevertheless the planets have not been entirely neglected in recent research. The great light-gathering power of large modern telescopes has enabled spectrographs of very high dispersion to be used for the more detailed study of the spectra of the planets and the great advances in the manufacture of plates sensitive to the infra-red region of the spectrum have made possible the investigation of a region of the spectrum the importance of which arises from the fact that the selective absorptions by planetary atmospheres lie mainly in this region.

From theoretical considerations it is possible to decide whether or not any planet may be expected to possess an atmosphere. The natural tendency of an atmosphere is to diffuse away into space. In order to overcome the gravitational pull of the planet any particle whether large or small must acquire a velocity greater than a certain minimum value determined by the mass and radius of the planet.

The rate at which this loss of fast-moving molecules from the upper atmosphere takes place depends upon the relative magnitudes of the velocity of escape and of the mean velocity of the molecules. Jeans found that if the velocity of escape is four times the mean molecular velocity the atmosphere would be practically completely lost in fifty thousand years but if the velocity of escape is five times the mean molecular velocity twenty-five thousand million years would be required for the loss to be almost complete. If therefore the velocity of escape is as great as five times the mean molecular velocity of hydrogen the atmosphere will be practically immune from loss.

The velocities of escape from the moon and from Mercury are not much greater than the mean molecular velocity of hydrogen so that an atmosphere of hydrogen would escape almost instantly from either body. It appears that the moon if it had never been hotter than at present would have lost water vapour nitrogen and oxygen completely, but would have retained carbon dioxide and heavier gases; Mercury, under the same supposition would have lost almost all its water vapour and nitrogen and most of its oxygen, but would have retained heavier gases to a large extent. The loss is likely to be under-estimated because during the initial rapid cooling the loss must have been considerable. It is certain that the moon has no atmosphere now. The evidence of an atmosphere on Mercury is not fully conclusive but the opinion of Antoniadi that Mercury may possess a very tenuous atmosphere is not in conflict with the theoretical evidence.

THE EARTH

Coming to the earth the escape velocity is 11·2 km./sec. which is almost exactly six times the mean molecular velocity of hydrogen at 0° C. Hence the atmosphere of the earth should be immune from loss of hydrogen and all other gases. At the present time the amounts of hydrogen and of helium in the earth's atmosphere are very small. The supply is being gradually replenished by the weathering of the igneous rocks of the earth's crust which contain uranium and thorium and also consequently helium. Yet the atmosphere does not now contain more than a fraction of the amount of helium that it has gained in geological times. There is thus direct observational evidence that helium is being lost from the atmosphere at the present time.

There is one process by which the escape of helium can be brought about. It is well known that the night sky is faintly luminous. In the spectrum of the night sky the characteristic green auroral line as well as the two red lines are always present. These lines are emitted by oxygen atoms that are in what physicists term a metastable state. The atoms in a metastable state may remain for an average time of a second or longer in that state before emitting their energy in the form of radiation. There is a high probability that before this occurs the atom will have collided with another atom when its energy will be converted into kinetic energy. By such a collision an atom of hydrogen or of helium could acquire a speed greater than the velocity of escape from the earth but an atom of nitrogen or oxygen would not by this process acquire sufficient speed to escape. The loss of hydrogen and helium from the atmosphere of the earth is thus made possible by the fact that free oxygen is present in the atmosphere.

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* From the Norman Lockyer Lecture delivered under the auspices of the British Association on December 6.

It appears probable that the primitive earth must have remained hot sufficiently long for most of its initial atmosphere to have been lost. It was pointed out by Russell and Menzel that in the stars and the nebulæ neon is as abundant as argon, whereas in the earth's atmosphere argon is five hundred times more abundant than neon. Nitrogen is far less abundant on the earth than in the stars. These large differences in relative terrestrial and solar abundance can be accounted for on the supposition that the rate of loss of atmosphere was very rapid when the earth was hot. When the cooling had proceeded sufficiently far for the escape of the atmosphere to cease, neon had been depleted to a much greater extent than the heavier argon. If this supposition is correct, much of the original oxygen, nitrogen and water vapour and all the original helium and free hydrogen must have been lost. As the molten earth cooled, great quantities of water vapour, carbon dioxide and other gases would have been evolved from the solidifying magma; these with the residual gases from the initial atmosphere, formed the new atmosphere which as the earth was then relatively cool, could not escape.

The presence of free oxygen in the atmosphere of the earth needs explanation, for processes are in continual operation that are depleting the store. One of the principal causes of depletion is the weathering of the igneous rocks to form sedimentary deposits which is occurring. In this process much of the ferrous oxide is oxidized to ferric oxide. It has been estimated that during geological times the amount of oxygen thus depleted from the atmosphere is about twice the quantity now present. It is clear that the oxygen must be replenished in some way, and this is done by green vegetation on the earth's surface.

VENUS

The atmosphere of Venus is in marked contrast to that of the earth. The velocity of escape from Venus is 10·2 km./sec. It may therefore be expected that Venus will have an atmosphere comparable with that of the earth in extent and density. The presence of an extensive atmosphere is confirmed by observation. Photographs in ultra-violet light record cloudy markings which rapidly change their form and are of short duration.

To determine the composition of the atmosphere of Venus, or of any other planet, recourse must be had to the spectroscope. Absorption in the atmosphere of the earth is a complicating and troublesome factor. These absorptions can be identified in two ways. First, by observing the spectrum of the sun at different altitudes; the terrestrial absorptions become stronger the lower the altitude. Secondly, if the spectra of light from the east and west limbs of the sun are compared, the absorptions of solar origin show a slight relative displacement caused by the solar rotation, whilst the absorptions of terrestrial origin are undisplaced. The absorptions of terrestrial origin having been identified, the absorptions produced in the atmosphere of a planet can be investigated by photographing the spectra of the planet and the moon on the same night and at the same altitude. Any absorption present in the spectrum of the planet and not in that of the moon, or much stronger in the spectrum of the planet than in that of the moon, must originate in the atmosphere of the planet. Another, and more delicate, method of investigation is to photograph the spectrum of the planet at a time when it is approaching or receding from the earth most rapidly. The absorptions due to the planet's atmosphere are displaced with respect to those due to our own atmosphere.

Complete information about the constitution of any planetary atmosphere is not obtainable, however, because many possible constituents of the atmosphere show no absorptions in the region accessible to study. Amongst such undetectable constituents are hydrogen, nitrogen, helium, neon and argon.

The investigation of the atmosphere of Venus has given no certain evidence of the presence of oxygen. Observations have led to the conclusion that the amount of oxygen must be less than one thousandth part of that above an equal area of the earth. More surprising, perhaps, than the failure to detect oxygen, is the failure to detect the presence of water vapour, even though the tests for water vapour are less sensitive than those for oxygen.

The most interesting fact about the atmosphere of Venus is the great abundance of carbon dioxide. In 1932, Adams and Dunham discovered three well-defined bands in the infra-red region of the spectrum of Venus. These bands had not at that time been observed in any terrestrial spectrum. Theoretical investigations indicated that they might be due to carbon dioxide; this was first confirmed by Dunham. Later, Adel and Slipher reproduced the three bands by passing light through 45 metres of carbon dioxide at a pressure of 47 atmospheres; the absorptions so obtained were less intense than the corresponding absorptions in the spectrum of Venus. They concluded that the amount of carbon dioxide above the surface of

Venus is equivalent to a layer two miles in thickness at standard atmospheric pressure and temperature For comparison it may be mentioned that the amount of carbon dioxide present in the earth s atmosphere is equivalent to a thickness of only about 30 feet

The carbon dioxide will have a powerful blanketing effect and it is not improbable that the temperature at the surface of Venus may be as high as or higher than that of boiling water The high temperature the lack of oxygen and the abundance of carbon dioxide can be interpreted as indications that there cannot be any great amount of vegetation on Venus

MARS

Mars occupies a position between Mercury on one hand and Venus and the earth on the other as regards size mass and velocity of escape The velocity of escape is 5 0 km /sec It may be expected that Mars will have a much thinner atmosphere than Venus or the earth The presence of an atmosphere on Mars can be proved by photographing the planet in light of different colours Photographs in the infra red show permanent markings which are evidently surface features whereas photographs in the ultra violet show none of these The atmosphere is extensive enough to scatter ultra violet light to such an extent that the light cannot penetrate to the surface and out again The difference in size of the images in ultra violet and infra red light indicates that the atmosphere extends to a height of fully fifty miles above the surface

The polar caps provide additional evidence of an atmosphere on Mars They wax and wane with the changing of the seasons The changes are to be explained by the melting or deposition of ice snow or hoar frost and from the rate at which the caps decrease as summer advances it can be calculated that they are not more than a few inches thick

All attempts to detect oxygen in the atmosphere of Mars have been unsuccessful The amount of oxygen is certainly not more than one thousandth part of the amount in the earth s atmosphere The red colour of Mars which is unique among the heavenly bodies provides indirect evidence of oxygen suggesting rocks that have been completely oxidized The amount of water vapour in the atmosphere of Mars is so small that it can be detected only under the most favourable conditions At the Lowell Observatory which is at an altitude of 7 250 feet Slipher in 1908 by comparing the spectra of Mars and the moon when at the same altitude under conditions of exceptional atmospheric dryness found that the water vapour absorptions were slightly stronger in the spectrum of Mars than in that of the moon

Carbon dioxide has not been detected in the Martian atmosphere There is some evidence of the existence of vegetation on Mars Seasonal changes in form and coloration of the dark areas seem to be reasonably well established and the interpretation of these changes as due to the seasonal growth of vegetation is plausible The presence of some carbon dioxide in the atmosphere may therefore be inferred Mars appears to be a world in the state that the earth will ultimately reach when the oxygen in the atmosphere will have been almost entirely exhausted by the progressive weathering and oxidation of the rocks

THE MAJOR PLANETS

The major planets Jupiter Saturn Uranus and Neptune may be considered together They are large massive planets of low mean density the visible disks of which are considerably oblate Saturn has the lowest mean density of any of the planets only seven tenths that of water The velocities of escape from all the major planets are so high that extensive atmospheres are to be expected containing an abundance of hydrogen and helium

The telescopic appearance of Jupiter and Saturn confirms the existence of dense atmospheres Markings in the form of belts parallel to the equator may be seen these are of complex structure and their details are continually changing Photographs in the infra red show many differences from those in the ultra violet but again the recorded features are continually changing so that the infra red light does not penetrate to the surface

Some theoretical results of interest have been deduced from the oblateness and mean density of these planets Jeffreys has concluded that they consist of a core of rock generally similar to the inner planets in its constitution and of about the same mean density surrounded by ice coatings of great depth above which are very extensive atmospheres According to the calculations by Wildt the rocky core of Jupiter has a radius of about 22 000 miles the ice coating is 16 000 miles in thickness and the depth of the atmosphere is about 6 000 miles The rocky core of Saturn is about 14 000 miles in radius it is covered with a layer of ice some 6 000 miles thick over which is an atmosphere extending to a height of 16 000 miles Saturn has the most extensive atmosphere of any of the planets which explains why it has the lowest mean density and the most flattened disk The pressures of these extensive atmospheres are very great, at the bottom of Jupiter's atmosphere, for example, the pressure is fully a million times the pressure at the bottom of the earth's atmosphere At a relatively small depth in the atmosphere, the pressure is great enough to compress the gas to a density nearly equal to that of the corresponding liquid.

The densities of the atmospheres are low, according to Wildt's calculations they are 0 78 for Jupiter and 0 41 for Saturn This enables most of the possible constituents to be excluded, for all known gases, in the liquid or solid state, have densities exceeding 0 3, with the exceptions of hydrogen and helium, and the only other gases whose densities in the liquid or solid state are less than the density of the greater portion of the atmosphere of Jupiter are methane and ethane It is concluded that the atmospheres of the major planets must contain large quantities of free hydrogen and helium The planets are believed to have been formed from the sun which is known to contain a large amount of hydrogen to the extent of about one third part by weight As massive planets, like the four major planets, would retain their light constituents, it is to be expected that hydrogen and helium would be present in large amount in their atmospheres

PLANETARY SPECTRA

The spectra of the major planets are of great interest Huggins discovered visually absorption bands in the orange and green in the spectrum of Jupiter These bands appear more strongly in the spectrum of Saturn, but are not found in the spectrum of the rings—a conclusive proof that they originate in the atmosphere of Saturn Uranus and Neptune show for the most part the same bands with still greater intensity, together with some additional ones In recent years, the spectra have been extended far into the infra red by Slipher, and several intense bands have been found in that region

The origin of these bands remained unknown until a few years ago Then Wildt succeeded in proving theoretically that certain of the bands agreed in position with bands of ammonia and that others agreed with bands of methane These conclusions were confirmed by Dunham who, using much higher dispersion, was able to obtain a more complete resolution of the bands into their component lines and found a complete coincidence He estimated that the quantity of ammonia gas producing the absorptions in the spectrum of Jupiter is equivalent to a layer 30 feet thick under standard conditions The amount is less in Saturn The ammonia absorptions are not detected in the spectra of Uranus and Neptune

Methane is present in much larger amount Adel and Slipher found that a 45 metre path of methane, at a pressure of 40 atmospheres, gave bands intermediate in intensity between those of Jupiter and Saturn The much greater strength of the methane absorptions in Uranus and Neptune is probably accounted for by the lower temperatures of these planets The ammonia must be frozen out of their atmospheres making it possible to see through them to a greater depth Adel and Slipher estimated that 25 miles of methane at atmospheric pressure would be required to give absorptions as strong as those of Neptune The higher gaseous hydrocarbons have been looked for in vain in the spectra of the outer planets All the absorption bands appear to be accounted for by ammonia and methane It is a grand slam

The presence of ammonia and methane in the atmospheres of the large planets is not surprising They are to be expected as a consequence of the reaction of hydrogen with nitrogen and carbon dioxide on a cooling planet Such reactions resulted in an atmosphere of hydrogen, helium, and other inert gases mixed with methane ammonia and water vapour, but with little or no carbon dioxide or free nitrogen Below this there would be a deep ocean strongly alkaline from the ammonia in solution As the temperature fell still further, the ocean would freeze It may be mentioned that an ocean consisting of one part of ammonia to two parts of water would freeze at −100° C, all the four major planets are colder than this

The ammonia in the atmospheres of Jupiter and Saturn must be nearly on the point of condensation, and the clouds over these planets may consist of droplets of liquid ammonia or even small crystals of frozen ammonia The mean temperatures of Uranus and Neptune due to solar radiation alone are about −200° C and −220° C respectively At the temperature of Neptune, the methane must be nearly ready to condense

The nature of the planetary atmospheres, about which so little was known until recently, seems now to have been solved in its broad outlines As a brief summary we find that we can divide the planets and their satellites into three groups the small ones, entirely devoid of atmospheres, the middle sized ones with atmospheres of moderate extent devoid of hydrogen or compounds of hydrogen with nitrogen or carbon but containing oxygen or compounds of oxygen, and the large ones, with very extensive atmospheres, devoid of oxygen or compounds of oxygen but containing hydrogen and compounds of hydrogen.

Facts and Theories in Protein Chemistry*

IN the last decade many investigations of an exact nature have been made on the proteins in solution and in the solid phase Unfortunately by a dissipation of the available research energy among a wide variety of proteins and by a signal absence of co operation among the researchers themselves, less significant advances have been made in the elucidation of fundamental principles than would otherwise have been the case It was a happy inspiration therefore which brought together most of the authorities on protein chemistry in Europe at the Royal Society on November 17 to compare their experiences and discuss each other s difficulties

Prof The Svedberg (Uppsala) opened the conference with a vigorous and notably wide survey of recent developments in the physical chemistry of the proteins According to precise physical measurements protein particles have such characteristic and reproducible properties that it is no longer possible to deny them the right of classification as giant molecules Sedimentation studies on native soluble proteins reveal a striking homogeneity in the sizes of individual molecules and the method of electrophoresis reveals a similar homogeneity in their free charges Measurements of protein molecular weights by sedimentation equilibrium or by a combination of sedimentation velocity and diffusion give values which, rather unexpectedly conform to a law of simple multiples

Assuming 17 600 as the unit of molecular weight, the values of some sixty native proteins so far investigated including the giant hæmocyanin molecules with weights of several millions may be expressed as multiples of this unit by factors containing powers of 2 and 3 The rule is approximate only suggesting the existence of some underlying architectural principle in the arrangement of the amino acid residues Differences in the percentage amino acid composition of proteins may explain the spread of molecular weights above and below the simple multiple value Determinations of osmotic pressure give values which agree well with molecular weights obtained by sedimentation methods X ray investigations of pepsin insulin lactoglobulin and hæmoglobin in the crystalline state have given values of 40 000 37 200 36 500 and 69 000 respectively while the ultracentrifuge gives 37 000 38 000 39 000 and 68,000

Viscosity measurements on anisotropic proteins may be correlated with the axial ratios of the corresponding molecular ellipsoids of rotation by means of equations proposed independently by Kuhn Burgers and Polson From the axial ratio the molecular frictional coefficient may be calculated, and this in turn supplies the necessary information for calculating molecular weights from diffusion data Molecular weights thus obtained from viscosity and diffusion data agree with the ultracentrifuge values only when Polson s equation which has a purely empirical basis is used Studies on the peptic digestion of egg albumin by Tiselius show that the decomposition products have a much lower electrophoretic mobility than the uncharged protein This supports the view that the constituent units of a protein particle are bound together by specific chemical linkages and that the particle is in fact a single molecule

Recent theories of protein structure proposed by Wrinch and by Bergmann and Niemann imply the chemical individuality of the protein molecule These theories are important as a stimulus to further research but caution must be observed in their acceptance In the case of Bergmann and Niemann s theory which assumes a fundamental regularity in the arrangement of the amino acid residues in the molecule certain difficulties exist For example the theory gives a molecular weight of 69 000 for hæmoglobin based on a cysteine content of 0 5 per cent and assuming three cysteine residues per molecule Ultracentrifugal and X ray methods show however, that hæmoglobin may be split reversibly into halves of approximately equal size

Dr Linderstrøm Lang (Copenhagen) emphasized the value of enzymic degradation as a method of studying the structure of the protein molecule, especially in recent years with the advent of crystalline and relatively pure enzymes Considerable care is still required in the interpretation of the results of these studies since it is now becoming clear that some fundamental change scarcely distinguishable from denaturation is a necessary preliminary to the enzymic disruption of polypeptide bonds in the protein molecule Dr D Wrinch (Oxford) gave a clear presentation with the aid of models of her cyclol hypothesis which assumes that the protein molecule is constituted of diazine and triazine rings arranged alternately in a kind of fabric which may be folded according to purely geometrical considerations The space enclosing fabric with 288 amino acid residues takes

* Substance of a discussion on The Protein Molecule held by the Royal Society on November 17

the form of a truncated tetrahedron and this represents the globular protein molecule of weight 35 000 Dr A Neuberger (London) pointed out that the presence of diazine and triazine rings in proteins is not supported by chemical facts It has never been shown that a lactam lactim tautomerism exists in peptides nor has a polymerization of peptides to cyanidine like rings been realized The chemical and enzymic behaviour of proteins is also not in accordance with the cyclol hypothesis The Bergmann and Niemann hypothesis was also criticized by Dr Neuberger on the grounds that the limits of error in the present methods of estimating amino acids are so great as to render the deductions made from them statistically of doubtful value

Dr G S Adair (Cambridge) showed that for hæmoglobin egg albumin and serum albumin the maximum values for the molecular radii calculated from measurements of diffusion made at Uppsala were not more than 5 per cent greater than the minimum values calculated from measurements of the hydration and density of protein crystals suspended in sodium phosphate buffers He also discussed the effects which salts have on the iso electric points of proteins Dr K O Pederson (Uppsala) described new work on the dissociation of proteins particularly the type of molecular splitting which one component of a binary mixture induces in the other The dissociation is more marked when a carbohydrate rich protein is mixed with a carbohydrate poor one It is also marked in serum in which there is evidence that phosphatides take a role similar to the carbohydrate The X fraction seen in the sedimentation diagram of normal serum is identical with the intermediate or β globulin seen in electrophoresis and this fraction according to Tiselius and Blix is the main carrier of the serum phosphatides Changes which affect the serum calcium for example dialysis addition of salts etc affect the sedimentation rate of the X component The effect is probably on the phosphatide linkage

Dr Pederson suggested that these and other dissociation effects are best explained by postulating that the larger protein molecules consist of small primary protein units linked into a secondary structure by means of carbohydrate phosphatide nucleic acid etc This view received striking support from Mr J St L Philpot (Oxford) who described how the sedimentation constant of casein can be altered at will to any value between 6 and 10 4 by the addition of calcium This appears to be a case of primary protein units linked by a polyvalent inorganic ion A surprising fact however is that only one boundary—an apparently homogeneous one—is present It is possible that the primary protein units are very small but if in fact they are about 100 000 in weight ($S_{w\,20^{\circ}}=6$) the absence of two boundaries might be explained by postulating an extremely mobile form of calcium casein equilibrium

Prof H H Weber (Munster) opened the afternoon session with a paper on the proteins of muscle dealing particularly with myosin Solutions of this protein show a high and anomalous viscosity and marked anisotropy of flow Solutions more concentrated than 2 per cent cannot be obtained in the disorientated state but orientated threads may be spun like artificial silk to much higher concentrations These threads resemble muscle fibres closely in swelling power tensile strength elastic properties and X ray appearances Measurements of the double refraction and the *eigendoppelbrechung* of the stretched myosin thread show that these correspond quantitatively with the values for the *Q* disks of muscle The *Q* disk consists therefore of fully orientated myosin rods Complete elastic stretching of the myosin filament results from stretching of the rods themselves the process consisting evidently in a straightening of folded filamentous molecules Myosin may be denatured by heating above 40° C the threads undergoing an irreversible decrease in double refraction and a marked contraction The view is put forward that muscle contraction consists in a chemically induced denaturation of myosin molecules which is reversible in the circumstances pertaining to muscle Dr G Boehm (Basle) showed a number of X ray diagrams of stretched myosin threads Prof K H Meyer (Geneva) developed some interesting ideas on mechanically induced molecular transformations citing the solubility and elastic changes caused in the crude material from the silk gland by simple stretching and the crystallization of metastable selenium by similar treatment He is of the opinion that blood plasma may be regarded as a supersaturated fibrinogen solution and that mechanical denaturation may suffice to explain the phenomena of blood clotting Dr W T Astbury (Leeds) referred to the elegant method of progressive piling of protein monolayers on a metal slide until it is possible to measure the thickness of a monolayer by means of a screw micrometer

Dr Evert Gorter (Leyden) discussed the behaviour of those proteins which spread easily on water surfaces and others for example fibrinogen and myosin which only do so after treatment with traces of proteolytic enzymes Spreading experiments only give information about one side of the film—fortunately the more important polar side in contact with the water The view that spread proteins are denatured is not in agreement with all the facts Denatured egg albumin does not spread and pepsin and trypsin remain active as proteolytic enzymes after spreading Spreading does not necessarily cause denaturation because the polar groups remain active and free Denaturation by shaking on the other hand results from juxtaposition of polar surfaces in the foam so that only non polar groups are exposed and the foam becomes insoluble It is unlikely also that spread proteins are denatured since these are employed widely in the architecture of living tissues Dr J F Danielli (London) pointed out that from a consideration of surface forces, it appears that the attraction between hydrocarbon residues of the amino acids are sufficient to maintain a folded globular form in the native protein These forces are insufficient however to maintain a specific rigid structure and additional chemical bonds must be postulated for this purpose

Miss D Crowfoot (Oxford) followed by Prof J D Bernal (London) discussed the technical difficulties in protein crystallography especially those arising from the weakness of the reflections and from hydration of the crystals Both speakers referred to the inadequacy of the X ray data available on the proteins and to the necessity for caution in the interpretation of the results Of the seven proteins so far examined dried insulin is the simplest having a rhombohedral cell containing only one Svedberg unit of 35 000 One cannot be certain even in the case of insulin whether the crystallographic unit is a true unit or itself consists of sub units Prof J R Marrack (London) discussed experiments with conjugated antibodies which lead to the conclusion that the antibody-antigen reaction is not due to simple combination of polar groups but probably involves specific amino acid configurations Dr F R Holiday (London) supported this view on the basis of immunity phenomena exhibited by serum albumin after incomplete digestion with pepsin

A S McFARLANE

Sir Charles Parsons and Marine Propulsion

ON December 2 at the Institution of Mechanical Engineers before an audience which included many engineers who have been closely associated with the application of the Parsons steam turbine to ships Mr S S Cook delivered the third Parsons Memorial Lecture taking as his subject Sir Charles Parsons and Marine Propulsion Born in 1875 and like Parsons a Cambridge wrangler Mr Cook has been connected for a long period with the Parsons Marine Steam Turbine Company and is well known in engineering circles for his original investigations and his memoirs on the marine steam turbine

The story which Mr Cook unfolded may perhaps be regarded by some as a thrice told tale for Sir Charles Parsons either himself or in collaboration with others placed on record in papers to technical institutions the various steps in the progress of the turbine as applied to steamships but there are features in the story which when told by others only heighten our respect and admiration for Parsons when he was faced with difficulties which would have overwhelmed men of less determination None of those who were present at the Diamond Jubilee Review of 1897 and saw the little *Turbinia* steam at more than 30 knots up and down the lines could have known that three years previously the same craft with her original machinery to the intense disappointment of Parsons and his colleagues had failed to obtain a speed of even 20 knots The spectators said Mr Cook may have been thrilled to see a tiny vessel racing down the lines at such unusual speed but their feelings could have been nothing compared with those of the few on board the vessel who had emerged so triumphantly from depressing failure into glorious success

The Parsons turbine it will be remembered was invented in 1884 For the next ten years or so it was used exclusively for driving electric generators and it was not until the compound condensing turbine had shown its superiority over the best reciprocating engine that any steps were taken to apply it to ships The speed at which it revolved seemed to some to rule it out for this purpose In January 1894 however after some preliminary work Parsons took out Patent 394 for Propelling a steam vessel by means of a steam turbine which turbine actuates the propeller or paddle shaft directly or through gearing and the pioneer company the Marine Steam Turbine Company was formed The directors of the company were the Earl of Rosse Parsons N G Clayton C J Leyland J B Simpson and A A Campbell Swinton After some experiments with models, the *Turbinia* was built She was 100 ft long and 44 tons displacement Into her Parsons fitted a single water tube boiler and a single radial flow turbine Designed to develop 1650 h p the speed of the turbine was 1600–1700 r p m A single propeller of 20 in diameter was used The results being unsatisfactory, thirty one different trials were made with different propellers, but the best speed fell short of 20 knots "At this stage,' said Mr Cook, "we cannot fail to admire the indomitable courage of Parsons One may hazard the opinion that with most engineers the experiments would have ended there The gap between the estimated speed of 30 knots and the 20 knots actually obtained was an enormous one The power varying as the cube of the speed, such a difference indicates a shortage of propulsive power in the ratio of 8 to 27 Faced with a failure of this magnitude, most men would have cut their losses, and in that case there might never have been a *Mauretania* or a *Lusitania*, no *Dreadnought* or super dreadnoughts, no *Queen Mary*—who knows ? '

To locate the failure, Parsons fitted a torsion meter on the shaft, probably the first marine torsionmeter of any type The greater part of the loss was found to be due to 'cavitation', a phenomena which had been observed by Sir J I Thornycroft and S W Barnaby during the trials of the 27 knot destroyer *Daring* They had found that if the mean pressure of propulsion over the blade area exceeded 11¾ lb, cavitation occurred In the *Turbinia* the pressure had been some 60 lb With this knowledge, and backed, as he always was, by his colleagues, the *Turbinia* was fitted with new machinery, consisting of three turbines in series driving three propeller shafts having altogether nine propellers Ready again for trial in February 1896, a speed of 32¾ knots was obtained and after other modifications, 34 knots, or four knots more than the fastest torpedo craft afloat

Mr Cook did not say how much all this pioneering work had cost, far more, it may be presumed, than the capital of £24,000 with which the company was formed Sixty years before, the Ship Propeller Company had sustained a loss of £50,000 over the historic screw driven *Archimedes*, a vessel of only a few hundred horse power The demonstration at Spithead had, however, shown the possibilities of the new means of propulsion, and a new company, the Parsons Marine Steam Company, having been formed with a nominal capital of £500,000, an order was obtained from the Admiralty for the destroyer *Viper*, and at the same time Sir W G Armstrong, Whitworth & Co ordered turbine machinery for a destroyer afterwards named the *Cobra* Both of these vessels were unfortunately wrecked in 1901 These disasters might well have seriously affected the fortunes of both inventor and his company had they not already secured the co operation of the Dennys of Dumbarton and Captain John Williamson, in the building of the Clyde river steamer *King Edward*, the pioneer of turbine-driven mercantile vessels The success of the *King Edward* had far reaching results She was soon followed by the cross Channel steamers *Queen*, *Brighton*, *Princess Maud* and *Londonderry*, and the Dumbarton built vessels *Lhasa*, *Linga*, *Lama* and *Lunka* for the British India Steam Navigation Company The marine steam turbine was now successfully launched on its astonishing career, and the end of its first decade was marked by the construction of the *Lusitania*, *Mauretania* and H M S *Dreadnought*

With the completion of these notable vessels," said Mr Cook, it might be thought that Parsons had reached his goal But Parsons was far from satisfied ' The application of the steam turbine so far was limited to fast vessels of large power Could it be used for vessels of moderate speed ? First of all, Parsons introduced the combined system in which the steam exhausting from a reciprocating engine was utilized in a low-pressure turbine The pioneer vessel with this arrangement was the *Otaki* also built at Dumbarton Then he turned to the use of toothed wheel reduction gearing He had fitted such gearing in a 10 horse-power launch in 1897, but experiments were necessary before using gearing for larger vessels So the *Vespasian* was purchased, her triple expansion engines were replaced by single reduction geared turbines and she was set to work in the North Sea Her success ushered in yet another revolution in marine propulsion To day, single reduction geared turbines are found in the majority of warships and in such vessels as the *Queen Mary* and the new *Mauretania*

But the full tale of Parsons' pioneering work in connexion with marine propulsion does not end with the direct driving turbine, the exhaust turbine or the geared turbine He was the first to make a vacuum tank for the study of model screws, he invented the vacuum augmentor, he introduced the creeping mechanism for gear cutting machines, he made exhaustive experiments on the erosion of propellers, and he was the first to appreciate the value of the Michell thrust-block Then, too, he was ever an advocate of the use of steam at high pressures and high temperatures, and in the Clyde steamer *King George V* fitted turbines working with steam at 550 lb pressure and 750° F temperature The world, said Mr Cook, is the debtor to Parsons for his faith in the turbine, his courage and perseverance, and also for the wise provisions he made for the dissemination of his knowledge and experience Parsons has won titles to fame in many spheres of applied science, but in none of brighter lustre than in the field of marine propulsion

Obituary Notices

Prof. E. M East

PROF EDWARD MURRAY EAST whose death has recently been reported belonged to the group of Mendelian pioneers who began their investigations in the first decade of the present century His most important contributions to plant genetics were in connexion with the breeding of potatoes maize and tobacco Not only was some of his work of great practical value, but he also made fundamental contributions to various aspects of plant breeding especially to inbreeding and hybrid vigour selection and the explanation of the phenomena of self sterility in plants He was one of the leading American plant geneticists of his time

Dr East was born at Du Quorn, Illinois, on October 4 1879 and graduated at the University of Illinois in 1900 He became assistant chemist and then assistant in plant breeding at the Agricultural Experiment Station of the University of Illinois, and in 1907 received the Ph D degree for a thesis entitled A Study of the Factors Influencing the Improvement of the Potato This like much of his later work, was characterized by quantitative as well as qualitative treatment of his material at a time when nearly all the early Mendelian work was mainly qualitative and descriptive in character

East was shortly appointed agronomist at the Agricultural Experiment Station Storrs Connecticut whence in 1909 he went to Harvard as assistant professor of experimental plant morphology at the Bussey Institution Since 1926 he has been professor of genetics in Harvard University East s work on inbreeding, begun at Storrs culminated in a book ' Inbreeding and Outbreeding , published in collaboration with D F Jones in 1919 His investigations of maize were especially valuable as indicating at an early period that quantitative characters such as length of cob are inherited and segregated according to the Mendelian rules Part of this work was done in collaboration with Dr H K Hayes The inheritance of flower size in interspecific crosses of *Nicotiana* was one of the earliest studies of its kind

Probably East's most important contribution to plant genetics was his masterly analysis of self sterility in tobacco, in a series of papers beginning about 1915 He first crossed *Nicotiana alata* with *N sanderæ*, and by analysis of the offspring and the crosses which could be made between them, he discovered that they fell into three groups of plants, each heterozygous for two different sterility factors or S genes These he called S_1S_2, S_1S_3, and S_1S_3 A plant which was S_1S_2, for example, could only be successfully pollinated by pollen carrying the S_3 factor The other types of pollen tube grow so slowly in the style that the flower drops off before the pollen tubes reach the ovary But he showed that by opening the buds, and so giving the pollen tubes a longer interval for growth, self fertilization could take place producing plants homozygous for particular S factors The number of such S factors in *Nicotiana* was finally increased to fifteen all allelomorphic that is representing different changes in one locus of a chromosome Similar conditions have since been found in various other plants such as red clover and *Brassica*

East was always interested in the general biological principles related to genetics, and in his later years was particularly concerned with questions of human population and related problems Mankind at the Crossroads (1923) which was widely read was a valuable study of population problems and the world s food supplies although the emphasis on over population has been partially negatived by the continued fall in birth rates A volume entitled Biology in Human Affairs was edited in 1927

During the period 1908 18 East was a collaborator in the tobacco breeding investigations of the United States Department of Agriculture and during the Great War he was chairman of the Botanical Raw Products Commission R RUGGLES GATES

Prof A K Mordvilko

ALEXANDR KONSTANTINOVICH MORDVILKO, an aphidologist and parasitologist of world repute who died on July 12 was born in 1867 in the village of Stolovichi Minsk province of Russia As a son of a minor cleric he received his general education in the Minsk seminary but then entered the University of Warsaw and after taking his degree in natural sciences in 1893 obtained a post graduate scholarship which enabled him to study first at Warsaw then at the zoological stations of Naples Marseilles and Villefranche Two years as lecturer (on animal parasitology) at the University of Kiev were followed by an appointment to that of St Petersburg then of Moscow In 1911 he joined the staff of the Zoological Museum of the Russian Academy of Sciences where he spent the rest of his life while giving lectures at the University and the Agronomical Institute

As the theme of his first scientific work written at the end of his university studies Mordvilko took the investigation of the Aphididæ (plant lice) of the Vistula region, including their bionomics and anatomy This group of insects is remarkable for exhibiting a wide range of biological phenomena of great general significance such as polymorphism, change of hosts, variations in the life cycle and types of reproduction etc Their study became his life work

The execution of this work by Mordvilko is an outstanding example of results that can be achieved by a thorough and many sided study of a single group of organisms His morphological work is remarkable for its accuracy and abundance of exactly observed details, while the biological significance of various structures was kept in view His systematic work, which resulted in a mass of most carefully described new genera and species and in revisions of whole difficult groups of aphids, can be taken as a standard for any taxonomist His main interest was, however, the intensive study of the bionomics of aphids, most particularly with regard to the evolution of the life-cycle and the change of hosts Exhaustive studies of many groups of aphids with alternate hosts led Mordvilko to the elaboration of a remarkably well documented theory of the origin and evolution of the habit of changing hosts in Aphididæ, which he has later extended to the explanation of a closely parallel phenomenon in the fungi causing rust (Uredinales) Connected with these specialized series of investigations were the more theoretical works of Mordvilko on parasitism in general, as well as on the problem of evolution and species formation

As a man, Mordvilko was almost unbelievably modest and unassuming, and, on the first encounter with him, created a wholly false impression of a bashful and probably narrow minded person, interested in nothing but his plant lice On a closer acquaintance he appeared as an exceptionally widely educated man, with far reaching and original ideas on many aspects of biology The outstanding features of his character were deeply felt kindness and sincere friendliness to everybody, outwardly expressed in a most charming quiet, endearing smile All his acquaintances were regarded by him as friends and became so, and he was incapable of making any enemies

It can be truly said that A K Mordvilko s death closes a long and most fruitful chapter in the study of the Aphididæ, to the knowledge of which he has contributed more than anybody else

B P UVAROV

DR UVAROV has outlined Prof Mordvilko s contribution to science and it remains to me to add my personal tribute to the memory of one who over a long number of years and often at great difficulty to himself proved such a valued correspondent His vast knowledge was ever at our service, he put himself to endless trouble to satisfy our needs for study material, his books and papers were generously presented He was a man of infinite pains and the embodiment of the patient investigator, taking sometimes twenty years to elucidate a single point For forty three years Mordvilko was carrying on his aphidological and other studies and during the last twenty broadened his basis so much that for years to come the suggestions contained in his works will give rise to new lines of research and though some of his theories may have to be modified, he will remain an outstanding builder F LAING

WE regret to announce the following deaths

Sir Thomas Callendar deputy chairman and managing director of Callendar s Cable and Construction Co, Ltd, a pioneer in electricity supply, on December 2 aged eighty three years

Mr W P Dreaper O B E formerly superintendent of H M Factories at Sutton Oak and Ellesmere Port, lately editor of the *Chemical World* on December 2 aged seventy years

News and Views

Publication of Scientific Research

A LARGE part of Sir William Bragg s presidential address to the Royal Society delivered on November 30, was concerned with scientific publications, and he referred particularly to the duty of the Society in connexion with the encouragement of research to secure the preparation and presentment of its results, so that they can be sufficiently appreciated and incorporated with understanding into every activity, intellectual or physical, to which they apply Though he does not think that men of science can claim to be given the direction of affairs in which their discoveries play a great part simply on that account, they are at least bound to see that acquired knowledge is rightly stated so that it can be rightly used, and he regards the vigorous action of the British Association in such matters as a commendable extension of its original purpose This consideration of opening to mankind the new fields of natural knowledge strengthens the case for reconsidering the arrangement and presentation of research results which arise from the voluminous character of present day research Commenting on the small attendances and lack of good discussion when papers are presented before a scientific society, Sir William Bragg referred to greater stress which has recently been made on the provision of opportunities for organized discussions in which some important subject of recent development was considered by the workers in that field Very satisfactory attendances have been obtained at such meetings

SIR WILLIAM BRAGG considers that the recent plan of publishing summaries of papers as an appendix to the *Proceedings* as soon as the papers are received while publication of the papers themselves is deferred in the usual way, not merely secures an earlier announcement of the discovery, but also the collection of summaries presents the general trend of research to those who are not specialists With regard to summaries, he pointed out that the ideal is more than a mere digest or shortened form of the paper, and should be different from the paper itself, in that it is addressed to a wider circle of readers, which may include the experts, but includes also many others, who should, in fact, receive the principal attention

Accordingly, he stressed the importance of insisting that the general account given in this way should be intelligible to a sufficient number of persons Sir William also queried whether it is necessary that the *Transactions* and *Proceedings of the Royal Society* should contain as much as they do at present When a new departure in experiment or theory is made and a new fact discovered or a new co relation, it is right that a careful and complete explanation should be given and if it is not too long, it is excellent that it should appear in the *Proceedings* If, however, the novelty leads as it often does, to a steady output of observation, extension, confirmation and illustration many figures and bulky tables, complete publication to the world might become unnecessary The scientific world requires a general account of progress made so that its bearing may be clear The *Proceedings* should accordingly contain papers of original discovery or fresh departure but as regards continuation papers, as they may be called, properly written summaries should be enough

Co-operation in Research

INTERNATIONAL co operation in scientific research was also discussed in appreciative terms by Sir William Bragg, and he referred to a letter received from Dr Bosch, president of the Kaiser Wilhelm Gesellschaft, inviting the co operation of the Royal Society in some scientific enterprise which would advance science and at the same time promote understanding and good will, in which an exchange of visits between representatives of the Kaiser Wilhelm Gesellschaft and the Royal Society was suggested

National Registration for Man-Power

IN the House of Commons, on December 1, Sir John Anderson, Lord Privy Seal outlined the Government s scheme for organizing the national resources in the service of the State The plan involves an immediate voluntary register of man and woman power throughout the kingdom, the publication of a handbook written in simple language as a guide to be sent to every household, a co ordinated campaign of recruiting for the Services further development of training facilities for new volunteers, making preparations for compiling in the minimum length of time a universal register under compulsory powers in the event of war The scheme received general approval from the House Though the time is not propitious for considering the scheme from the particular point of view of the scientific worker (further details must be known before this can be done), it is gratifying to think that embodied in the scheme is the possibility of the man of science being given the opportunity to give the State of his best (see NATURE of October 15), that is, not as a military subordinate , but in a position where he has ' a chance to use his imagination and knowledge co ordinated with that of his fellow scientific workers and technicians to criticize and direct, in so far as he is competent the character of operations" Thus, and only thus, can science be expected to contribute its full share to Sir John's scheme for ensuring that our man power and woman power are organized in the most effective and practical way for the voluntary service of the State

A FULL list is also to be prepared of all the key occupations which would become so essential to the nation in mobilizing for defence In addition, special arrangements are being made for the compilation of separate registers of persons possessing exceptional professional or technical qualifications Many of the scientific and technical institutions we understand, have already taken steps to compile such registers, and these will be available to the Government when required These registers together with the records already available of men included in the special list of vital occupations will constitute the National Voluntary Register In the last War many specially qualified men including men of science were engaged in the Services at posts which could have been just as ably if not even more ably filled by men with less specialized training The National Voluntary Register will go far in preventing such a waste of man power in the event of another war The Government s action in building up its scheme on a voluntary basis rather than resorting to compulsion at any rate during peace time follows true democratic principles and is therefore commendable Any doubts over this point of view should be allayed by Sir John s statement that these precautionary steps taken now will make it possible to compile a compulsory register within three weeks if necessary In the event of war of course it would be necessary to survey and marshal our resources as a whole The voluntary register would not then be enough and it would become necessary to compile a universal register under compulsion To be effective, however, such a register must be up to date and this condition can be satisfied only if it is compiled at the time when the occasion for its use arises

Indian Cultural Studies

IN the discussion which followed Mr Barger s lecture at the Royal Society of Arts on November 30 (see p 1046) interest in the future of the India Museum at South Kensington and the position of Indian studies in Great Britain will appear to have eclipsed the claims to attention of the lecturer s pioneer archæological work in Swat and Afghanistan The importance of the question raised in his concluding remarks will be accepted in palliation The anomalies and obstruction to development arising from the lack of cohesion and co operation among the eight or ten organizations in London associated with Indian studies were characterized with wit and acumen by Mr F J Richards and echoed by each subsequent speaker in the discussion while these criticisms were endorsed by Sir Richard Winstedt, who described briefly such steps, inadequate as they admittedly are, as it has been possible to take to meet these deficiencies in some measure by the provision of lectures in Indian art and archæology at the School of Oriental Studies an institution, which, it is to be noted, already has wide commitments in other directions On one point, which for some time past has been regarded with dismay among those interested in Indian cultural studies, Lord Zetland, who was in the chair, was able to reassure his audience. The risk, he said, that the collections of the India Museum might be dispersed, is at an end; and indeed, there is a prospect that the Indian sculptures at the British Museum (Bloomsbury) may be transferred to the India Museum at South Kensington.

THE discussion was an indication, if such were needed, of the existence of a strong body of instructed public opinion, restricted though it may be in extent, that a remedy must be sought for the present highly unsatisfactory position of Indian cultural studies. That there is need for an organized centre devoted to them may be argued on the ground of public policy in view of the future relations of Great Britain and India; but it is also at the moment in pressing need of educational facilities in London. Contrary to the contention frequently advanced, Mr. Richards, from his experience as an honorary lecturer on Indian archæology in the University of London of some years' standing, was able to testify to the demand for instruction in this group of subjects; while the gratitude with which the rearrangement of the Indian collections at South Kensington on cultural lines has been acclaimed is a measure of the general appreciation of the possibilities of further systematic development in teaching and research. Whether provision of an organized centre of teaching and research can most suitably be made in connexion with the India Museum on the lines suggested in relation with the University of London is a matter for further consideration. The position of the Victoria and Albert Museum, of which the India Museum is at present a part, under the Board of Education, is anomalous. It presents difficulties, not insuperable, no doubt, which render comparison with other museums exercising teaching functions beside the mark, even though here, as in other of the national collections in London, the system of guide lecturers exists for instructional purposes. This system might well be extended to meet needs of more advanced instruction. In any event, no scheme of instruction can attain efficiency without the closest association with the collections and staff of the India Museum; nowhere else in Great Britain is there the systematic knowledge and the carefully graded series of specimens, for example, in pottery or beads, which may not be sufficiently spectacular for exhibition in public galleries, but are of the indispensable groundwork in instruction.

Mr. E. Thurlow Leeds

MR. EDWARD THURLOW LEEDS, keeper of the Ashmolean and the Department of Antiquities in the University of Oxford, whose election to a professorial fellowship at Brasenose College is announced, holds a position of distinction among archæologists for his carefully documented studies in Celtic and Saxon art and archæology. Mr. Leeds was educated at Uppingham and Magdalene College, Cambridge, on which foundation he was a scholar. He joined the staff of the Ashmolean as an assistant in the Department of Antiquities in 1908. Since the Great War, Mr. Leeds's influence on the teaching of archæology at Oxford has been profound; and his appointment as keeper of the Ashmolean on the death of Dr. D. G. Hogarth was regarded as both opportune and a well merited recognition of his efforts in developing these studies in the University. Mr. Leeds was a vice-president of the Society of Antiquaries of London in 1929–32 and Rhind lecturer in archæology in 1935, his lecture on 'Early Saxon Art and Archæology' afterwards appearing in book form. Mr. Leeds's responsibilities as keeper are now to be enlarged by the addition of an Institute of Egyptological Studies to the Museum. This is in accordance with a decree passed in Congregation of the University on November 29, which gives practical effect to the bequest, accepted in January last, by the late Prof. F. Ll. Griffiths, professor of Egyptology in the University of Oxford, and Mrs. Griffiths for that purpose. Although the Institute will form a department of the Ashmolean, it will be under the control of its own committee of management, a representative body.

The Scientist and the Philosopher

FOR his Friday evening discourse at the Royal Institution on December 2, Viscount Samuel took as his subject, "The Scientist and the Philosopher". He said that in the complicated civilization of the modern world a division of labour is necessary, but this is sometimes carried to excess. The separation between science and philosophy gives an example. This is not, as it might seem, a merely abstract and academic matter, remote from affairs. Action is ruled by ideas. Philosophies of some kind move the nations. Every land resounds with the tramp of armies, and the air throbs with the droning of their aircraft. Behind the armies are the dictators or the parliaments. Behind them are the political creeds, and behind the creeds are the philosophers who inspired them. Our age needs above all else a new synthesis of science and philosophy together with religion, to supply the ideas that should guide the modern world. There are many things that philosophy should accept from science. Scientific workers in their turn may derive help from philosophy. They might be induced not to attribute physical qualities to human mental concepts, such as space; nor to assume that, because phenomena are out of reach of our means of observation, it follows that Nature does not determine them according to uniform laws. Two fundamental questions remain unsolved, and philosophers await the answers: from physics, the cause of gravitation, and from physiology the nature of thought. It is often said that these can never be solved; but if we view what has been the progress of knowledge between the stone age and now, further advances such as these are not inconceivable; they may indeed be close at hand. There is nowadays a marked convergence of science and philosophy. Let this develop and let religion, guided by reason and conforming to fact, take her place in the great synthesis; then man will feel at one with himself, will confront with new energy the confusions and perils that beset him, and be able to march with confident step into the future.

From Magic to Science

A MEETING of the Society for the Study of Alchemy and Early Chemistry took place on December 7 at Queen Mary College London when Mr J C Gregory delivered a lecture entitled From Magic to Science Mr Gregory traced the interplay between reliance on magical efficacies on one hand and a recognition of rationally conceived agencies or natural laws on the other Thus alchemy *complicated by mysticism and* animism, had its rational theory as in the Aristotelian Doctrine of the Elements, and its reliance on laboratory procedure It had also its magically conceived efficacies such as the reputed powers of the Philosopher s Stone As the rational recourse constantly invaded magic so the magical recourse influenced rational procedure There came a point however, when the magical belief was discarded to make way for a more scientific concept of natural laws Mr Gregory pointed out that the seventeenth century corpuscle was a great scientific rationalizer of magic Boyle discreetly reserved however some medicinal virtues for gems as a scientifically purified magic His reduction of the potency in the Powder of Projection or in the Alkahest to corpuscular catalysis illustrated the rationalization of magic by science Though the master Therion still hoped to vindicate the thaumaturgic agent of alchemy he deferred to present thought by applying the method of science to the art of magic

International Telephone Conference

A MEETING of the Comité Consultatif International Téléphonique (C C I F) was opened in London on December 5 by Sir George Lee engineer in chief of the Post Office The conference is being attended by about a hundred delegates from fourteen different countries and will continue until December 17 Most of the delegates are telephone experts and they are discussing various technical problems encountered in the operation of international line telephone communication The work of the Conference is divided between two committees, the first of which is studying the technical problems of long distance telephone calls, including the suppression of noise and the improvement of quality of reproduction of the human voice The second committee is studying the special problems encountered in carrier current telephony in which a number of conversations are carried simultaneously as a modulation of a high frequency current on one pair of wires As an extension of this problem the question of providing international circuits for television programmes will be considered The holding of the conference in London is particularly opportune for during the past fifteen years direct connexions with the majority of the capital cities of Europe over the ordinary land line network have been established in London which with the development of long distance radio links has thus become the main world switching centre for inter continental telephone calls

Radio Communication for the Colonies

ACCORDING to a statement in *The Times* of November 30, the chairman and managing director of Messrs Cable and Wireless, Ltd has made an offer to the Government to create a system of wireless telegraphic and telephonic communication throughout the Colonial Empire without cost to the administrations or the peoples concerned The scheme provides for the installation of radio equipment at each of the cable stations where no commercial wireless service is already in operation The Company will bear the cost of installation and any experiments necessary, and while the new facilities will be complementary to the existing cable services their commercial use will bring additional revenue to the Company The scheme is of great significance from strategic and economic points of view, the wireless stations will ensure a second line of defence for inter Colonial communication and provide the Colonies with a means for their keeping in touch with aircraft and ships in home waters in addition Imperial development and unity will be promoted through an extension and cheapening of communications The establishment of the service would also enable a great deal of valuable technical research to be carried out in connexion with the propagation of waves to various parts of the world In view of the advantages accruing to the Colonies under the proposals the offer has been made on the assumption that the Company would be given a non restrictive licence on broad lines

Memorials to Inventors

ON November 17 and 24 memorials were unveiled respectively to John Boyd Dunlop (1840 1921) who fifty years ago invented the pneumatic tyre for cycles and to Joseph Aspdin (1779 1855) the inventor of Portland cement The memorial to Dunlop is a plaque which has been erected at Fort Dunlop, Birmingham the great works of the Dunlop Rubber Company Dunlop who was born at Dreghorn, in Ayrshire became a student at the Edinburgh Veterinary College and in 1867 started in practice as a veterinary surgeon in Belfast It was while living at 28 May Street in that city that he made his first pneumatic tyre and applied it to his son s tricycle the following year 1889 Harvey du Cros (1846 1918) formed a company in Dublin for the manufacture of pneumatic tyres and from this has sprung the world wide tyre industry of to day There are already memorials to Dunlop in Edinburgh and Belfast The memorial to Aspdin consists of a plaque and memorial gates at St John s Church Wakefield where the inventor is buried Aspdin was born in Leeds and became a stonemason His patent for Portland cement is dated October 21 1824, and on the hundredth anniversary of that day the president of the American Portland Cement Association Mr F M Kelley unveiled a bronze tablet to the memory of Aspdin which the Association had erected on the plinth of two of the columns supporting the roof of the Leeds Town Hall The memorial at Wakefield was dedicated by the Bishop of Wakefield and unveiled by Lord Wolmer on behalf of the Cement and Concrete Association Little is known of Aspdin s career After taking out his patent he started manufacturing cement at Wakefield and one of the first important structures in which it was used was Brunel's Thames tunnel. Aspdin's son William (1816–64) played a considerable part in the development of the cement industry and erected works in Germany, where he died.

British School of Archæology at Athens

AT the annual meeting of the British School of Archæology at Athens which was held at Burlington House, Piccadilly, London, W.1, on November 29, when the Crown Prince of Sweden was in the chair, Mr. J. D. S. Pendlebury gave an account of his recent excavation of the city of Karphi in Crete. This was one of the cities on the hills surrounding the plain of Lasithi, and its great interest lay in the fact that it contained an example of a large house which probably dated from within two generations of the Trojan War and thus afforded an excellent illustration of the house of Homeric times. The city was situated on an exposed spot with cliffs on three sides, that on the north having a sheer drop of 2,000 feet. It contained two cemeteries, a temple and, among other buildings, as already mentioned, a house, the largest of the period yet found. It is interesting to note that the roofing system of the whole town is that still in use among Cretan peasants. It would appear that bronze age civilization came to an end in Crete about 1100 B.C., when there was an invasion of people from outside who introduced the Greek language and settled at first near the sea. The old Minoans found sanctuary in the hills where they continued to live on. Occupation at Karphi came to an end some two hundred years later, at about 900 B.C. Its evacuation apparently was peaceful, its inhabitants no doubt then considering it safe to live in a less exposed situation. In the course of the meeting, two announcements of no little importance were made. Prof. J. L. Myres, in moving the adoption of the annual report, stated that news had been received by the last mail of the discovery of an important Minoan tomb at Knossos, which was to be investigated at once; and Sir John Forsdyke announced that owing to the increase in the Government grant from £500 to £1,000 per annum and the coming into operation of the Richard B. Seager bequest, the activities of the School in excavation would be considerably extended in the coming year.

Woad Mills

AMONGST the many at one time flourishing industries connected with agriculture carried on in Great Britain was that of the cultivation and preparation of woad, and in a paper read by Mr. Rex Wailes before the Junior Institution of Engineers on November 25 is described its cultivation in gradually decreasing quantities down to 1932, when the last crop in the world was gathered at Boston in Lincolnshire and prepared for market. Woad has been grown for centuries in Great Britain and prepared for market as a mordant or fixer for indigo dye. Its use in dyeing requires much skill and its preparation is a lengthy process. The plant rapidly exhausts the soil in which it is grown, necessitating frequent removal of the woad mill and appurtenances to fresh sites. As in the case of many ancient industries, the woad mill evolved by village craftsmen seems peculiarly well fitted for its purpose. It ground the leaves into small pieces and after about an hour the mill was stopped and the pulped mass taken out and kneaded into balls about 6 in. in diameter; these were stacked on trays in open tiers of gratings where they dried for some weeks and were then removed to store rooms preparatory to couching, the most difficult operation in the preparation of woad. The balls were first broken up by the rollers in the roller house and then taken to the couching barn near by and spread on the floor to a depth of about 3 ft., watered, and allowed to ferment. During this process temperature was carefully controlled and not allowed to exceed 125° F. The woad was turned daily at first and less frequently thereafter, the total time being 6–8 weeks. After couching, the woad was dried and rammed into barrels, its appearance then being like compressed peat or plug tobacco.

Technical Training at Leeds

THE City of Leeds College of Technology enrolled in 1937–38 more than four thousand students, of whom all except 14 per cent attended evening classes only. In a report presented by the Principal on the occasion of a distribution of awards by Prof. Lancelot Hogben on November 29, an appeal was made to employers to promote a largely increased attendance at part-time day courses of technical training in principles. That serious practical difficulties stand in the way of large scale releases of employees for this purpose was freely admitted, but few would be found to deny that there is a crying need for constructive effort to make good the gaps in vocational education resulting from the obsolescence of the apprenticeship system in industry. In the great majority of trades at the present day the only qualification for receiving the pay and status of a journeyman is the attainment of the age of 21. The Principal wants industrialists to co-operate with the College in devising schemes, separate for each trade, such as are already in operation in the engineering trade in the Midlands, for issuing some agreed form of apprenticeship certificate giving full recognition to workshop training as well as to technical college work.

Standard Time

THE recent unveiling in Toronto, announced in *The Times*, of a bronze plaque of Sir Sandford Fleming recalls that it was only sixty years ago that he proposed the system of standard time now universally used. The advent of railways and telegraphs to North America made the continued use of local time an inconvenient practice. The railways began to use their own time, which was seldom in accord with the local time of any place on the line. When more than one railway served a town, there were usually two or more railway times as well as the local time, and confusion was rife. Fleming, who was a Scot, became chief engineer of the Canadian Pacific Railway, and he realized that something must be done to end this state of confusion. In 1878, he proposed to the Canadian Institute in Toronto that the solution lay in dividing the globe into 24 time belts each of fifteen degrees of longitude, each belt to mark a difference of one hour in time. The Marquis of Lorne, at that time the Governor General, submitted the proposal to the British Government, which, however, did not approve. The Tsar of Russia then initiated an international conference in Vienna in 1881 to discuss the matter. This led to a second conference in Washington in 1884 and the almost universal adoption of the proposal after the railways of Canada and the United States had already put standard time into use.

Ramsay Memorial Fellowship

THE following Ramsay Memorial fellowships for the year 1938–39 have recently been awarded: Dr. Vernon Hollis Booth, a British fellowship of £300, tenable for two years, at the University of Cambridge, Mr. Donald McNeil, a Glasgow fellowship of £300, tenable for two years at the University of Glasgow, Dr. Alfred Epprecht, a Swiss fellowship of £300, tenable for one year, at the Imperial College of Science and Technology, London. The Trustees have renewed the following fellowships for a second year: Dr. A. E. Alexander (British fellow), at the University of Cambridge, Dr. E. de Salas (Spanish fellow), at University College, London, Dr. J. J. Hermans (Netherland fellow), at University College, London, M. Jean Monvoisin (French fellow) at the Royal Institution, London, Mr. Hazime Oosaka (Japanese fellow), at University College, London, Dr. E. C. Stathis (Greek fellow), at the Imperial College of Science and Technology, London.

Announcements

PROF. H. SHAPLEY, director of the Harvard College Observatory, Cambridge, Mass., has been elected a member in the Section of Astronomy, and Prince Louis Victor de Broglie, of the Institut Poincaré, Paris, a member in the Section of Physics, of the Royal Swedish Academy of Sciences.

PROF. EMILE ARGAND, professor of geology, mineralogy, petrography and palæontology in the University of Neuchâtel, and Dr. E. A. Stensio, director of the Department of Palæozoology in the Naturhistoriska Riksmuseum, Stockholm, have been elected foreign fellows of the Geological Society of London. Prof. H. von Eckermann, assistant professor of mineralogy and crystallography in the University of Stockholm, Prof. D. W. Johnson, professor of physiography in Columbia University, and Prof. A. A. Öpik, professor of geology in the University of Esthonia, have been elected foreign correspondents.

AT a meeting of the Royal Society of Edinburgh held on December 5, the president, Sir D'Arcy Thompson, showed and gave to the Society a copy of the billet of the corresponding meeting sixty years ago (December 16, 1878), when he had read a paper "On Ulodendron and Halonia" to the Society. This paper, communicated by Sir Wyville Thomson, was afterwards published by the Geological Society of Edinburgh, along with a plate drawn by another young man, known later on to all geologists as Benjamin Peach.

HONORARY degrees have recently been conferred by the University of Paris on the following: Prof. Szent Gyorgi, professor of medical chemistry in the University of Szeged faculty of medicine, Dr. S. P. L. Sörensen, director of the chemical section of the Carlsberg Laboratory, Copenhagen, and Dr. Karrer, director of the Institute of Chemistry, University of Zurich.

PROF. JULES BORDET, director of the Pasteur Institute of Brussels, was presented with the Grand Cross of the Legion of Honour at the opening meeting of the Congress of the Association of French-speaking Microbiologists.

THE Sir Frederick Hobday Presentation Fund has now reached its first £1,000 contributed by about 850 subscribers. The committee has decided to continue its work in order to obtain the amount necessary for the object which Sir Frederick Hobday had in view, namely, the endowment of a chair of comparative medicine. Subscriptions should be sent to the honorary secretary, Mr. E. I. Cox, 3 St. John's Avenue, S.W.15.

THE Annual Conference of the Geographical Association will be held at the London School of Economics on January 3–6, 1939, under the presidency of Sir Thomas Holland. The subject of Sir Thomas's address will be "The Geography of Minerals". Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

THE annual meeting of the Institute of British Geographers will be held in the London School of Economics on January 5–6. Further information can be obtained from Mr. J. N. L. Baker, The University, Oxford.

THE twenty-seventh annual Conference of Educational Associations will be held at University College, London, W.C.1, on January 2–9, 1939, under the presidency of the Right Hon. Lord Macmillan. The subject of the presidential address will be "The Function of the University". A joint conference on "The University in a Changing World" will be held on January 5. Further information can be obtained from the Conference Secretary, Gordon House, 29 Gordon Square, W.C.1.

THE Cambridge University Press is to publish shortly "Karl Pearson", a memoir consisting of two articles by his son. It surveys his life from his earliest days, giving extracts from letters to show the development of his philosophy, and details of his many activities. It is illustrated with many portraits, and there are appendixes summarizing his unpublished lectures and reports.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 1041

Blue Sunlit Aurora Rays and their Spectrum

IN the morning of September 15 last, between 3^h and 4^h M T T (sunrise in Oslo 5^h45^m), blue sunlit aurora rays were observed like those of March 23 1920[1] Simultaneous photographs from two stations showed that the blue part was lying from about 250 km to 650 km above the earth We succeeded in taking some good spectra which were very similar to a most interesting spectrum taken by Lord Rayleigh[2] of the aurora of May 14 1921 In Fig 1 is seen the spectrum taken on Agfa Isopan plate *ISS*, exposure from 2^h35^m to 3^h55^m, of the summits of sunlit aurora rays among which the greater part were blue The small spectrograph used was loaned by the Auroral Observatory in Tromsö The wave lengths have been measured by Dr Harang and are written above the spectrum

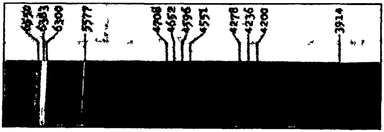

Fig 1

SPECTRUM OF THE SUMMITS OF BLUE SUNLIT AURORA RAYS AT A HEIGHT OF ABOUT 400 KM 650 KM TAKEN WITH A SPECTROGRAPH FROM THE AURORAL OBSERVATORY TROMSÖ

TABLE 1 RELATIVE INTENSITIES

Blue sunlit rays		Strong curtains in shadow	
6550 A	Not well separated from the next one	6550 A	27
6300	245	6300	29
5577	100	5577	100
4708	6	4708	no trace
4278	130	4278	20
3914	1[illegible]3	3914	2

TABLE 2 RELATIVE INTENSITIES

Wave length (A)	Blue rays	Common aurora (Vegard)
4708	100	100
4652	97	9
4596	85	44
4551	70	26
4278	100	100
4236	9	24
4200	35	8

In Fig 2 is seen a spectrum of the same rays with another spectrum of lower yellow green curtains in the earth s shadow going down to about 92 km Both spectra were taken on Agfa Isopan *ISS* of the same stock with a spectrograph of great light power but small dispersion

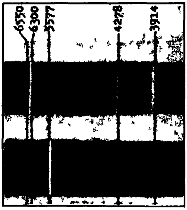

Fig 2

SPECTRA TAKEN WITH A 60° PRISM SPECTROGRAPH AND SMALL DISPERSION ABOVE THE SAME BLUE SUNLIT AURORA RAYS AS IN FIG 1 BELOW YELLOW GREEN CURTAINS HEIGHT OF LOWER BORDER ABOUT 92 KM

All spectra were taken from my auroral station in Oslo by my assistant Mr Herlofson

By courtesy of my colleague V M Goldschmidt, records were made of these spectra using his large Zeiss photometer I am indebted to Dr Oftedal for doing this work and to Mr Herlofson for measuring the photometer records Table 1 shows the great difference between the two spectra in Fig 2

From this it is seen that either the relative intensity of 6300 to 5577 A has increased 8 times of 4278 A 6 5 times and of 3914 A 7 times in going from the yellow green curtains to the blue rays or else that the intensity of the line 5577 A has enormously decreased This agrees with my visual observations[3] on March 23 1920 and with Lord Rayleigh s observations on May 13–15 1921 as regards the intensity of λ5577A to 4278A and 3914A

Of special interest is the enhancement of a series of nitrogen bands in the blue and violet relative to the bands 4708 A and 4278 A seen in Fig 1 as well as in the spectrum published by Lord Rayleigh Table 2 gives the relative intensities for these bands, assuming absorption and plate sensitivity to be constant for each of the intervals 4551 4708 A and 4200 4278 A and the corresponding relative intensities for ordinary auroras according to Vegard[4]

CARL STORMER

Institute of
Theoretical Astrophysics,
Blindern, V Aker Nov 2

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[1] *Geofys Pub* **4** No 7 47 (1926)

[2] *Proc Roy Soc* A **101** (1922)

[3] *Nord Astr Tidssk* 1 4 (1920)

[4] Die Deutung der Nordlichterscheinungen etc *Ergebnisse der exakten Naturwiss* **17** 228 (1938)

Experimental Scrutiny of the Influence of Gravitation on Light

IT is remarkable how few decisive verifications of second order relativity in physical systems have been effected. one can only recall the experiments of Michelson and Morley, Rayleigh and Brace, and FitzGerald and Trouton. It is therefore desirable that the very remarkable investigation by H. I. Ives and G. R. Stilwell at the Bell Telephone Laboratories in New York, entitled An Experimental Study of the Rate of a Moving Atomic Clock [1], which has recently come into my hands, should not be overlooked. They have succeeded in measuring the second order change in the free periods of the hydrogen atoms in canal rays flying transverse to the line of sight, which the finite speed of light demands, and in closely verifying the theoretical frequency factor $(1 - v^2/c^2)^{1/2}$

This is because the periods when transposed from the observer's to the vibrator's own frame should remain unaltered, if there is a universal standard of intervals of time the same for all free vibrators.

We may pursue the subject into the influence of gravitation. if its field belongs to the vibratory system, the same invariance of period referred to the system itself ought to hold[2]. But it produces a velocity v given by the equation of scalar energy $\frac{1}{2}mv^2 = mV -$ constant, where V is the potential of the field. hence we would infer that the field is responsible for a factor of change of frequency $(1+2V/c^2)^{1/2}$, so that the product of the two factors should be unity up to the second order.

This is just the expression for the influence of gravitation that has been adopted by the observing astronomers, following Einstein, but their efforts to verify it have been embarrassed by various disturbing influences.

It is to be noted that for vibrators in the gravitational field of the high solar atmosphere v is negligible, for their downward motion is not free as they are supported by collisional forces. it follows that such influences also produce their own changes in the frequency of vibration, which would be not easy to specify directly. This unsettles the results of stellar and nebular measures.

One notes that the transverse influences are verified on the periods of diatomic hydrogen and the elusive triatomic hydrogen, but the monatomic form does not appear. Null second order effect of a uniform magnetic field is found, which agrees with theory, for such a field would not affect the circuital equations.

It comes out that the unmodified frequencies are exactly the same for the diatomic and the triatomic hydrogen vibrators, which as the experimenters remark is a significant result. The absence of monatomic hydrogen vibrators may perhaps be ascribed to the smallness of these particles and the resulting rarity of stimulating encounters.

JOSEPH LARMOR

Holywood,
N. Ireland
Nov. 11

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[1] *J. Optic. Soc. Amer.*, July 1938.

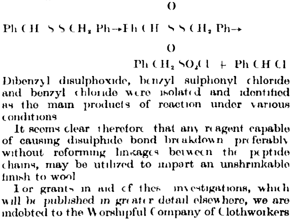
[2] Cf. a note Universal Mental Time by the writer in *Journal of Theological Studies*, Jan. 1938.

Reactivity of the Sulphur Linkage in Wool

PRESENT DAY methods of imparting an unshrinkable finish to wool depend for their success on the formation of a gelatinous degradation product of keratin on or under the surface scale structure of the fibres. As a rule the necessary degradation is brought about by chlorine, the layer of cortex immediately underlying the scales being attacked preferentially when an aqueous solution of chlorine is used[1]. The attack may, however, be restricted to the surface of the fibres by taking advantage of the inaccessibility of dry fibres to reagents of comparatively low molecular weight[2], as for example in the processes where gaseous chlorine[3] or solutions of chlorine in inert organic solvents are applied to wool of low water content.

From first principles it is evident that the degradation essential for unshrinkability must be realized by the fission of disulphide bonds or peptide linkages, the former being the more important. Apart from the fact that chlorine is known to cause disulphide bond breakdown, proof of this generalization is afforded by the fact that chlorine peroxide, which converts cystine into cysteic acid[4], imparts an unshrinkable finish to wool when applied from solution in carbon tetrachloride[5]. Further, since potassium permanganate, manganese heptoxide and Caro's acid can, under the correct conditions, be used to impart an unshrinkable finish to wool[5], it seems clear that any oxidizing agent capable of causing disulphide bond breakdown is *ipso facto* a potential agent for producing unshrinkability.

As regards the recent process utilizing a solution *of sulphuryl chloride in white spirit*[6], disulphide bond breakdown is again the cause of unshrinkability, because we have been able to show that sulphuryl chloride reacts with dibenzyl disulphide in the following manner at 37° C.



$$\mathrm{PhCH_2{\cdot}S{\cdot}S{\cdot}CH_2Ph \rightarrow PhCH_2{\cdot}\overset{O}{S}{\cdot}\underset{O}{S}{\cdot}CH_2Ph \rightarrow PhCH_2SO_2Cl + PhCH_2Cl}$$

Dibenzyl disulphoxide, benzyl sulphonyl chloride and benzyl chloride were isolated and identified as the main products of reaction under various conditions.

It seems clear therefore that any reagent capable of causing disulphide bond breakdown, preferably without reforming linkages between the peptide chains, may be utilized to impart an unshrinkable finish to wool.

For grants in aid of these investigations, which will be published in greater detail elsewhere, we are indebted to the Worshipful Company of Clothworkers (London) and the International Wool Publicity and Research Secretariat.

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Nov. 1.

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[1] Speakman and Goodings, *J. Text. Inst.*, 17, T607 (1926).

[2] Speakman, *Trans. Faraday Soc.*, **26**, 61 (1930). *Proc. Roy. Soc.*, A, **132**, 167 (1931).

[3] Wool Industries Research Association, King, A. T., and Galley, R. A. E., B.P. 417 19.

[4] Schmidt and Braunsdorf, *Ber.*, **55**, 1529 (1922). Schmidt, Haag and Sperling, *Ber.*, **58**, 1394 (1925).

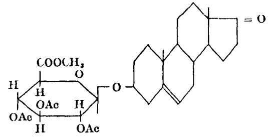
[5] Nilssen, Ph.D. Thesis, University of Leeds (1937).

[6] Hall, A. J., Hicking, W. N., and Pentecost, S. J., B.P. 464,503.

Synthesis of Sexual Hormone Glycuronides

THE importance of glycuronic acid lies in its property of condensing with hydroxylic compounds to produce the so called coupled glycuronic acids. In this way these substances become soluble in water and therefore also in urine. From the researches of Cohen and Marrian[1], Cohen, Marrian and Odell[2], as well as those of Venning and Browne[3], glycuronic acid also plays a part in the mechanism of the elimination of the sex hormones. These investigators succeeded in isolating and identifying œstriol glycuronide in an amorphous form (Marrian), and pregnandiol glycuronide in a crystalline condition (Venning and Browne), from pregnancy urine. The crystalline sodium salt of œstriol glycuronide proved to be about thirty times as weak as free œstriol on a subcutaneous injection into adult ovariectomized mice. Pregnandiol glycuronide was claimed by Venning and Browne to be the form in which progesterone is eliminated. The latter cannot couple, however, and must first of all be converted into the hydroxylated pregnandiol, within the organism. I wish to report here the synthetic preparation of the coupled glycuronic acids of dehydroandrosterone and of α œstradiol monobenzoate.

Methyl α acetobromoglycuronate prepared according to the directions of Goebel and Babers[4], and the corresponding hormones, were the starting materials. When the synthesis was carried out in indifferent media, such as, for example, benzene in presence of silver carbonate, condensation took place with the elimination of bromine and the simultaneous formation of an oxygen bridge and the production of the corresponding derivative of the hormone glycuronide. Thus dehydroandrosterone furnished the acetylated glycuronide of the constitution shown in (I), as a well defined, crystalline substance, m p 194–196° (uncorr) $[\alpha]_D^{\circ}$ − 8 4° in chloroform



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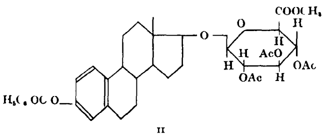

II

α Œstradiol benzoate afforded a similar, well defined, crystalline substance, m p 189 191° (uncorr) with constitution shown in (II). This substance is optically inactive.

Hydrolysis with barium hydroxide in methyl alcoholic solution splits off the acetyl and the benzoyl as well as the methyl groups, with the production of the crystalline barium salts of the hormone glycuronide. The coupled hormone — glycuronic acids are obtained in glistening, mother of pearl like scales by treating the barium salts with sulphuric acid.

(1) Dehydroandrosterone glycuronide melts at 262 264° (uncorr), the colour turning brown and decomposition taking place.

(2) Œstradiol (17) glycuronide melts after shrinkage at 191–194° (uncorr) while the colour turns yellow and decomposition takes place.

On account of lack of material, the hormone glycuronides have not yet been obtained in an analytically pure state. They are fairly readily soluble in hot water.

The following preliminary data on the biological activity of the two preparations may be given. A daily dose of 20 γ of dehydroandrosterone glycuronide per capon dissolved in propylene glycol and smeared on the comb on each of four successive days was inactive. 77 γ per capon gave a sectional comb growth of 14 per cent after five days. 120 γ of œstradiol glycuronide injected subcutaneously during 24 hours in three doses of 40 γ, produced heat in castrated mice, 12 γ was inactive. The considerable loss of activity of the substances in the form of a glycuronide compound is similar to that found by Marrian and collaborators for œstriol glycuronide.

We are now determining the physical constants of the analytically pure preparations and preparing other glycuronides.

E SCHAPIRO

Pharmaco therapeutical Laboratory,
University,
Amsterdam
Oct 3

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[2] Cohen S L Marrian G F and Odell A D Biochem J 30 iv 2250 (1936)

[3] Venning E M and Browne J S Proc Soc Exp Biol Med 34 792 (1936)

[4] Goebel W F and Babers F H J Biol Chem 11 347 (1935)

Tyrosinase and Catechol Oxidase

THE nature of tyrosinase has been under discussion for a very long time. Raper and his school[1], Graubard and Nelson[2], and Keilin and Mann[3] believe it to be a distinct enzyme, different from catechol oxidase. Onslow and Robinson[4], McCance[5], and Richter[6] believe it to be a catechol oxidase plus o chinone plus dehydrogenase. Kubowitz[7], whose work appeared in a recent issue of the *Biochemische Zeitschrift* whilst we were preparing for publication our results, states that it is identical with catechol oxidase. Recent books[8,9] appear to accept the first of these views.

The tyrosinase that we have worked with was extracted from *Sepia*. The action of the enzyme from this source has been shown by one of us[10] to be identical with that of Raper's meal worm tyrosinase. In agreement with most of the workers mentioned above, we have found that the partially purified tyrosinase acts on tyrosine with a very long induction period.

This induction period can be reduced, as has long been known, by adding a trace of o diphenol.

We have found that this 'activating effect' consists merely of the reduction of the induction period. After a short autocatalytic period, evidently depending on the quantity of the o diphenol added, the reaction in the two systems proceeds at equal speeds

Moreover, the rate of the oxidation process, as followed in Warburg respirometers, is linear for a very long time

The simplest explanation of these facts lies in the assumption of an equilibrium

Tyrosine + o chinone ⇌ dioxyphenylalanine + catechol,

when catechol is added to the system This has been demonstrated by simple chemical means, in the absence of an enzyme, by the addition of a recently prepared o chinone solution to a tyrosine solution and subsequent extraction with ether We found a considerable decrease in the concentration of tyrosine, and a *proportional increase in the concentration of* diphenol

Thus we think that the only enzymatic step in the phenol oxidation is the dehydrogenation of the diphenols in the corresponding o chinone, whilst the oxidation of the monophenols in the corresponding o diphenols is a simple chemical process occurring automatically These results suggest that the presumption of a tyrosinase (monophenolase) is not necessary to explain the tyrosine (monophenol) oxidation, and consequently tyrosinase (monophenolase) need not exist at all

Details of our work will shortly appear elsewhere

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D KERTESZ

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Nov 11

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[2] Craulard M and Nelson J M *J Biol Chem* **111** 757 (1937)
Keilin D and Mann T *Proc Roy Soc* B **125** 187 (1938)
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[3] McCance R H *Biochem J* **20** 1138 (1926)
[4] Richter D *Biochem J* **28** 901 (1934)
Kubowitz F *Biochem Z* **299** 32 (1938)
[5] Franke W in v Euler's Chemie der Enzyme **2** 44 and 365 (1934)
[6] Oppenheimer C Die Fermente und ihre Wirkung Suppl 2 1164 (1937)
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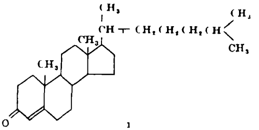
Photochemistry of Δ^4-Cholestenone

THE carcinogenic properties of œstrone, and the close structural relationship between the powerful carcinogenic hydrocarbon methylcholanthrene and the steroids, makes the hypothesis appear justified that perhaps light cancer of the skin is due to photochemical conversion of steroids situated in the skin into carcinogenic products We have therefore, in collaboration with Prof L Halberstaedter (Jerusalem), begun to investigate the changes brought about by ultra violet irradiation of steroids, and report here our results with Δ^4 cholestenone (I)

So far, only sterols seem to have been investigated in this way (ergosterol, cholesterol) but recently the photo oxidation of a hydrocarbon, $\Delta^{2,4}$ cholestadiene, leading to a peroxide, has been studied by Skau and W Bergmann[1] and by Butenandt and Kudszus[2] When a hexane solution (5 per cent) of Δ^4 cholestenone[3] is exposed to the full light of a mercury arc[4], the formation of an insoluble, well crystallized substance sets in immediately (The same phenomenon has been observed in benzene solution) This substance, which proves insoluble also in the other usual organic solvents, is conveniently recrystallized from ethyl malonate or ethyl succinate, forming needles not melting up to 360° C The high melting point, insolubility and analysis point to a dimolecular reaction product (formally analogous to ergopinacol and similar substances), the analyses seem to prove the formula $C_{42}H_{62}O_2$ (calc C, 84 2, H, 10 3, found C, 83 85, 83 97, 83 62, 84 19, H, 11 0 11 0, 10 7 10 5), which is derived from



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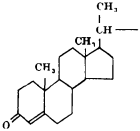

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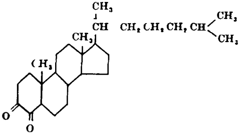
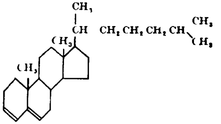


III



IV

cholestenone (I) by loss of six carbon atoms and dimerization of the remainder of the molecule

The insolubility of the substance has prevented so far the elucidation of its structure by degradation reactions, so it can only tentatively be assumed that the side chain of (I) is split at C_{20} and dimerization occurs at this point (II) If so, the skeleton of progesterone is formed from that of cholesterol—so far no conclusive attempts have been reported to convert cholesterol into sex hormones by biological means[5]—and our observation is an interesting analogue of the photochemical decomposition of the side chain in lactoflavin to form 'lumi lactoflavin'[6], but in this case hydrogenation of the involved carbon atom occurs instead of dimerization

The formation of the high molecular product (II) is accompanied by the production of a resinous by product, which separates partly on the walls of the quartz vessel and prevents further interaction with the mercury radiation when the vessel is emptied and cleaned the solution deposits anew the above substance The nature of this by product has not been elucidated

When in the irradiation of cholestenone (I) oxygen is not rigidly excluded, a second product is formed through photo oxidation It can be isolated from the hexane mother liquor of (II) by evaporation trituration of the residue with isopropylalcohol and recrystallization of the insoluble part from butyl alcohol, and forms prismatic needles, m p 157° C ($[\alpha]_D = +23\ 3°$ in chloroform) According to the analysis (found C, 80 8, 80 3, H, 11 0, 10 9, calc for $C_{27}H_{44}O_2$ C, 81 0, H, 11 0 per cent), the substance is the known[7] cholestane 3 4 dione (III), like the substance itself its condensation product with *o* phenylene diamine, however, showed a higher m p (228°, from isopropyl alcohol) than recorded in the literature (found N 5 8 calc for $C_{33}H_{48}N_2$ N 5 9 per cent) The course of this photo oxidation is analogous to the formation by means of selenium dioxide of 3 4 dihydroxy derivatives from cholesterol and dihydro ergosterol[6]

Finally, it may be put on record that cholesteryl acetate, on irradiation is mostly resinified, from the resin it has been possible in some instances to isolate—by distillation *in vacuo* (b p 228 230°/2 mm) and trituration of the distillate with methanol and acetone—$\Delta^{3\ 5}$ cholestadiene (IV)[8], from acetone, m p 76°, $[\alpha]_D = -100°$ in chloroform (found 88 0, H, 11 9, calc for $C_{27}H_{44}$ C, 88 0, H 12 0 per cent) As cholesteryl acetate can be distilled without decomposition the hydrocarbon would have been formed by irradiation or more likely during distillation from a less stable photo product

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Daniel Sieff Research Institute,
Rehovoth

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[1] J Amer Chem Soc 60 986 (1938)

[2] Z physiol Chem 253 1 4 (1938)

[3] Prepared according to Schoenheimer J Biol Chem 110 461 (1935) It is most conveniently purified by distillation in vacuo (b p 245 / 0 3 mm) and recrystallization from isopropyl alcohol

[4] For the method see Weizmann Hirshberg and Bergmann J Amer Chem Soc 60 1 39 (1938

[5] Rondoni Z physiol Chem 241 71 (1936) 245 8 (1936) V ss and Rabald Z physiol Chem 245 6 (1936)

[6] Compare for example Karrer and co workers Helv chim Acta 17 1010 (1934) Butenandt and co workers Ber dtsch chem Ges 69 779 (1936) Inhoffen Ber dtsch chem Ges 70 169 (193)

[7] Rosenheim and Starling J Chem Soc 3 7 (1937) Callow and Rosenheim J Chem Soc 387 (1933)

[8] Compare Stavely and W Bergmann J Organic Chemistry 1 07 (1936)

Effect of Growth Substances on Growth and Fruiting of *Melanospora destruens*

IT has been shown[1] that a strain of the ascomycete *Melanospora destruens* which makes only negligible growth on a synthetic medium will grow vigorously and will produce perithecia on a similar medium to which a crude extract of lentils is added

Schopfer[2], Robbins and Kavanagh[3] and others have shown that the addition of vitamin B_1 to a synthetic medium will promote growth of *Phycomyces Blakesleeanus* and some other fungi

Wildiers[4] in 1901 showed that a growth substance which he called 'bios' was essential for the development of certain yeasts Later Eastcott[5] was able to split up bios into two parts one of which was identified as inositol Similarly Buston and Pramanik[6] fractionated the growth substance necessary for the development of *Nematospora gossypii* into an inositol fraction and an inositol free fraction Kogl and co workers have recently isolated a substance 'biotin with bios activity from egg yolk and have shown that while inositol biotin and aneurin (vitamin B_1) are necessary for maximum growth of some yeasts certain other fungi require only aneurin[7]

Through the kindness of Prof Kögl of Utrecht, I have been able to test the effect of biotin on *M destruens* A preparation of vitamin B_1 was also used

The strain of *Melanospora* used made negligible growth and produced no perithecia on a medium containing glucose potassium nitrate, magnesium sulphate and potassium dihydrogen phosphate The addition of various amounts of vitamin B_1 to this medium had no effect on the fungus When pure biotin methyl ester was added to the synthetic medium the *Melanospora* made good mycelial growth but produced no perithecia Growth and perithecial production were both good if both biotin and aneurin were added to the medium Thus these two growth substances have different effects on this fungus, biotin being necessary and sufficient for good vegetative growth and aneurin being necessary for the production of perithecia

The addition of inositol had no effect on either growth or fruiting

It is hoped to publish a fuller account of this work soon

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Nov 11

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[1] Hawker L E Ann Bot 50 699 (1936)

[2] Schopfer W H Compt rend Soc Phys Hist Nat Genève 48 105 (1931)

[3] Robbins W J and Kavanagh F Amer J Bot 25 229 (1938)

[4] Wildiers F La Cellule 18 313 (19 1)

[5] Eastcott E V J Phys Chem 32 1 94 (19 8)

[6] Buston H W and Pramanik B N Biochem J 25 16 6 (1931)

[7] Kögl F and Fries N Hoppe Seyl Z Phys Chem 249 93 (193)

Genetics of *Armadillidium vulgare* Latr

THERE are several varieties of the isopod *Armadillidium vulgare* Latr The colour of the commoner ones is either black or greyish A reddish brown variety also occurs I have obtained occasional specimens of this variety (var *rufobrunneus* Collinge[1]) from four different localities near Cambridge As can be seen from the accompanying table, this red colour appears to be a simple dominant to the commoner black colour (both the red male *A* and the red female *B* are heterozygous for this factor)

Brood	Parents	Progeny	
1 of 1937	Red male *A* × Red female *B*	27 red	13 black
1 of 1938	Red male *A* × Black female *C*	4 red	8 black
3 of 1938	Red male *A* × Black female *D*	5 red	11 black
of 1938	Black male *F* × Red female *B*	5 red	5 black

The apparent small size of the three broods in 1938 is due to the death of animals before they can be scored caused by faulty cultural methods

Brood 1 of 1937 was also scored for sex There were found 36 females but only one male (three animals died after having been examined for colour and before their sex was determined) The red female *B* thus appears to be thelygenic Vandel[2] has described in some detail the occurrence of amphogenic and monogenic (both arrhenogenic and thelygenic) females in another terrestrial isopod, *Trichoniscus provisorius* Racovitza The apparently normal 3 1 segregation for colour in this brood would not be expected if this brood were a parthenogenetic one such as are known to occur in triploid *Trichoniscus elisabethae* Herold (Vandel[3])

The exceptional male in Brood 1 of 1938 was of the black type with a pattern of yellow markings (var *variegatus* Lereb , see Collinge[4]) Such a variety appears, from collections and also from observations on the segregations in amphogenic broods to be normally a sex limited character found only in females Most males are entirely black in colour (var *plumbeus* Lereb , see Collinge[4]) All the red and black females in this brood also had the pattern of yellow markings

Work on the genetics of the different varieties of this woodlice is being continued, and it is also proposed to investigate the genetics of the amphogenic and monogenic types of females Such work must be slow since only one brood per year is obtained

H W HOWARD

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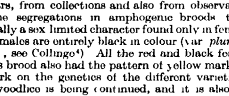
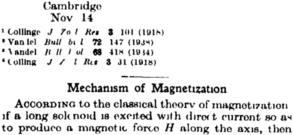
Nov 14

[1] Collinge *J Zool Res* **3** 101 (1918)
[2] Vandel *Bull biol* **72** 147 (1938)
[3] Vandel *Bull biol* **68** 418 (1934)
[4] Collinge *J Zool Res* **3** 31 (1918)

Mechanism of Magnetization

ACCORDING to the classical theory of magnetization if a long solenoid is excited with direct current so as to produce a magnetic force *H* along the axis, then if a long steel rod is placed axially in the solenoid the magnetizing force at the central part of the rod will be *H* and will be uniform over the cross section of the rod The following experimental results, however, indicate that this conception is incorrect





A solid drawn steel tube 24 in long, ¾ in outside diameter and ⅝ in inside diameter was arranged axially and centrally in a magnetizing solenoid about 4 ft 9 in long and about 4½ in internal diameter A search coil wound on a fibre rod support was arranged inside the steel tube midway between the two ends the general arrangement being as shown in the diagram The magnetic force inside the tube was then measured ballistically and the results are shown by the full line curve, which has been plotted as a function of the exciting current of the solenoid The steel tube was then removed whilst the search coil remained in position centrally in the solenoid The magnetic force was then measured ballistically and the values so obtained are shown by the broken straight line in the graph

It appears therefore that, for a given excitation, the magnetic force *H* inside the tube may be only about one half the value which is obtained when the steel tube is removed

These investigations are being extended by using a nest of tubes arranged with an annular space between every two consecutive tubes so that the magnetic force may be measured in each of the annular spaces

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Nov 14

Friction of Clean Metals and the Influence of Surface Films

WHEN a metal is cleaned in air the surface will still be covered with a relatively thick layer of oxide and other adsorbed impurities Friction measurements are usually made with metals coated in this way, and if a lubricant is added, it is superimposed on the surface films already present Recent experiments[1] show that an intermittent clutching and breaking away of the surfaces takes place during sliding The results suggest that local adhesions may occur at the points of metallic contact and that the sliding friction may be due to the making and breaking of these welded junctions The molecular field of force at the surface of a solid is profoundly modified by the presence of an adsorbed layer so that, if this view is correct we should expect the surface film to have a large influence on the friction

It is a matter of considerable experimental difficulty to remove the last traces of adsorbed film from a metal surface, and few attempts to measure the kinetic friction of naked metals have been made Jacob[2], and Shaw and Leavey[3] found that when metal surfaces were partially cleaned in a vacuum the *static* friction showed an increase Holm and Kirschstein[4] showed that the adhesion between metals which had been heated in a vacuum was high On the other hand, Poschl[5] states that when surfaces are cleaned in a good vacuum the sliding friction between the surfaces becomes vanishingly small We have measured the *kinetic* friction between various metal surfaces which have been cleaned by prolonged heating, in a high vacuum, to a temperature near the volatilization point Within the limits of experimental accuracy, the friction was independent of the sliding speed, and in every case the removal of the surface films caused a very large increase in the friction The coefficient of kinetic friction between outgassed nickel and tungsten surfaces, for example, was $\mu = 6$, which *is nearly twenty times greater than* the friction of these metals when cleaned in the ordinary way

These observations lend strong support to the view that local adhesion between metals may occur Under normal conditions, when the metals are exposed to the air, the presence of adsorbed films will reduce the field of force at the surface When this film is removed, the strength of the field is increased, the metals are able to approach more closely, and the molecular interaction and adhesion are very much greater

The effect of adding gases and vapours to the outgassed metals was interesting Hydrogen and nitrogen had very little influence the friction remained at its high value even after prolonged standing The admission of a trace of oxygen water vapour or caproic acid vapour all produced an immediate fall This suggests that the presence of a primary film is capable of reducing the friction between the metals In most cases however this initial rapid fall was comparatively small and the friction continued to decrease with time It was not until thicker films were built up on the surface that the friction fell to values near those observed under normal conditions of measurement In the case of copper, for example it was necessary to form a visible oxide film before the friction fell to μ 0 6 Caproic acid vapour behaved in a similar way After the small initial rapid drop in the friction there was little further change until the surface was allowed to stand for some time in the vapour at its saturation pressure so that condensation could build up polymolecular layers of the fatty acid The friction then fell to a low value comparable with that observed under boundary lubrication conditions (μ – c 0 1)

The view was originally put forward by Hardy[6] that under boundary lubrication conditions the solids were separated only by a unimolecular film adsorbed on each surface and that the *static* friction was due to the interaction of these two adsorbed layers Other experiments[7] have shown that the *kinetic* friction under boundary lubrication conditions cannot be regarded as a purely surface phenomenon It is much more complicated and the effects extend to a considerable depth beneath the surface of the solid These observations support this view and suggest that the primary film is not enough and that a layer of the substance several molecules in thickness must be present before it can function as an effective boundary lubricant for moving surfaces

F P BOWDEN
T P HUGHES

Laboratory of Physical Chemistry
Cambridge Nov 11

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[1] Bowden and [illegible] NATURE 141 691 (1938)
[2] Jacob *Ann Phys u Chem* 38 126 (1912)
[3] Shaw and Leavey *Phil Mag* 10 809 (1930)
[4] Holm and Kirschstein *Wiss Veroff Siemens Konz* 15 (1) 122 (1936)
[5] Pöschl see Ewald Pöschl and Prandtl The Physics of Solids and Fluids (Blackie 193)
[6] Hardy and Doubleday *Proc Roy Soc* A 100 550 (1922) and several later papers
[7] Bear and Bowden *Phil Trans* A 234 329 (1935)

Verses about Buckland

IN view of the interest recently displayed in an Elegy, intended for Professor Buckland (NATURE Oct 8, p 673, and Oct 22, p 758), it may be appropriate to record Buckland s own comment upon it in a letter which he wrote to Miss Jane Talbot at Penrice Castle in Gower on December 11, 1820 Buckland had just returned from a long Continental trip which, he said, had been less adventurous in the line of imprisonments and banditti than the last, but had not been lacking in curious incidents He then went on 'In contemplation of the possibility of my remaining underground upon the Continent for ever I found upon my return that Mr Whateley of Oriel had composed for me an elegy which I am happy to have it in my power to forward you a copy The copy which follows in his own handwriting shows that the printed versions in Mrs Gordon s Life and Correspondence of William Buckland and in NATURE of October 8 contain a few copyists errors

There was also printed in The Life of Buckland a rhyming account of one of his lectures, said to have been delivered early in 1822 The lines were, however, written earlier than this, as they are mentioned in a letter which Buckland wrote to Lady Mary Cole also of Penrice on October 29, 1819 He was writing from Axminster and said I received last week a poetical epistle from my friend Mr Shuttleworth containing one of my lectures done into rhyme It is extremely neat and full of humour and will be highly entertaining to you

Part of the epistle is printed in The Life of Buckland , and it describes in rhyme how the tutors and undergraduates sat beneath Ashmole s ample dome while the inventive Master discoursed upon the history of the earth and the life it had supported in past ages This part which is omitted from Mrs Gordon s book is as follows

Allow me now that map of mine to show—
Tis Glostershire ten thousand years ago—

It being the object of the versifier to produce at present merely a specimen of his intended work he has omitted the following fifty verses exclusively geological concluding with

Those Bones I brought from Germany myself
You ll find fresh specimens on yonder shelf,

and also a digression of 2 300 lines of which the concluding couplet is

So curl the tails of puppies and of hogs
From left to right the pigs from right to left the Dogs

and also for the same reason the subsequent and still more digressive digression which is terminated by the following admirable reflexion—the whole passage consisting of 5 700 fresh lines

And not wild but *tame* cats only teaze their prey

The concluding couplet which is given without any alteration from the mouth of the learned Lecturer is here subjoined solely because it serves as an additional proof if such were wanting of the close connexion which subsists between geological speculations and not the ideas only but also the language of complete poetry It will be observed that tho intended only as a common sentence of adjournment it has all the fluency and grace of the most perfect rhythm and of its own accord glides into sense and hitches in a rhyme

Of this enough—on Secondary Rock
To morrow Gentlemen—at 2 o clock

Buckland derived considerable pleasure from the verses which he inspired and in a letter to Lady Mary Cole he wrote I believe few ladies have given origin to more poetry than my bag and hammer I enclose you copies of one or two by Mr Duncan and Mr Conybeare, and you that have seen my rooms will judge of the accuracy of the description of them ' The lines by Duncan are those on the Comforts of a Professor s Rooms in Oxford , printed in The Life of Buckland (p 9), while Conybeare s effusion is as follows

ODE TO A PROFESSOR'S HAMMER

Hail to the hammer of Science profound
Flint Stone and Rock
Quail at its shock
And their fragments fly as the sparks around

Beneath the storm of its thundering blows,
Rending and opening and staggering and reeling
Mountains reluctant their story disclose,
The secrets of Millions of Ages revealing
The fossil dead that so long have slept
And soon world after world into ruin swept
Start at the sound
Of its fearful rebound

Though fathoms deep in adamantine fold
The solid Rocks their fast bound corpses hold
Though every age— and thousands since have past
Hath made that sepulchre more deep, more fast
Yields the firm Rock and through the rifted stones
Pours the strange light on the long shrouded bones

A Sun—not that whose earlier Ray
Illumined their primæval lay
But younger many a generation—
Their sun's great Grandson at the Last
Shines on each antiquated beast
And now first wakes their slumbering nation

Each old crocodile grins with vast amaze
While rousing him from his marble hearse
As a world so new and so strange he surveys
And doubtless he thinks that since his younger days
Things are strikingly changed for the Worse

The manuscripts upon which the foregoing notes are based are in the Department of Geology at the National Museum of Wales, having been presented to that Institution by Dr Mervyn Gordon

F J NORTH

National Museum of Wales,
Cardiff Nov 9

Binocular Vision

The ability to see stereoscopic pictures without a stereoscope referred to by Mr G R R Bray in NATURE of Nov 26 p 959, is if not common, at least fairly easy to acquire I have been able to view such pictures with naked eyesight for many years past If one places a pair of stereoscopic pictures at the normal distance from the eyes for comfortable vision and then directs one's gaze just over the top of the pictures at some more distant object two images of each of the pictures will immediately appear By a little practice the right hand image of the left picture and the left hand image of the right picture can be brought into coincidence the coincidence occurring rather suddenly in the end and as it were *engaging* in that position This sudden coalescence is I presume due to the eyes refocusing at normal distance each on its own picture When this has occurred the equilibrium is fairly stable

I have sometimes thought that it might be possible to teach this little accomplishment to an audience, and then to exhibit stereoscopic pictures in this way on the screen

T S PATTERSON

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Points from Foregoing Letters

PHOTOGRAPHS of spectra of blue auroras at a height of 250-650 km taken at Oslo, Norway, on September 15 last are submitted by Prof C Stormer By comparison with the lower (92 km high) yellow green curtains of the auroras in the earth's shadow, the spectra of the blue auroras show that the relative intensity of the lines 6300, 4278 and 3914 A has increased considerably (6 – 8 times) as compared with the line 5577 A

Sir Joseph Larmor directs attention to the work of Ives and Stilwell, who have measured the second order change in the free periods of the hydrogen atoms in the canal rays flying transverse to the line of sight, thus verifying the theoretical frequency factor $(1 - v^2/c^2)^{1/2}$, he also discusses the second order effects that might be expected from the influence of gravitation upon light

The unshrinkable finish imparted to wool by various processes depends on the formation of a gelatinous degradation product of keratin, on or under the scale structure of the fibres, according to Dr J B Speakman, B Nilsson and G H Elliott, they state that this may be accomplished by means of any reagent (such as chlorine) which is capable of breaking down the disulphide bonds

Prof L Califano and D Kertesz find that the 'activating effect' of *o* diphenol upon the action of 'tyrosinase' extracted from *Sepia* is merely a reduction of the induction period, they consider that the assumption of the existence of a tyrosinase enzyme to explain the tyrosine oxidation is unnecessary

Dr E Bergmann and Y Hirshberg describe the changes brought about in Δ^4 cholestenone by ultra violet irradiation Besides resinous material, a bimolecular reaction product, $C_{42}H_{62}O$, is formed by loss of six carbon atoms and dimerization

Dr Lilian E Hawker finds that in order to grow the fungus *Melanospora destruens* on a synthetic medium composed of glucose, potassium nitrate, magnesium sulphate and potassium dihydrogen phosphate it is necessary to add biotin (a growth substance obtained from egg yolk) for good vegetative growth and aneurin (vitamin B) for the production of perithecia

H W Howard reports that in the wood louse *Armadillidium vulgare* Latr a red variety behaves as a simple dominant to the commoner black form In a brood of 37 which showed a 3 1 segregation there were 36 females and only one male

Measurements made by Dr T F Wall of the magnetic force at the axis of a long solenoid, (i) when a steel tube is arranged axially in the solenoid and (ii) when the steel tube is removed, indicate that one aspect of the classical theory of magnetization is incorrect

Dr F P Bowden and T P Hughes find that when the adsorbed films normally present on metals are removed the kinetic friction between them is very great and may be twenty times that usually observed A layer several molecules in thickness must be present before a substance can function as an effective boundary' lubricant for moving surfaces

Research Items

Modern Maya Houses of Central America

AN elaborate study of the modern Mayan house of Central America has been made by Mr Robert Wauchope (Carnegie Inst Washington, D C , *Pub* No 502, 1938 Pp 181 with 37 pl) with special reference to its bearing on the archæological problem of the construction and arrangement of the dwelling house of the ancient Mayas Archæological excavation, owing to the character of the structure reveals little evidence, except of the substructures Attention was directed especially to the manner in which the modern house falls to pieces The close resemblance between the ancient house as shown in the frescoes and the modern house has been pointed out frequently Present day Maya villages are probably assembled more systematically than those of ancient times, when they were either located at haphazard or clustered in the neighbourhood of important buildings There is evidence to suggest that the present day practice was followed according to which an owner builds on houses additional to his own to accommodate tenants for stipulated service At present the isolated house is rare in Yucatan and Campeche, but common in Guatemala The siting of a house is determined by the condition of the site poor drainage, outcrops of rock or rough surface being avoided The floor is composed of the ground, levelled and improved by marl and earth A low platform or substructure is erected to support the house Some are provided with terraces Most modern dwellings are of the single room type but there are also some with an enclosed room at the back and an open porch front or with three or four rooms facing on porches and located side by side under a single roof Houses in the Maya area are either apsidal flat sided with rounded corners rectangular, square or rounded in ground plan The same plan in building is followed throughout The mainposts of the house are well inside the line of the walls and stand independently of the rest of the house framing Cross beams rest on the forks of the mainposts and carry the plates The chief weakness of the Guatemalan house is in its long axis The main types of roof are the hip roof and the gable roof Practically all are quarter pitch The use of adobe brick differentiates the houses of Honduras, Guatemala and highland Mexico from those of Yucatan, where rubble masonry wet or dry, is in use Windows are rare

Decarboxylation by the Typhoid Bacillus

MADELEINE LACHAMPT (*Thèse de Paris*, 1938 No 661) has investigated the action of *Bact typhosum* on the two amino acids histidine and tyrosine, which are respectively capable of producing histamine and tyramine by decarbolization The decarbolization of histidine which gives rise to histamine takes place as the result of the action of various micro organisms such as *B aminophilus* some strains of *Bact coli* *Bact lactis aerogenes* and Friedlander s bacillus, and can also be produced by *Bact typhosum* in a culture medium containing a source of carbon and nitrogen distinct from histidine Decarbolization of tyrosine which gives rise to tyramine is produced by *B aminophilus*, *Proteus vulgaris* *Bact lactis aerogenes* and *Bact coli*, and can also be produced by *Bact typhosum* in a medium containing a source of carbon and nitrogen distinct from tyrosine

Japanese Martin Fly

THE black chinned martin *Delichon urbica dasypus* is infected by a house fly, *Stenopteryx nipponica* (Fam Hippoboscidæ) regarding the biology of which nothing has so far been published The species described by K Kishida in 1931, seems to be limited to the black chinned martin, for no specimen was found in the nests of swallows or other birds, although the nests of the martin were heavily infested and a few individuals were found attached to the birds themselves Kaoru Huziematu now describes the life history in detail from observations made at Tubame Hotspring Japan (*Sci Rep Tôhoku Imp Univ* , Ser 4 13, 59 , 1938) Mating generally takes place while the flies are in the nest, and the egg hatches in the uterus of the female insect, where by contraction and dilation of a tongue like organ the larva feeds upon glandular secretions After three instars, the full grown larva now covered with a more or less chitinized skin is deposited in the martin s nest The pupal period in the summer is 23 days but in the autumn after the emigration of the martins puparia were found in the nests and from these the adults do not emerge until the following spring In this respect the pupal life history resembles the stages of Sommerpuppe and Winter puppe described by Hardenberg in *Stenopteryx hirundinis*, the corresponding parasite of the European house martin

A New Method of Development in Tufted Mosses

A CURIOUS problem in the genus *Plagiochila* has been the explanation of the small plantules known as *P Stableri* which occur in the vicinity of *P. asplenioides* Douin (*Ann Bryologici* **11** , 1938) has now shown that *P asplenioides* develops axillary branch initials the upper developing into normal branches whilst the lower swell at the base and become detached The latter fall on to lower leaves soil and neighbouring mosses and there develop rhizoids and behave as small epiphytic or free living plantules with the characteristics of *P Stableri* Douin considers the development of similar branch initials to be responsible for the multiplication of the erect stems of many tufted mosses These are figured for *Funaria hygrometrica* In *Bryum argenteum* spore production is not sufficiently common to account for the rapid spread and increase in size of tufts, and yet neighbouring stems of the tuft show no connexion with one another Such deciduous branch initials would offer a satisfactory explanation of the prolific multiplication in such cases

Epicentres of Recent Earthquakes

PROVISIONAL epicentres of three recent earthquakes have been determined by the United States Coast and Geodetic Survey in co operation with Science Service and the Jesuit Seismological Association from instrumental records obtained at U S Observatories (*a*) 1938 Nov 5 d 8 h 43 3 m G C T , epicentre lat 38° N , long 141° E There was a probable after shock from the same epicentre on Nov 5 d 10 h 50 2 m G C T These were recorded by twenty three stations (*b*) 1938 Nov 6 d 8 h 53 m 57 s G C T , epicentre lat 36° N , long 144° E There was apparently an aftershock from the same epicentre on

Nov 6 d 21 h 38 7 m G C T These were recorded by twenty stations (c) 1938, Nov 10 d 20 h 18 7 m G C T , epicentre lat 56° N , long 159° W This was recorded by twenty three stations The first and second of these were off the north east coast of the main island of Japan and the third was immediately to the south of the Alaska Peninsula All have been mentioned previously in NATURE

Seismological Data and Volcanicity

E M ANDERSON applies seismological data to the magma problem in a paper delivered at the section of volcanology, International Union of Geodesy and Geophysics, on September 22 1936 (*Bull volcanologique*, 3 Series 2, Naples, 1938) The author is concerned to make out a case for a system of surface layers on the earth such as will be consistent with the petrological make up of such layers, which he considers necessary for the explanation of past and present volcanic activity The data used are in part derived from the study of actual individual earthquakes, and partly obtained from studies of the physical properties of rocks The layer which transmits the P_g and S_g waves is considered to be 10 13 km thick and to be petrologically similar to the Scottish Lewisian gneiss Two sets of P^* and S^* waves are considered possible necessitating a division of the intermediate layer into an upper one of tholeitic basalt similar to the Whin Sill, and a lower one consisting of olivine basalt The two together are considered to be about 25 km thick The author admits that the subdivision is still in the hypothetical stage Sparks s paper has been further discussed by Stoneley (NATURE November 5 p 840) The underlying material down to a depth of 480 km , which transmits the P_n and S_n pulses, is suggested to consist of dunite, peridotite or eclogite

Oxides of Bromine

IN 1937, Schwarz and Schmeisser reported the discovery of bromine dioxide BrO_2 which they prepared by passing the silent electric discharge between aluminium electrodes through a mixture of bromine and oxygen in the proportion of one part to five The oxide was described as an egg yellow solid It has now been further investigated by Schwarz and Wiele (*Naturwiss* , 26 742, 1938) When heated not only does it decompose to some extent into its elements but also it gives rise to a white compound apparently a higher oxide of bromine either Br_2O_7 or Br_2O_8 and a dark brown oxide Br_2O (about 20 per cent of the yield) The latter was isolated in the pure form It is no doubt identical with the compound obtained by Brenschede and Schumacher in 1936 but these workers obtained it with excess of bromine in carbon tetrachloride solution, and determined its formula by investigation of its absorption spectrum and from lowering of the freezing point The substance now obtained in the pure form dissolves in carbon tetrachloride with a strong green colour Molecular weight determinations in solution indicate that the substance has the simple formula Br_2O When allowed to act on carbon tetrachloride for a considerable time, the latter is oxidized to carbonyl chloride It reacts smoothly with sodium hydroxide forming sodium hypobromite Bromine monoxide has a powerful odour, reminiscent of hypochlorous acid It is stable below – 40°, but gradually decomposes above this temperature The rate of decomposition is not great, however, even at 0°

No-Loss Dimmers for Small Cinemas

IN the *Siemens Review* (14, (3), 146 , 1938) published in Berlin, a description is given of new apparatus for the gradual dimming of the lighting on the stage in cinemas, concert halls etc The Siemens dimmer has the great advantage over the early resistance dimmers that the dimming of the lighting is practically unaccompanied by losses At the last Leipzig Spring Fair a few of the smaller no loss dimmers were exhibited of the types employed in amateur theatricals, small cinematic exhibitions, etc There was shown a motor driven circular dimmer with one regulating arm, and a two arm dimmer with sheaves for hand operation from a control stand The rated load for one arm at 220 volts is up to 4 400 watts and for two arms it goes up to 5 500 watts Within these limits any number of lamps can be connected without in any way affecting the degree of the efficiency of the dimming For larger installations comprising more than two circuits, it is customary to use Siemens Bordoni dimmers If the supply is single phase sixteen circuits can be connected and if three phase fifty four circuits The Bordoni dimmer shown at the Fair was arranged for four circuits and equipped with four regulating slides, with corresponding driving frame The two circular dimmers were connected up for demonstration purposes to a part of the stand lighting the corresponding reduction in the current consumption being rendered visible to the visitors by the readings on a wattmeter

Wave Geometry

EARLIER investigations on this subject by a group of workers at the Hiroshima University Japan have already been mentioned in NATURE (Dec 21 1935, and May 22 1937) Previous notices dealt with fifteen papers Since that time no fewer than eighteen more have appeared The first twenty five papers have now been reprinted and published under the title of Collected Papers on Wave Geometry (Tokyo Iyubun Kan, 1938) One of the most interesting is No 22 by K Morinaga The Hydrogen Atom in Terms of Wave Geometry At first sight, the work appears to be quite different from the usual relativity of quantum treatment but the final results agree closely with those of Schwarzschild, de Sitter, Schrodinger, and Dirac However, there is one difference in the physical interpretation Although the ψ of the wave geometry equation has the same mathematical properties as that of the same symbol in Dirac s work, the former is associated mainly with the nucleus but the latter with the electron Paper 24, by T Iwatsuki Y Mimura and K Morinaga, and Paper 25, by T Sibata deal with Born s new field theory In the original form of this theory, various difficulties arise, and to deal with these what appear to be rather arbitrary assumptions are made It is shown that Born s theory can be regarded as a form of wave geometry, and that in consequence there is a natural and obvious method of overcoming the difficulties referred to As for the later papers, several of interest are contained in the *Journal of Science of the Hiroshima University* (8 , 1938) In Paper 31, K Itimaru shows that the red shift of the spectral lines of the nebulæ and the Hubble velocity distance relation can be deduced from wave geometry The wave geometry form of cosmological theory is nearly the same as de Sitter s, with one fundamental difference It is consistent with the existence of finite concentrations of matter, and so accords with the actual universe

Annual Meeting of the Royal Society

Awards of Medals*

Copley Medal: Prof. Niels Bohr, For. Mem. R.S.

Prof. N. Bohr has been for many years the recognized leader of theoretical atomic physics. His early work in 1913 provided the connecting link between Planck's conception of quanta and Rutherford's of the nucleus, and made it possible for the first time to constitute a consistent theory of spectroscopy. The development of this theory owes nearly as much to Bohr as did its inception. Among other things, he invented the principle of correspondence, according to which quantum phenomena pass over into the classical as a limiting case, following certain definite rules which Bohr laid down. This principle was of the greatest importance in the early days of the theory.

Besides providing a rational explanation of atomic spectra, Bohr's theory made it possible to give a satisfactory explanation of the structure of atoms and in particular to explain the changes in properties which occur as we go from one element to the next in Mendeléeff's Periodic Table. In doing so it provided an explanation of the shells of electrons proposed by J. J. Thomson. In the development of this theory Bohr's mathematical ingenuity and his application of the theory of perturbation played a large part.

When the principles of wave mechanics were initiated by de Broglie and Heisenberg, the latter of whom was a pupil of Bohr's, Bohr took an important part in the development of the new ideas and in transforming atomic theory to fit them. The view which is held at the present day of the relationship between waves and particles is very largely due to Bohr.

In the last few years Bohr has transformed the ideas held as to the structure of the nucleus by pointing out the intimate association of the particles which comprise it, and the necessity for treating them as part of a closely knit system more like a liquid than a gas. This fundamental idea has already had far reaching effects, and is the basis of almost all present work.

Although his published papers are of supreme importance, it is probable that Bohr's greatest contribution to physics lies in the influence which he has exerted over an enormous proportion of the leading physicists of the world.

Rumford Medal: Prof. R. W. Wood, For. Mem. R.S.

The study of physical optics owes much to Prof. Wood, who has been one of the leading experimenters in this field for the past forty years. Before the advent of Bohr's quantum theory, when our knowledge of the structure of atoms and molecules was very meagre, Wood had discovered the line and continuous absorption of sodium vapour, the phenomenon of resonance radiation of gases and vapours, and the quenching of this radiation by foreign gases. These discoveries opened up rich fields of research and were of the greatest value to later workers in laying the foundations of the theory of atomic and molecular spectra.

The elucidation of the phenomenon of resonance radiation demanded the utmost experimental skill and resource. Nothing less powerful than an improvised 40 ft. focus spectrograph sufficed for his work on the remarkable resonance spectra of molecules. In addition to his researches on the resonance radiation of metallic and other vapours, Wood investigated their magnetic rotation and dispersion. More recent but belonging to the same domain of experiment are the very interesting discoveries of Wood and Ellett on the magneto optics of resonance radiation.

Wood's mastery of technique is universally acknowledged. He has introduced many ingenious and striking devices to experimental method. These are too numerous to catalogue here, but special mention must be made of his method of the production of atomic hydrogen and his observations on the spontaneous incandescence of substances in atomic hydrogen which led to the invention of the atomic hydrogen welding torch by Langmuir, his very efficient and now widely used method of observing Raman spectra, his échelette grating which has proved to be the grating *par excellence* for the investigation of the near and far infra red, and his pioneer use of light filters in ultra violet and infra red photography.

A Royal Medal: Dr. F. W. Aston, F.R.S.

Few cases are known to science in which an important development has remained so much in one man's hands as has the study of isotopes, by means of the mass spectrograph, in those of Dr. Aston. Aston's attention was directed to isotopes by his work as assistant to Sir J. J. Thomson when the latter was working on the analysis of positive rays by the parabola method. The results for neon suggested very clearly that this element contained atoms of weight 20 and 22, but other explanations were conceivable.

After the Great War, by means of his mass spectrograph Aston showed that the lighter constituent of neon had a mass less than corresponded to the density of the gas as a whole, which was therefore a mixture. But the results went much further, and Aston found that not neon alone but also the majority of elements consisted of mixture of isotopes, in the sense already established by Soddy and others for certain products of radioactivity. This discovery profoundly altered men's views as to the nature of the ordinary chemical elements. For one thing, atomic weights as ordinarily determined were seen to be merely weighted means and not fundamental constants. By various modifications of this method Aston was able to extend his experiments to cover the great majority of the known elements, and to establish the existence of hundreds of isotopes. In addition, he was able to show that, with the exception of hydrogen, all the isotopes had nearly integral atomic weights taking oxygen as 16 This result was of great importance in connexion with Rutherford's theory of the nucleus

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*From the remarks made by Sir William Bragg, Pres. R.S., in making the presentations.

The later developments of Aston's work are concerned mainly with the small deviations from this whole number law Since on the theory of relativity mass and energy are equivalent the mass of a nucleus is a measure of its internal energy and the small divergences from whole numbers give the energy with which the constituent particles are bound together Using an improved mass spectrograph capable of an accuracy of 1 in 20 000 Aston has determined this binding energy with considerable accuracy, at least for the lighter elements

By determining photometrically the proportions of the isotopes Aston has been able to calculate 'chemical atomic weights which in some cases have corrected those found by the older methods Thus both in chemistry and in physics Aston's work has been of outstanding value

A Royal Medal Prof R A Fisher, F R S

Prof R A Fisher's contributions, both to the development of the logical theory of statistical methods and to the invention of efficient tools for the use of the experimental worker have been of outstanding importance Before Fisher entered the field (in 1912), the work of Galton Pearson and their immediate pupils had widely extended the connotation of statistical methods particularly in biological research Useful descriptive methods had been invented, and reasonably adequate tests of sampling errors when samples were large (say, a hundred or more observations) were made available As a result there was an enormous increase in the number of workers who applied quantitative methods to biological, medical and sociological problems

It may be said that in freeing the statistical methods of weaknesses obvious a quarter of a century ago, Fisher has been one of the chief contributors to the improvement of the logical basis of statistical methodology He has been the most important contributor both to the theory and practice of small sample analysis, and to the armamentarium of statistical tools for biological and technological research His own practical contributions to the study of genetics have been neither few nor unimportant but the scope of his work has covered a much wider field of scientific research concerning both the physical and biological sides

Davy Medal Prof G Barger, F R S

Prof G Barger's two most important contributions to knowledge are linked together namely, his work on the alkaloids of ergot and on the sympathomimetic amines After his isolation (with Carr) of the alkaloid ergotoxine, to which the effect of ergot on the cock's comb is due, he showed that the pressor bases from putrid meat were the products of decarboxylation of amino acids, and included *p* hydroxyphenylethylamine, derived in this way from tyrosine He worked out methods for the synthesis of *p* hydroxyphenylethylamine and allied compounds, and proved that this compound and also histamine, the product of decarboxylation of histidine, occurred in extracts of ergot

One of the earliest systematic investigations of the relation between chemical constitution and pharmacological properties was the work which Barger carried out in collaboration with Dale on the sympathomimetic amines of the phenylethylamine class He has made considerable contributions to our knowledge of the constitution of many alkaloids and also of many naturally occurring derivatives of amino acids Special mention may be made of his work carried out jointly with Harington, on the constitution and synthesis of thyroxine

Darwin Medal Prof F O Bower, F R S

Prof F O Bower's main contributions to botany have been the intensive study of the morphology and affinities of ferns and allied plants A series of papers on the development of spore bearing organs in the Pteridophyta is a contribution to phylogeny of great importance In his book Origin of a Land Flora (1908) Bower discussed evolutionary problems with special reference to the Bryophyta and Pteridophyta, twenty six years later he dealt with the same problem in Primitive Land Plants His three volumes on ferns (1923–28) are a classic work on the affinities of members of this group and a most valuable source of information In 1930 he discussed Size and Form in Plants Prof Bower has consistently devoted himself to a branch of botanical science in which he has long been regarded as a leading authority By his own researches and the judicial examination of recorded facts he has thrown light on the natural affinities of certain groups of plants

Hughes Medal Dr J D Cockcroft, F R S, and Dr E T S Walton

The discovery by Dr J D Cockcroft and Dr E T S Walton that the transmutation of elements can be effected by means of artificially accelerated particles has opened up a new line of work of outstanding interest and importance In previous experiments, initiated by Rutherford so long ago as 1919, the transmutation of several elements had been produced by bombarding them with the α particles from the natural radioactive substances In this early work it was thought that bombarding particles of very great energy were required to disrupt atomic nuclei The development of quantum mechanical ideas to nuclear problems made it possible for the first time to see how charged particles of low energy could penetrate into an atomic nucleus, and, moreover, enabled calculations to be made of the probability of penetration

It was on the basis of such calculations that Cockcroft and Walton came to the conclusion that protons accelerated by moderate potentials, of the order of a few hundred kilovolts, should be able to effect the disintegration of the lighter elements. During 1930 attempts were made to disintegrate lithium by bombardment with protons using accelerating voltages up to 300,000 v The results were at first negative, but continued experiment, in which the apparatus was re designed to give voltages up to 600 kv, was in 1932 rewarded with the successful disintegration of lithium by bombardment with protons Thus for the first time an atomic transmutation was effected by means entirely under the experimenter's control These experiments of Cockcroft and Walton gave a tremendous impetus to investigations in nuclear physics

Indian Archæological Investigation, Teaching, and Research*

THE mystery and fascination of Central Asia have been felt by three generations of travellers and scholars, and to day we are blinded by treasures which a series of great excavations has given to the museums of Europe and Asia. It is in the museums and weighty reports of excavations that the historian must quarry for the raw material of history. The history of Central Asia has yet to be written and for the most part we have to be content with brief and disconnected fragments forming a background on which we must try to place the pieces of archæological evidence. The present expedition was undertaken in part with the object of directing attention to these problems in part in the hope of providing a few fragments of evidence bearing on the great problem that of chronology in the study of the Buddhist art of Gandhara, the country which lay between the Indus and the Hindu Kush. The chronological scheme of Foucher who wrote what still ranks as the standard work on Gandharan art convenient and coherent as it is is purely stylistic, and does not meet the requirements of the archæologist and historian as had been demonstrated by the archæological investigations at Hadda of the French delegation which has been at work in Afghanistan since 1922. Evidence of the influence of Gandharan art has come from various central Asian sources extending so far as Turfan in Chinese Turkestan, but there is one blank in the record Bactria and the Oxus territory.

The present expedition beyond the Indian frontier spent the summer months of 1938 excavating in the valley of Swat and later on the invitation of the director of the French delegation and with the permission and assistance of the Afghan Government in an archæological reconnaissance of the archæologically unexplored territory in the north of Afghanistan, covering a distance of two thousand miles.

In the Swat valley Barikot was made the first camping site of the expedition in order to excavate some of the monastic and domestic sites in the three side valleys which converge at this point. In the course of the two months which were spent here, a complete survey was made of all the Buddhist ruins and a map was prepared showing not only the remains of stupas monasteries and fortresses but also of those of their dependent villages and terraced cultivations with the view of determining the areas of settlement and the relations between domestic remains and areas of cultivation in fact, to see what this small area looked like in Buddhist times. It was also hoped to determine the relation between specific pieces of sculpture and such domestic objects as might help, because of their appearance elsewhere in dateable contexts, to establish a chronology of Gandharan art.

Khanjar Khote a typical monastic site, and one of a number excavated, consisted of a main courtyard in which a stupa stands, surrounded by small stupas, following no fixed plan. They were evidently built by different donors and probably at different times. Behind is another courtyard and cells for monks some of which probably became niches in which a Buddha was set up aligned along a road and at higher levels built in the hillside. The harvest from the small stupas was not rich—a number of pieces of blue schist showing scenes from Buddha's life in relief two or three plaster heads, carved bases of model stupas and innumerable pieces of broken decoration. Amluk a solitary site on a mountain top was a more interesting place. Here the masonry was of unfamiliar pattern and the harvest richer. Hence came a 3 ft seated Buddha of Foucher's 'late variety'. The circumstances in which the sculptures were found suggests destruction by Mohammedan invaders rather then the slow decay of which Hiuen Tsiang speaks.

Two members of the party excavated an acropolis 120 ft high and covered with potsherds at Charbagh in Upper Swat but with disappointing results. Some terra cotta animal figures and one human torso may prove of value, but owing to the conservatism of the Indian potter it is probable that we shall never achieve an intelligible chronology or even classification of types of pottery such as the European archæologist is accustomed to use as his guide.

Until the plaster heads have been compared with those from Takht i Bahi and Hadda until seals pottery and iron objects have been studied and corroded coins have been cleaned and deciphered it cannot be said how much nearer this summer's work has brought us to an archæological as distinct from a stylistic chronology of Græco-Buddhist art or whether any contribution has been made to the solution of another problem—why such a virile hybrid art sprang up in a comparatively small area on the Indian frontier and spread to Afghanistan and Chinese Turkestan. The main type of the Swat Buddha, however, has been established. He is squat and expressionless with an Indian face. The Boddhisatva is not a saint but an Indian prince in Greek dress.

At the end of July two members of the party, the leader and one other left for Kabul and starting thence crossed the Hindu Kush into the Oxus plain where a large number of the mounds with which Bactria is covered were examined and measured. At Kunduz twenty five miles south of the Oxus there are a number of mounds and an impressive 'round castle, with mud walls more than a hundred feet high and half a mile in circumference. It may be one of the centres by which the Sassanid kings kept their precarious hold on Bactria. On one site here a find was made which may be of importance—carved bases of Greek columns which disprove the contention of M Foucher, that the Hellenistic cities of Bactria were built of mud and sun dried brick.

In the preparations for this expedition, although the keeper of the India Museum, London, and others were of the greatest assistance the lack of a centre for Indian archæological studies in London, it was stated, had proved a grave handicap. Unless such expeditions as this are to be nothing more than a flash in the pan, if British work in India is to have a long term programme, something more substantial is required than the occasional enterprise of one or two individuals There must be a permanent centre in London for teaching and research, which would be a base for such expeditions and for the study of the material they bring back It is obvious that the personnel of expeditions should not be recruited in haphazard fashion from persons with few qualifications There should be a team of specialists engaged in teaching and research who could be drawn upon for expedition work from time to time as occasion offered It is sad to think that at a time when India is much in our minds at a time when our relations with her have reached a turning point in history and she stands at the brink of a great experiment there should be no professional home in London for the study and appreciation of Indian history and culture Though there is still some doubt as to the function of a museum those who know what the present keeper has done for the India Museum a place where the student can now study each of its civilizations as a whole and in all its aspects would agree that if there is to be a centre for teaching and research and a base for future expeditions it can only be the India Museum

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* Abstract of a lecture on The Results of the Recent Archæological Expedition to Swat and Afghanistan in Relation to the Present Position of Indian Studies in this Country by Evert Barger lecturer in medieval history in the University of Bristol delivered before the Royal Society of Arts on November 30.

A discussion followed the lecture (see p 1029)

The Future of Gaseous Fuel

THE town's gas industry is now well advanced into its second century of activity, although during the last half century it has from time to time been considered by observers as doomed to supersession sooner or later by other methods of using coal Such opinions based as they were on superficial knowledge, were always unwarranted, as revealed by the fact of steady growth of the use of gaseous fuel and the number of its applications This growth has accompanied an increase in the efficiency of appliances The present position and future of the industry have been the subject of several addresses in recent months

Some time ago, Mr E V Evans read a paper to the Royal Society of Arts on the importance of coal carbonization in the life of the nation emphasizing *the range and indispensability of its products* The modern tendency to avoid arduous and dirty tasks of domestic routine promotes the expansion of the use of gaseous fuel which need not be stored and lends itself to automatic control The same tendency is seen in many industrial heating operations in spite of systems of charging which often do not encourage the free use of gas It is only since 1920 that the sale of gas has been based on the heating value and even now freedom to base sales on a rational system of charging is not complete On this depends the expansion of use for large scale operations

Sir Harold Hartley, in his presidential address to the Society of British Gas Industries said that the strength and vitality of an industry depends on the way it uses the resources of science Research is 'the best insurance of its future he said and he referred to what the application of science has done to maintain and promote development of the use of gaseous fuel The range and extent of this was given in very specific terms in a recent address of Sir David Milne Watson to the Fuel Luncheon Club, when he said that his own company—the Gas Light and Coke Co incurs annually an expenditure exceeding £100,000 on its research activities In them all types of scientific skill are brought to bear on the problem of gas manufacture and purification and utilization including the handling of by products

Mr Evans looking to the future envisaged the possibility of producing gas without coke—something which a very large increase in the use of gaseous fuel might render urgently necessary Already the industry has initiated research on the gasification of coal under pressure The possibility of securing far reaching gasification and the production of large yields of methane and primary tars is already foreshadowed If the early promise already shown is followed by economic success the distribution of fuel in gaseous form will receive a great impetus While these developments are proceeding it will be interesting to watch the progress of the experiments made by the Soviet Union on the underground gasification of coal Following on experiments it is reported by the Russia Today Press Service that a commercial plant commenced operation in Gorlovka in 1937 Others are projected—one to supply Moscow and claims are made for the cheapness of the gas

H J H

University Events

CAMBRIDGE C B Davies of Trinity Hall has been appointed for the present academical year to the studentship offered by Imperial Chemical Industries Ltd

The degree of Master of Arts has been conferred upon Dr A J Bradley assistant director of research in crystallography

Sir Edward Mellanby secretary of the Medical Research Council has been appointed Rede lecturer for the year 1939

The following appointments in the Museum of Zoology have been made F R Parrington of Sidney Sussex College to be director, H B Cott of Selwyn College to be curator of vertebrates and Strickland curator J E Smith to be curator of invertebrates, Dr G C Varley of Sidney Sussex College, to be curator of insects Dr Varley has also been appointed University demonstrator in zoology

The British Electrical and Allied Industries Research Association and the Permanent Magnet Association have offered to make jointly a grant of £550 a year to the University for the purpose of supporting research on *magnetic materials* under the direction of Prof W L Bragg and the Iron and Steel Industrial Research Council has offered to the University a grant at the rate of £500 a year for research on the structure of alloys, to be carried out in the Cavendish Laboratory under the same direction In both cases, the grants will provide for the continuation of investigations which have been in progress for some time under Prof Bragg's direction, first at the University of Manchester and afterwards at the National Physical Laboratory

LONDON—The title of professor emeritus of embryology in the University has been conferred on Prof J P Hill, on his retirement from the University chair of embryology at University College, and that of professor emeritus of chemistry in the University on Prof Samuel Smiles on his retirement from the Daniell chair of chemistry at King's College

Science News a Century Ago

New or Rare Plants in Edinburgh

On December 10 1838, Robert Graham, professor of botany, sent to the *Edinburgh Philosophical Journal* a Description of several New or Rare Plants which have lately flowered in the Neighbourhood of Edinburgh The *Chorizema Dicksonii* he said, was raised by Dickson and Sons from seed sent from Swan River, Australia, the *Collinsia heterophylla*, the handsomest species of *Collinsia* yet known, was found by Nuttall on the Columbia and was raised at the experimental garden from seeds sent from America the *Eduardsia Macnabiana* had been cultivated in Edinburgh for some years but it was not known whence it came and the *Mirbelia augustifolia* though apparently a distinct species but without beauty, was raised from seed from New Holland

Littrow's Observations of Meteors

The *Athenæum* of December 15 1838 reprinted from the *Vienna Official Gazette* a note by Karl von Littrow on Falling Stars in August and November The phenomena said von Littrow, of an extraordinary abundance of falling stars, about the middle of November has been again observed this year On the 10th of November when we watched from eight in the evening till one in the morning, we counted about nine such stars in an hour On the 11th of November we counted about twenty in an hour On the 13th of November the sky suddenly cleared up an half an hour before midnight and remained perfectly serene till daybreak During those six hours we noted 1002 falling stars Von Littrow then went on to refer to the observations made in August

Karl Ludwig von Littrow (1811 77) was the son of Joseph Johann von Littrow (1781–1840) who from 1821 until his death was professor of astronomy and director of the observatory at Vienna In 1826–27 the latter erected an observatory in the middle of the city on the site of that founded by Father Maximilian Hell in 1753 Karl von Littrow became an assistant under his father in 1831, succeeded to the directorship in 1842 and it was during his period of office that in 1874–77 the modern observatory was built Newcomb in The Reminiscences of an Astronomer" tells how through colour blindness von Littrow had been led to wrong conclusions regarding alterations in the manuscript notes made by Father Hell of the transit of Venus of 1769

Brickmaking by Machinery

The *Mechanics Magazine* of December 15, 1838 contained a note on Jones's Machinery for Moulding Bricks The earth,' it said, in its descent, is forced into the moulds by great pressure as they pass under the Pug Mill and is delivered therefrom in perfect bricks upon pallet boards ready to be removed, the whole of which is done by the horse attached in the usual way to the Pug Mill producing from 1,000 to 2,000 bricks an hour The earth also being moulded with only one half the usual quantity of water will take considerably less time to dry A machine was at work last week on three successive days at Messrs Webb's brickfield, near Ball's Pond Church, Islington, and performed the work admirably "

Societies and Academies

London

Royal Society (*Proc* A 168 441 589, 1938).

R M **Lewis** and C N **Hinshelwood** The thermal decomposition of nitrous oxide

B F J **Schonland** D J **Malan** and H **Collens** Progressive lightning (6)

H A **Jahn** A new Coriolis perturbation in the methane spectrum (1) Vibrational rotational Hamiltonian and wave functions (2) Energy levels

N **Arley** On the theory of coincidence experiments on cosmic rays

R **Eisenschitz** The specific heat of β brass

N **Feather** and J V **Dunworth** A further study of the problem of nuclear isomerism the application of the method of coincidence counting to the investigation of the γ rays emitted by uranium Z and the radioactive silver Ag^{106}

Paris

Academy of Sciences (*C R* 207 881 948 Nov 14 1938)

L **Cayeux** The problem of the ancient port of Tyre studied in the light of petrography Petrographic examination of material brought up from the roadstead confirms the results of air and other photographs that the ancients were able to undertake submarine construction

A **Chevalier** Improvement in the production and quality of French colonial coffees

G **Calugareano** Invariants of extension of regular *fonctions analytiques à l infini*

L **Hibbert** Curves of equal modulus of *fonctions entières*

L **Reingold** Calculation of the theoretical mean combustion temperature and the corresponding pressure

D **Barbier** D **Chalonge**, E **Schahmanèche** and **Mlle** N **Morguleff** The Balmer discontinuity in the spectrum of supergiant stars of types *B*, *A*, *F*

V **Frolow** Mareographs of the United States facts and hypotheses

R **Lucas** Thermal expansion of liquids

L **Quevron** An integrator of radiant energy

P **Barchewitz** and M **Parodi** Absorption spectra of mono substituents of benzene in the distant infra red, from 180 to 600 cm^{-1} (17–55 μ)

M **Servigne** Infra red emission in the luminescence of some rare elements Substances in solid solution in calcium tungstate have been examined

P **Auger** Study of large cosmic ray showers at an altitude of 3,500 m They behave as showers caused after their entry into the atmosphere by electrons of energy exceeding 10^{13} ev and containing a component capable of traversing more than 10 cm of lead

J **Solomon** Statistical theory of nuclei

V **Dolejšek**, J **Bačkovský** and J **Faus** Hyperfine structure of X rays

R **Audubert** Application of the Debye Huckel theory to the estimation of a solution of mastic

H **Moureu** and G **Wetroff** Formation and polymerization of the radical phosphonitrile, PN.

M **Tiffeneau** and **Mlle** B **Tchoubar** Action of magnesium halides in the state of etherates on aliphatic, aromatic and cyclic 'oxides'

Y Deux Isomerization of the oxide of dimethyl vinylethylene to dimethyl 2 2 butene 3 al migration of the vinyl radical

J Hoch Substances showing a female sex hormone effect, synthesis of two oxocyclopenteno 1 2 phenanthrenes

A Meyer and H Drutel Formation of colouring matters of the isocyanine group by intermolecular condensation of 4 chloroquinaldines

G Vavon and P Montheard Velocity of formation of oximes phenylhydrazones and semicarbazones of the phenol aldehydes

A Bersier Eolian traces of the pre Molassian in the primary sediments of the Swiss Molasse

J Legrand Causes of the long period oscillations of the mean annual sea level at Brest and on the coasts of the North Sea

Mlle A Pereau Annual component of the levels of the Nile

L Berthois Influence of currents in marine deposits

M Chadefaud Pyrenoids of Algae

R Fontaine, R Guillemet P Mandel and P Branzeu Aspects of nitrogen consumption in experimental intestinal occlusion in the dog

Ach Urbain, R Cahen Mlle M A Pasquier and J Nouvel Action of zinc on the effects of testosterone and of prolans Zinc increases the gonadotropic effect of these substances

J Chaussin and L Lescœur Physico chemical study of the nychthemerous fraction of the urinary elimination in a diabetic

R Engeland and A Bastian Contribution to our knowledge of elastoidine

J Roche and Mlle F Bullinger Phosphatases of the osseous system of fishes (selachians and teleosteans) All the bones, teeth and scales examined contained phosphomonoesterase A_1 identical with that of the skeleton of mammals and birds The permanence of the cartilaginous skeleton of selachians is not due to absence of this phosphatase but to its mode of distribution

Amsterdam

Royal Netherlands Academy (*Proc*, 41 No 8, 1938)

E Cohen and W A T Cohen de Meester Acute tin plague (3) Extremely small amounts of magnesium added to purest tin produce acute tin plague, that is, greatly increase the rate of transformation of white into grey tin Traces of bismuth have the opposite effect

W van der Woude and J J Dronkers Rectilinear congruences in the three dimensional projective space built up of quadratic reguli

H Warren, D Kuenen and L G M Baas Becking On the relation between internal and external media in *Artemia salina* (L) var *principalis* Simon The NaCl content of the blood of this phyllopod can account quantitatively for its osmotic properties, and there are indications that regulation is effected by means of excretion or uptake of water

C S Meyer Contributions to the theory of Whittaker functions (3)

A F Monna Theory of curves in Hilbert space

W F H M Mommaerts. Some chemical properties of the plastid granum In the phyllochlorin of a grana-suspension the ratio protein units to porphin nuclei is 1 1 as is the case in other conjugated proteins of great biochemical importance

M F I Nicolai and C Weurman Some properties of chlorophyll multifilms A study of Langmuir Blodgett films formed by spreading chlorophyll on protein or lecithin layers

I C Bursch I I Florschütz and I M van der Vlerk An early palæolithic site on the Northern Veluwe (Holland) The artefacts found near Wezep and the geological and archæological evidence of their age

A N Burkitt External morphology of the brain of *Notoryctes typhlops*

Cracow

Polish Academy of Sciences and Letters (*C R* Oct 3, 1938)

Th Banachiewicz Method of numerical resolution of linear equations of the calculus of determinants of the inverses and of the reduction of quadratic forms

M Wierzbicki Dielectric constants of some univalent electrolytes at different temperatures

K Dziewonski I Chomik and M Książek Compounds derived from α, β dinaphtho γ pyrone

K Dziewonski and L Cholewa Syntheses of compounds of the type of 2 phenyl 3',4' 2 3 quinolino quinoline

Szarski Vascularization of the thymus in some Urodeles

(*C R*, Nov 7, 1938)

Th Banachiewicz Chio's law, Cracovians and matrices

I Nayder and I Piech Refraction and dispersion of liquid phosphorus

S Dobinski and A Jagielski Adsorption in the solid state In certain alloys, the components with lowest superficial pressure condense on the surface

E Kurzyniec Variation of the electric resistance at low temperatures of (1) alloys of tin and zinc, (2) alloys of lead and antimony At the temperature of liquid hydrogen and liquid nitrogen, the ratio R_t/R_0 increases rapidly with increase of zinc, reaching a maximum at 1 2 atomic per cent of zinc and then decreases almost linearly to the value for pure zinc For lead antimony alloys, the ratio increases rapidly for minute additions of lead

M Blumenthal Action of water vapour on amalgamated aluminium A crystalline modification of aluminium hydroxide is obtained The reaction can be explained by the theory of adsorption and active centres

M Blumenthal and Z Sotirow Thermal dissociation of cerium carbonate

S Kulczynski Peat bogs of Polesia Eighteen types are differentiated by their floristic, hydrological and biological characteristics

T A Bochenski Frutification cones of Sigillarians and their mode of insertion on the trunks The cones of the 'oil' fossils studied carry either megaspores (1 6 mm diameter) or microspores (0 05 mm diameter), but not both

Grodziński Cytological researches on the yolk of chicken's egg under normal and experimental conditions

Forthcoming Events

[Meeting marked with an asterisk is open to the public]

Monday, December 12

ROYAL GEOGRAPHICAL SOCIETY at 8 30 Dr Hugh Scott 'A Journey to the Yemen

Tuesday, December 13

ROYAL ANTHROPOLOGICAL INSTITUTE (in the rooms of the Royal Society), at 8 30 Dr D F Thomson Survey of Arnhem Land'

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W C 1), at 8 30 W G Templeman 'Plant Growth Hormones and their Uses', illustrated by lantern slides

CHADWICK PUBLIC LECTURE (at the London School of Hygiene and Tropical Medicine), at 5 30 – Leonard Colebrook 'The Control of Puerperal Fever' *

Wednesday, December 14

INSTITUTION OF CIVIL ENGINEERS, at 6 30 —W A Tookey Dugald Clerk and the Gas Engine his Life and Work' (Dugald Clerk Lecture Students' meeting)

Thursday, December 15

ROYAL METEOROLOGICAL SOCIETY (at the Gaumont British Theatre, Film House Wardour Street W 1) at 5 —Sound films Fog" and Ice Formation to be followed by discussion

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 Sir Humphry Rolleston The Early History of Morbid Anatomy' (Thomas Vicary Lecture)

LONDON MATHEMATICAL SOCIETY (at the Royal Society, Burlington House, Piccadilly W 1), at 5 Dr D H Lehmer 'The Computational Side of the Theory of Numbers"

CHEMICAL SOCIETY (at the Royal Institution), at 6 — Dr Irving Langmuir, For Mem R S Monolayers on Solids" (Faraday Lecture)

Friday, December 16

SOCIETY OF CHEMICAL INDUSTRY (LIVERPOOL SECTION) at 6 —W A S Calder "Why a Chemist ?" (Hunter Memorial Lecture)

ROYAL INSTITUTION, at 9 Dr John Thomas Josiah Wedgwood and his Portraits of 18th Century Men of Science

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned

SCIENTIFIC OFFICER in the Chemical Defence Research Department of the War Department 14 Grosvenor Gardens, S W 1—The Chief Superintendent (December 12)

ASSISTANT (grade II) for library and publications work in the Building Research Station—The Establishment Officer Department of Scientific and Industrial Research 16 Old Queen Street, Westminster S W 1 (December 13)

SCIENTIFIC OFFICER (physics and/or mathematics) at the Royal Aircraft Establishment South Farnborough Hants—The Chief Superintendent (Ref 264 O December 16)

ASSISTANT (grade II) in the Meteorological Office—The Under Secretary of State (S 2 B Met) Air Ministry, Adastral House Kingsway W C 2 (December 17)

RESEARCH CHEMIST in the Department of Clinical Investigation and Research Manchester Royal Infirmary—The Director (December 23)

CHEMIST in the Admiralty Chemical Pool—The Secretary of the Admiralty (C L Branch) (quote Ref C E 10493/38 December 23)

LECTURERS IN BIOLOGY GEOLOGY AND GEOGRAPHY AND CHEMISTRY at the New England University College Armidale Australia—The Registrar, The University Sydney (December 31)

SENIOR LECTURER IN MATHEMATICS in the Lester School and Henry Lester Institute of Technical Education Shanghai—Messrs Viney Price and Goodyear Empire House St Martin's le Grand, London, E C 1 (January 12)

ASSISTANT IN THE INTELLIGENCE SECTION in the Mineral Resources Department of the Imperial Institute—The Establishment Officer

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

North of Scotland College of Agriculture Report on the Work of the North of Scotland College for the Year 1937 38 Pp 42 (Aberdeen North of Scotland College of Agriculture) [1411

University College of North Wales Calendar for Session 1938–39 Pp 440 (Bangor University College of North Wales) [1611

Publications of the International Tin Research and Development Council No 80 Flux Inclusions in Hot Dipped Tin Coatings By Paul Rocquet Pp 10 +4 plates Free No 81 The Effect of Small Additions of Tellurium on the Mechanical Properties of Pure Tin By Prof D Hanson and Dr W T Pell Walpole Pp 16 Free (London International Tin Research and Development Council) [2111

Ministry of Agriculture and Fisheries Agricultural Statistics 1936 Vol 71 Part 2 An Analysis of Agricultural Production Prices and Supplies in England and Wales Pp ii +113 254 (London H M Stationery Office) 2*s* 6*d* net [2111

Other Countries

Smithsonian Institution Bureau of American Ethnology Bulletin 119 Anthropological Papers Pp ix +204 +12 plates (Washington, D C Government Printing Office) 40 cents [1211

Advisory Committee on Education Staff Study No 9 Vocational Rehabilitation of the Physically Disabled By Lloyd E Blauch Pp ix +101 (Washington, D C Government Printing Office) 15 cents [1211

Svenska Hydrografisk Biologiska Kommissionens Fyrskeppsundersokning År 1934 Pp 46 År 1935 Pp 46 (Goteborg Elanders Boktryckeri A B) [1411

Meddelanden från Goteborgs Hogskolas Oceanografiska Institution 13 Measurements of Submarine Daylight By Hans Pettersson and Horace H Poole With an Appendix On the Standardisation of Photoelectric Cells by means of Sun Radiation By Anders Angström Pp 34 (Goteborg Elanders Boktryckeri A B) [1411

Alcool motor e motores a explosão Por Eduardo Sabino de Oliveira Pp 356 (São Paulo Instituto de Technologia) [1411

Advisory Committee on Education Staff Study No 15 Public Education in the District of Columbia By Lloyd E Blauch and J Orin Powers Pp x +99 (Washington D C Government Printing Office) 20 cents [1611

U S Department of the Interior Office of Education Bulletin 1938 No 4 School Use of Visual Aids By Cline M Koon Pp viii +8 10 cents Bulletin 1938 No 8 The Elementary School Principalship Some Aspects of its Development and Status By Bess Goodykoontz and Jessie A Lane Pp v +43 10 cents Bulletin 1938 No 9 College Projects for Aiding Students By Fred J Kelly and Ella B Ratcliffe Pp v +69 10 cents (Washington D C Government Printing Office) [1611

University of California Publications in Zoology Vol 42 No 3 The Pterylosis of the Falconiformes with Special Attention to the Taxonomic Position of the Osprey By Lawrence V Compton Pp iii +173 212 50 cents Vol 42 No 5 Territory Annual Cycle and Numbers in a Population of Wren Tits (*Chamaea fasciata*) By Mary M Erikson Pp iii +247 334 +plates 9 14 1 25 dollars (Berkeley Calif University of California Press London Cambridge University Press) [1611

Proceedings of the United States National Museum Vol 86, No 3041 Revision of the North American Beetles of the Staphylinid Subfamily Tachyporinae Part 2 Genus Coproporus Kraatz By Richard E Blackwelder Pp 10 (Washington D C Government Printing Office) [1611

Journal of the Indian Institute of Science Vol 21A Part 24 Hydrogenation of Oils by the Continuous Process Part 2 Hydrogenation of Cottonseed and Olive Oils by Nickel Carbonate —Kieselguhr Catalyst By V T Athavale and S K K Jatkar Pp 285 294 (Bangalore Indian Institute of Science) 14 annas [2111

Report of the Aeronautical Research Institute Tôkyô Imperial University No 168 Buckling of a Cage form Cylinder under Axial Compression By Katsutada Sezawa and Masami Murakami Pp 425 452 45 sen No 169 On the Corrections to the Measured Take Off Run By Hidemasa Kimura Pp 453 472 35 sen (Tôkyô Kôgyô Tosho Kabushiki Kaisha) [2111

Catalogues, etc.

Natural History Book Catalogue Botany Conchology, Entomology Geology Ornithology, etc (No 275) Pp 44 (London Dulau and Co Ltd)

Hormone Therapy (No 4) Pp 54 (London Organon Laboratories)

Zeiss Nachrichten Folge 2 Heft 6, Juni 1938 Pp 183–222 (Jena and London Carl Zeiss)

*p*H Values What they Are and How to Determine Them By T Tusting Cocking Fifth edition revised and enlarged Pp 32 (London The British Drug Houses, Ltd)

Anthropology and Folklore, Archæology and Kindred Subjects with a Section on Linguistics (Catalogue No 633) Pp 54 (London Francis Edwards, Ltd)

Bücher Anzeiger Nr 172 Pp 64 (Leipzig Gustav Fock, G m b H)

Catalogue of Optical Projection Apparatus Part 2 Science and Colour Process Lanterns Projection Microscopes, Polariscopes, etc Pp 24 (London Newton and Co)

Science and Medicine (List 31) Pp 36 (London E P Goldschmidt and Co Ltd)

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Vol 142 SATURDAY DECEMBER 17 1938 No 3607

Science and Learning in Distress

In the early summer of 1933 the Academic Assistance Council was founded under the presidency of Lord Rutherford and with the active support of many distinguished men of science and other scholars to find places in the fabric of world science and world scholarship for men and women driven from their countries and their work for racial religious or political reasons Such persecution was not new even in the very recent past it had happened again and again in Russia and was still happening but the scale of its application in Germany and the distinction of its victims demanded immediate help The Academic Assistance Council had no partisan political or national bias Indiscriminate relief was to be no part of its work Its purpose was to act as a link between the scientific workers and other scholars displaced and the universities and research institutions of the world so that their exceptional abilities exceptionally trained—to quote the noble declaration of the Council's founders—should not be lost

It was hoped that the emergency would pass but as the years went on intolerance and persecution grew no end was in sight The Academic Assistance Council took permanent shape therefore as the Society for the Protection of Science and Learning its wider purpose was now to act as a clearing house of information and advice to exiled scholars and to persons institutions and departments desiring to help them its narrower purpose—within the limits of its resources—to offer temporary maintenance grants and other aids to re establishment The spread of racial doctrine to Italy the consequences in Austria and Czechoslovakia of the political events of 1938 and their reactions in neighbouring countries the continuation of civil war in Spain the extreme xenophobia of the U S S R and recent events in Germany all these have added to the need for information and advice on one hand for direct assistance on the other When a ship is in distress no sailor and few landsmen will not want to go to its help

The Society has just issued its annual report from which it appears that a widespread appeal is shortly to be issued for funds on one hand for interest and sympathy through membership on the other The problem has been complicated and enlarged by the events of 1938 but the Society has not turned aside from its original purpose and principles It exists not to advertise a particular point of view but to do an honest job of work in seeing that ability and experience in science and scholarship are not wasted It does not it cannot disregard human values but its charity is devoted to those who can contribute to the common stock of learning It stands for the brotherhood of scientific endeavour regardless of race and creed and politics and it stands for it not by passing pious resolutions or by putting out disguised political propaganda but by trying to help colleagues in their need Foreign scientific workers are found work which restores their self respect and makes others realize their value in their common task so that not seldom they become self supporting From the start however the Society has done its best to avoid any unfair competition of exiled scientific workers and other scholars with those in the countries where they are seeking refuge and has realized and urged that in the long run such competition is as little in the interest of the exiles as in that of scientific workers as a whole

The Society must maintain its authority and integrity in the face of its increasing task In Germany alone fourteen hundred university teachers and research workers have been displaced many of them among the most distinguished in the world not merely debarred from teaching and research they are not allowed to make a living at all More than four hundred Austrian men of science and other students have been displaced and of these only about a hundred have been able to leave the country The full effects of the racial policy in Italy and of the partition of Czechoslovakia have yet to be felt Spain from which scholars of both parties have been helped is still no place for tolerant sensitive academic people and the U S S R has disappointed our hopes by turning out those who originally found work and refuge there

Caution in the circumstances must often seem intolerable to humane men but the Society's stringent caution in accepting responsibility bears fruit Work has been found permanently for about 550 scholars in thirty eight different countries from Australia to Venezuela for about 330 temporarily in twenty five countries Turkey which is building a new civilization has welcomed numbers of the displaced university men

In November 1937 the Society called an informal conference at Oxford of representatives of European universities and the ideal of an international exchange for information and employment came nearer to realization The Society's register of exiled scholars is now unique authoritative and international Any academic or research institution can have the benefit of its records of those exceptional abilities exceptionally trained lost to their own countries but not if the Society can prevent it to the service of knowledge anywhere else in the world

Funds and interest are however an imperative need first for the work of administration information and advice secondly for direct help in human emergency It is to be hoped that the wider educated public particularly in the English speaking countries will respond generously to the appeal for support which the Society is making and come to the help of science and learning in distress

Serialism and Immortality

The New Immortality
By J W Dunne Pp 157 (London Faber and Faber Ltd, 1938) 3*s* 6*d* net

THIS little book is intended to supply the general reader with a more or less popular account of the theories about time and the self which Mr Dunne has developed in considerable detail in his previous works An Experiment with Time and The Serial Universe Mr Dunne thinks that these theories are entailed by certain quite general facts about time and change on one hand and about self consciousness on the other The former reduce to the linguistic fact that we talk of future events as becoming real or 'coming into existence of past events as having ceased to be real or having passed out of existence, and so on The latter reduce to the linguistic fact that each of us uses expressions like my self and your self which seem to imply in the case of each of us the existence of an owned self and an owning self and an I which knows them both and sees that the one owns the other

Mr Dunne assimilates this latter distinction with another about which he makes much ado This is the distinction between a recording instrument for example a magnetometer a body which influences it in virtue of one of its properties for example a magnet and the reading which the instrument records when thus influenced Mr Dunne thinks that we are liable to confuse the reading of the instrument with the agent which causes the instrument to record this reading and that many important consequences follow on which the distinction throws a flood of light I find it hard to believe that anyone except an extremely eminent mathematical physicist engaged in writing extremely bad philosophy ever would make such a gross mistake

Taking these linguistic expressions literally and seriously Mr Dunne quite correctly infers that he is committed to an endless series of times and an endless series of observers He also infers that each term in the series of times reduces all the previous terms to additional dimensions of *space* Time would be the last term of a series which from the nature of the case would have no last term This appears to me to be a plain *reductio ad absurdum* of Mr Dunne s theory He disguises it from himself by talking airily about the observer at infinity and by palpably false analogies with infinite series which have upper limits

Mr Dunne thinks that his theory is supported by certain empirical facts about dreams He also claims to show that the characteristic features of the special theory of relativity and the quantum theory are necessary consequences of his serial theory I have never been able to follow this deduction even in the full exposition of it in The Serial Universe , one part of it appears to depend on a juggle with the square root of minus one based on a misapplication of Argand s diagram I should think that the condensed form of it in the present work would be completely unintelligible to all readers

The main object of this book is to expound and illustrate a theory of immortality which is closely bound up with the serial theory of time and the self The first order observer collapses with the death of the body but the higher order observers are unaffected Although they can get no more sensory experiences they retain and can rearrange in any order they like those sensory experiences which were obtained before death by use of the first order observer Mr Dunne explains and illustrates this theory very well by analogies with music and with typewriting Even if Mr Dunne s general theory were intelligible and true he produces no cogent positive reason for holding that the higher order observers would survive the death of the body He is content to argue by what seem to me to be quite unconvincing analogies that the burden of proof lies on anyone who doubts this However this may be if the theory is self contradictory as I believe it can lend no support to any conclusion C D BROAD

Birds of Britain

The Handbook of British Birds

By H F Witherby (Editor) Rev F C R Jourdain Norman F Ticehurst and Bernard W Tucker Vol 2 (Warblers to Owls) Pp xiii + 352 + 30 plates (London H F and G Witherby 1938) 21s net

THERE are to be five volumes of the Handbook of British Birds and the second volume which has just been published deals with the warblers the thrush family wheatears whinchats and redstarts nightingale and robin hedge sparrow and wren the water ousel the swallow and the swift family the nightjar and the kingfisher the woodpeckers and the wryneck The cuckoo and its strange habits are described and there is a series of photographs of a young cuckoo in the act of throwing an egg out of the nest The latter part of this volume is given up to the owls –the snowy and the short eared owls the little owl and others

It is stated that the reception of the first volume has been most gratifying and the second volume is fully up to its high standard The illustrations are clear, and the coloured plates especially helpful A series of valuable diagrammatic maps are incorporated in the text H F Witherby has compiled three of these maps The first shows the breeding distribution in the British Isles of the reed warbler the second shows the nesting distribution of the greater spotted woodpecker and the third the breeding distribution of the little owl in Britain It is by the way of interest to know that a full inquiry has proved that this alien owl introduced in Britain during the nineteenth century is not so destructive as is generally supposed but Mr R M Lockley has shown that they work great havoc among storm petrels when they take up their quarters on islands where the petrels are nesting

Other maps in the book show the breeding distribution of the nightingale (N F Ticehurst) and the recovery in Africa of swallows ringed in Europe (L Schuz)

In an interesting map compiled by H N Southern is shown the northward migration of the swallow through Europe during spring and early summer Mr Southern has found that swallows make the northward flight from Spain to the north of Norway a distance of more than two thousand miles in about seventy seven days at a fairly steady rate The average date of the arrival of the swallow in Spain and Italy is March 15 and in the north of Scandinavia June 1 It is to be hoped that Mr Southern may later compile a similar map showing the northward migration of the swift and that he may be able to explain the late northward movement of these birds which the reviewer has seen flying northward at a great height over the Cairngorms in mid June and again passing north east over the Isle of Skye (where the swift does not nest) at the same time of year

Presumably these swifts are travelling to the most northerly limit of their breeding range

There is also in this volume a helpful chart of the song periods of British birds compiled by H G Alexander

Not the least admirable feature of these Handbooks of British Birds is their accuracy a standard difficult to attain to as new species and subspecies of birds are yearly being discovered It is a number of years since the Hebridean thrush was separated as a distinct species from the British song thrush In the Isle of Skye in the reviewer s experience the range of the Hebridean thrush is interesting In the treeless district of the north west of Skye which is only sixteen miles from the nearest of the Outer Hebrides the resident thrush appears to be the Hebridean thrush These birds are very tame and can be watched closely But in the east and south of Skye in the woods and gardens of Portree Broadford and Sleat the song thrushes appear to be an intermediate form between the British song thrush and the Hebridean song thrush

In the volume under review the song period of the Hebridean song thrush is stated to be from February until the end of June This rather under estimates the duration of song as the bird is habitually in full song during the first three weeks of July and sometimes when it nests late is heard in full song until mid August singing as is its custom from a house top or from a wall or from a patch of whins The song of the Hebridean thrush is softer and less assertive than the song of the British song thrush and the reviewer has noticed that particular phrases are less often repeated

A large immigration of thrushes not of the Hebridean form takes place each October to the north west of Skye and the birds appear to remain along with immigrant blackbirds throughout the winter

In reading the records in this book one is struck by the number of rare birds recorded from Fair Isle that small and lonely island lying in the Atlantic midway between Orkney and Shetland Here such rare British visitors as the rock thrush Eversmann s warbler red rumped swallow needled tailed swift red spotted bluethroat and white spotted bluethroat—to name only a very few—have been recorded It is seldom that an island on the track of migrating birds has an accurate observer residing on it but Mr Stout the postmaster of Fair Isle is an enthusiastic and competent ornithologist

It is necessary to say in recommending this latest volume in this practical Handbook series that it is a book which the amateur bird enthusiast as well as the expert cannot well be without if she or he is to remain up to date in bird watching and in bird lore S (

Theoretical and Practical Organic Chemistry

(1) Organic Chemistry
By Prof Frank C Whitmore Pp x + 1080 (London Chapman and Hall Ltd 1937) 40*s* net

(2) Systematic Organic Chemistry
Modern Methods of Preparation and Estimation By Prof William M Cumming Dr I Vance Hopper and Prof T Sherlock Wheeler Third edition revised by William M Cumming and I Vance Hopper Pp xxvi + 548 (London Constable and Co Ltd 1937) 25*s* net

(3) Laboratory Practice of Organic Chemistry
By Prof G Ross Robertson Pp xi + 326 (New York The Macmillan Co 1937) 10*s* net

(1) PROF WHITMORE has written a one volume reference text designed for those already possessing reasonable knowledge and experience in organic chemistry It is certainly a long time since an author has claimed to treat the whole of organic chemistry in a single volume of rather more than 1 000 pages Of the book 0 57 is given to the description of the aliphatic compounds 0 07 to the alicyclic compounds 0 17 to the aromatic compounds 0 08 to the heterocyclic compounds and 0 11 to the index which comprises no less than 122 pages This index has a character of its own under linkage for example references to twenty three different types are given It is not only an index but also a special type of dictionary of organic chemistry No organic chemist will be surprised that Prof Whitmore has been occupied during eight years in making this most readable and so far as a reviewer can test it accurate and up to date compilation

Whether the book will satisfy the majority of organic chemists would appear to be doubtful In certain directions the subject matter is adequate in others it is otherwise Only one synthesis of indigo is referred to in outline in two and a half lines alizarin and camphor are likewise summarily dealt with These are examples of isolated and fundamentally important compounds with which the author may expect his readers to be already acquainted Taking a group of compounds if the carbohydrates and glycosides can be successfully discussed in forty one pages Prof Whitmore s treatment is a model of compression

The successful learning of organic chemistry largely depends on the manner of use of original literature by the student In many cases Prof Whitmore gives references only to the name or names usually not more than two of the worker or workers whom he judges to be outstanding This is not wholly satisfactory and many will disagree with the author s opinion Probably to save space references to original literature are not given and it is interesting to know that an American author considers The Annual Reports of the Progress of Chemistry published by the Chemical Society in London worthy of repeated reference because they offer excellent summaries

Prof Whitmore s Organic Chemistry may be styled an excellent summary If this modern text book be compared with the much older and almost classical Lehrbuch der Organischen Chemie of which Victor Meyer and Paul Jacobson were the original authors many deficiencies appear and one may regret that no one seems inclined nowadays to emulate the work of these two famous chemists and those who have attempted to bring their work up to date

(2) The second volume under notice is a practical book deserving of high commendation It has a reputation of fifteen years and this is the third edition In plan and contents it is in the front rank of text books for the successful training of the students in the practical side of organic chemistry

After two chapters dealing adequately with the most general types of reactions in organic chemistry apparatus and methods including details regarding the determination of constants of pure materials and modern methods for the separation of mixtures the preparation and reactions of classified organic compounds are fully illustrated Then follows a section dealing with the electrolytic preparation of typical compounds the preparation of pure compounds from naturally occurring materials and of stereoisomeric compounds which indicates something of the comprehensive character of the practical training outlined by the authors

It would be difficult to improve on the section dealing with quantitative methods The authors fully justify the inclusion of macro micro and hemi micro methods of analysis of organic compounds and it is clear they deprecate the tendency in certain schools to omit exercises in ultimate analysis since micro methods have come into common use and are now to a great extent carried out by professional analysts It might add to the value of this section if other alternative methods of determining say bromine and chlorine were introduced in later editions

A useful list of reactions of certain important types of organic compounds and a comprehensive index complete this book which brings successfully the work of the lecture room into the laboratory It would appear that the only drawback is the omission of the year of the volume from references to original literature and specialized text books Particularly for students the year is more important than the actual volume number the use of which has now been abandoned by the Chemical Society

(3) Prof Ross Robertson s guide to practical organic chemistry is much smaller than that by Prof Cumming and his colleagues and both books are departures from the older books on the subject which are largely detailed working recipes

One third of the present volume is taken up by a critical discussion of the principles of manipulation and the elementary physical chemistry on which depends the separation of solid and liquid organic compounds from mixtures The remaining two thirds of the book is devoted to laboratory experiments on the preparation and properties of organic compounds These are not intended to be comprehensive and have been discriminately selected with the view of carrying out a limited number of typical reactions rather than a large number of those having little relationship to each other Other more comprehensive books are referred to including that by Prof Cumming and his colleagues and this portion of the book is particularly well written Each typical exercise is preceded by a theoretical statement briefly summarizing important details concerning the physical and chemical properties of the particular substance and the best conditions for realizing the reaction or reactions concerned Then follow the details of the actual preparation and the isolation of the product a list of other analogous preparations with references and finally a number of questions arising out of the methods of procedure which have been adopted in this and analogous cases

There is a brief account of the qualitative analysis and identification of certain types of organic compounds but the author has omitted any reference to their ultimate quantitative analysis This could easily be included in a subsequent edition if the author wishes to make the course he outlines even more useful than it is already for training for original investigation

The book is well printed with clear diagrams Altogether it can be recommended as a useful critical treatment of the principles of practical organic chemistry CHARLES S GIBSON

Plant Ecology

Plant Ecology
By Prof John F Weaver and Frederic E Clements Second edition (McGraw Hill Publications in the Botanical Sciences) Pp xxii+601 (London and New York McGraw Hill Book Co Inc 1938) 30*s*

THE first edition of this text book was published in 1929 with 520 pages The short preface to the new edition dated January 1938 points out in concise phrases some of the more important advances in plant ecology made in less than a decade The wide acceptance of succession is a basic principle in the study of vegetation has led to a better understanding of invasion ecesis and the stabilization of climax vegetation The use of plant species and plant communities as indicators the changed concept of xerophytism and improved methods of studying the environmental factors are among the advances which are enabling the ecologist to grasp the complex interactions of plant life Particularly important to the plant ecologist are the new conceptions of the vast importance of climate and vegetation in soil development On the applied side too plant ecological studies are making great advances Erosion largely due to man s misuse of the natural plant cover has been realized as a problem of national and international importance

Ecology suffers in its presentation from an inherent drawback which is not so evident in some other biological subjects It depends very much upon taxonomy and floras differ greatly in different parts of the world The synecologist has to name and ecologically to describe and classify the species components of the vegetation with which he is concerned It follows that much of his description can only be followed or at least fully appreciated by biologists familiar with the local flora

In text books the general principles have to be exemplified by reference to plants the very names of which may be new to foreign readers many of whom will certainly have no personal acquaintance with the plants themselves An ecological text book has therefore its greatest value in one country that from which the author takes his examples The authors of the work here reviewed take the vast majority of their examples from North American vegetation While it is true that they have not overburdened their text with plant names and illustrate the book freely with photographs and other reproductions most of the species mentioned and a fair proportion of the genera will be unknown to most British readers Differences of size climate physiography and economic history between the United States and the British Isles also hinder this book from being an ideal text book for use in the latter On the other hand the enthusiasm of the authors for their subject the very full statement of general principles and the comprehensive bibliography (of 1035 references) must make the work extremely valuable for reference It is so far as Great Britain is concerned a book for the teacher rather than for the school or college student and as such it can be heartily recommended W B TURRILL

Iris Patterns and their Inheritance

Structural Variations of the Human Iris and their Heredity
with Special Reference to the Frontal Boundary Layer By Dr Viggo Eskelund Pp 243 (Copenhagen Nyt Nordisk Forlag Arnold Busch London H K Lewis and Co Ltd 1938) 21*s* net

THE laws of inheritance of blood groups and types are now so well established that in certain cases paternity can be definitely excluded Dr Eskelund believes that the various patterns of iris found in man could also be classified on an hereditary basis and eventually perhaps provide equally good or even better evidence of paternity

In a laborious study of photographs of the living iris in 154 subjects conducted under the auspices of the P Carl Petersen Foundation at the University of Copenhagen he has arrived at certain preliminary conclusions which will interest without convincing most of his readers He holds that iris pattern can be definitely classified into types To achieve this one must take the anatomical conditions of the various regions (for example anterior and posterior layers of the stroma uveal border presence or absence of crypts depth of colour and distribution of chromatophores etc) and arrange them under headings of combinations of variables

The author s description of the various types is rendered slightly difficult for English readers by the use of an unusual terminology For example his frontal boundary layer is what we are accustomed to call the anterior layer and his scratches are small crypts The photographs are beautifully reproduced but it would be easier to follow the suggested classification if Dr Eskelund had used a higher magnification in examining the eye before photographing it It also seems doubtful whether he has described anything like the possible number of types There seems for example to be little or no reference to racial differences which are often great or to the effects of racial interbreeding

It will certainly be generally admitted that there is some hereditary factor influencing iris pattern Indeed this has been shown already by the work at the Galton Laboratory on both normal and pathological irides in man and animals To what extent however reliance can be placed on a classification necessarily rough to subserve any medico legal purpose is uncertain It is probable that iris pattern is as individualistic as finger print pattern and it might prove to have an even greater identification value since it cannot be obliterated Its value in proving heredity must however remain doubtful until many more pedigrees of several generations have been examined in different races

Fossil Gastropods

Handbuch der Palaozoologie
Herausgegeben von O H Schindewolf Band 6
Gastropoda Lieferung 1 Teil 1 Allgemeiner Teil und Prosobranchia Pp viii + 240 (Berlin Gebruder Borntraeger 1938) 45 gold marks

ALTHOUGH students of most nationalities are now well provided with text books of palæontology no comprehensive work of reference giving a complete survey of existing knowledge of the subject has appeared since the publication of Zittel s famous Handbuch der Palæontologie (1876 1893) To remedy this deficiency a new Handbuch (a term the connotation of which appears to have undergone a process of evolution) is now in course of preparation under the general editorship of Prof O H Schindewolf The collaboration of nearly fifty specialists belonging to several nationalities has been secured for this work which it is proposed to publish in twenty volumes the majority of which will consist of several *Lieferungen* The appearance of the first part of this huge undertaking is thus an event of some importance to palæontologists

The author Dr W Wenz is well known as an authority on the Cainozoic non marine Gastropoda and the compiler of the very substantial section of the Fossilium Catalogus which deals with this group Even for such an indefatigable worker the preparation within a few years of a treatise defining and classifying every recognized genus and subgenus of the Gastropoda from the Cambrian faunas to those of the present day must have been no mean task It is true that M Cossmann s Essais de Paléoconchologie Comparée (1895–1925) not quite completed owing to its author s premature death has to some extent paved the way for this work by assembling an enormous quantity of data concerning the range and distribution of the various groups and by giving good descriptions and figures of genotypes So far as the Palæozoic genera (with which the present part mainly deals) are concerned however Dr Wenz does not appear to have been much influenced by the ideas on classification advanced by his predecessor

The general scheme of classification adopted is that given in J Thiele s Handbuch der systematischen Weichtierkunde (1929 1935) which is likely to remain the standard work of reference on the Recent Mollusca for some time to come Except for a series of introductory chapters which include a useful review of modern ideas on gastropod phylogeny the present part deals entirely with the Archæogastropoda the first of the three orders into which the subclass Prosobranchia is divided Much of the detailed classification proposed is certainly new a great part no doubt is merely tentative in view of the dissimilarity of many of the groups dealt with to Recent forms of known anatomical characters It would have been preferable if the author had indicated which families are erected for the first time

In matters of nomenclature this work appears to conform strictly with the International Rules and no attempt has been made to perpetuate obsolete names by the arbitrary selection of *nomina conservanda* The wise decision has been made to dispense with the section as a taxonomic group subsidiary to the subgenus Well printed text illustrations almost entirely copied from pre existing works illustrate the most important genera

The Genus Youngia

By Ernest B. Babcock and G. Ledyard Stebbins, Jr. (Publication 484.) Pp. iii+106+5 plates. (Washington, D.C.: Carnegie Institution of Washington, 1937.) n.p.

THE genus *Youngia* was described more than a century ago by Cassini, but the characters on which the genus was based did not preclude the inclusion within it of species of several allied genera of the *Cichorieæ*, and Cassini's species have long been merged in the genus *Crepis*. During his long study of the taxonomy and genetics of the latter genus Prof. Babcock has repeatedly come in contact with certain Asiatic species invariably included in the genus *Crepis* which appeared generically distinct. For the reception of these species the genus *Youngia* has been re-established and redefined.

Twenty-seven species, six of which are newly described, are included in the re-established genus which is divided into six sections. The species mainly inhabit China with extensions westwards to Ceylon, Kashmir and the Pamir-Altai cordillera and eastwards to Formosa and Japan. The monographic treatment includes discussions of the interrelationships of the sections and of the species within the sections, whilst admirably clear illustrations are given of all the species and subspecies. Two of the more widely distributed and polymorphic species which have been studied genetically show that variability is associated with polyploidy and parthenogenesis probably resulting from hybridization. This has led the authors to refrain from naming lesser variant forms which are merely listed by number after the appropriate species. The major subspecific entities receive names but their citation as trinomials is to be regretted. The comparative scarcity of herbarium material consequent upon the remoteness of the localities at which many species occur will certainly lead to future additions to, and perhaps modifications of, the authors' arrangement; yet the work will remain of lasting value in having for the first time brought together and clarified the relationships of a group of species the previous systematic treatment of which has been unsatisfactory. W. A. S.

Modern Methods of Refining Lubricating Oils

By Vladimir A. Kalichevsky. (American Chemical Society Monograph Series.) Pp. 235. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1938.) 30s. net.

IN the United States, the older cruder methods of refining are fast becoming obsolete and are being everywhere replaced by solvent processes, which have the great merit of removing the unsatisfactory asphaltic constituents generally termed naphthenics. In addition, the systematic use of additives for improving certain particular characteristics is beginning to become of commercial importance. The time is ripe for the description and discussion of these new methods of refining and the general principles which underlie them: it is now provided in handy book form by Mr. V. A. Kalichevsky, as one of the well-known American Chemical Society series of monographs.

The solvent refining processes represent a great advance in chemical engineering and are characterized indeed by considerable daring as, for example, in the use of liquid propane as a solvent. They are continuous and even involve the use of two solvents which carry the separated constituents of the crude oil in opposite directions.

Besides removing the asphaltic constituents, a second separate solvent treatment is used to remove the high melting waxes so that the final products are straw coloured fluid oils which do not thicken even at the low temperatures experienced in high flying.

The book tells the full story in a practical manner and should be welcomed by a large number of those engaged in the lubricating industry. E. F. A.

The Children's Play Centre

its Psychological Value and its Place in the Training of Teachers. By D. E. M. Gardner. (Contributions to Modern Education.) Pp. xv+143. (London: Methuen and Co., Ltd., 1937.) 3s. 6d. net.

WE refer to this book not so much because of its detailed account of the working of a play centre, a subject which is somewhat outside our province, as because we think it exemplifies a really scientific approach to the problems of child study. As Dr. Susan Isaacs points out in her foreword, young teachers find it difficult to connect the generalizations of their text-books of psychology with their own experience, or with the actual children they have to face in the schools. In fact, they begin at the wrong end. They are led to disobey the accepted rules of pedagogic and of scientific method. From this mistake the play centre, where children can be observed under the most natural conditions, provides a way of escape. Let the young teacher begin there and the text-books will convey far more meaning than they usually do at present.

The Observer's Book of British Wild Animals

Compiled by W. J. Stokoe. Pp. 224. (London: Frederick Warne and Co., Ltd., 1938.) 2s. 6d. net.

THIS is the fifth of a series of handy pocket books (see also NATURE, 141, 351, 1938), one of their merits being that they actually are pocket books, 5½ in. by 3½ in., and therefore convenient to carry on nature rambles. In this volume, sixty-nine species of British animals are described, and the text is illustrated by seventy-two illustrations, forty-six of which are in colour. Naturally, most of the book is devoted to mammals, but the few British reptiles and amphibians are also described. The term 'animals' in the title is used in the common, but erroneous, sense. However, so far, birds and butterflies have been dealt with in previous volumes. Thus, the present volume concludes in this series consideration of all terrestrial vertebrates. To those interested in the natural history of the countryside, this "Observer's Pocket Series" can be strongly recommended.

Cultural Contacts of Science*

By Sir Richard Gregory, Bart., F.R S.

IN the study of man and his activities three types of cultural development may be recognized and they are all measured by different standards In the Fine Arts the imaginative qualities of the mind appeal primarily to the emotions through stimulation of the æsthetic judgment material culture is the province of mechanical arts and science—the domain of reason—is systematic and formulated knowledge in all fields of human understanding—natural moral social and political Natural science or natural philosophy is only one division of science as thus defined The history of civilization is a history of intellectual development in which science has been the chief factor in changing habits of thought from superficial observation and speculative and anthropomorphic theories of causation to clear concepts rational conclusions and progressive principles in the advancement of man and society

In the most primitive times man had to acquire knowledge of the world of Nature around him in order to survive The effort to secure the food and shelter necessary for his existence demanded a never ceasing exploitation of the resources of his environment for the progressive improvement of his material equipment—an equipment which he learned to turn against his fellow man no less than against the animal world upon which he preyed for food and clothing or against which he must defend himself But in this struggle even more than on his personal prowess his skill and his knowledge of the habits of food plant and animal man relied upon his imagined understanding of and his supposed power to control the hidden causes of the nature and behaviour of the beings and objects of his world—in other words his will to survive was rooted in magic Though the magical beliefs of primitive man may seem to us vain and crude let us not despise them for in these blind gropings to probe causation in Nature we may see the remote and humble beginnings of the urge to the understanding of the universe which is science

It is not, however with man s progress in relation to material development with which we are now concerned but with the contacts of science with what is known as polite' learning—literature religion, and other expressions of the human spirit The noblest aims of man are not represented by great industrial advances but by the search for the truths upon which they are based and by the influence of this effort upon personal and social ethics These intellectual or spiritual associations of science were more common in former times than now when we are passing through or perhaps as it may be just emerging from a materialistic age in which they tend generally to be neglected

The Fine Arts and literature are usually confined to the expression of what are understood to be the eternal verities of life and so long as this is so though their form of expression may change a supreme standard of excellence may be reached in any epoch In the fourth and fifth centuries before the Christian era the works produced by the artistic and literary genius of the Greeks are masterpieces which will command admiration for all time and ancient Rome India and China have each had a golden age of artistic and literary achievement Similarly in western Europe architecture painting and poetry have reached the highest level of excellence at various epochs and then suffered a decline Apart from the development of technical excellence progress in any of these arts of expression can only be in the elaboration and enrichment of creative ideas but the store of these is not thereby increased and each age—each type of civilization—must work out its own ideals Artists may aspire to emulate the paintings of Raphael or Leonardo da Vinci but they cannot use the works themselves as a background upon which to add their own conceptions

Science however differs from the Fine Arts in the fact that every discovery extends the boundaries of knowledge and may be the starting point of further progress It was upon the foundations laid by Kepler and Galileo that Newton was able to construct the universal law of gravitation and it is by the succession of such discoveries that science advances while the picture it presents is continually being enlarged and having new details added to it The time may come when art and literature will be moved by such achievements of the human mind to make manifest their real meaning and the imagination will be so quickened by the spirit of man reaching out to the stars that artistic and literary response to the beauty and mystery of Nature will be deeper than ever before

Associations of science with literature in former times are chiefly connected with astronomy—the oldest of the sciences and the one most closely united with spiritual feeling. At the beginning of the history of civilization, the sun and moon were given divine attributes as well as used to mark the times of operations of life in days, months and years. Five thousand years ago, the Babylonians and Egyptians possessed a considerable store of knowledge of the skies. The constructions of the great temples and pyramids of Egypt, as described in preserved records, and shown in existing remains, are of particular astronomical interest as well as for the study of mythology and religious belief. One of the most impressive structures of this kind, the remains of which still exist, is the great temple of Amon Ra at Karnak, near Luxor, the length of which is about five hundred yards with the open end pointing in the direction of the setting sun at the summer solstice. The rising of the star Sirius—the brightest in the heavens—just before the sun in July of each year heralds the annual inundation of the Nile and was used by early Egyptians to mark the beginning of a new year.

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* Outline of the Elihu Root Lecture delivered at the Carnegie Institution of Washington on December 8 and to be published by the Institution in book form

Observations of groups of stars seen just above the sun at dawn or at twilight were associated with seasons and other events on the earth in very early times. The groups were figures on a celestial dial, and the sun took a year to pass round the complete circle of the heavens upon which they were fixed. The division of the circuit into twelve parts or signs made up the Zodiac as recognized and used for religious and seasonal observances by the Chaldeans, the Chinese, the Egyptians, Hindus, Persians, Greeks, Romans, and other peoples. The twelve signs or constellations of the Zodiac seem to be referred to in Joseph's second dream and in Jacob's blessings of his children.

The sun as the source of all heat, light and life on the earth was the central object of religious belief of most early peoples. Whether it was worshipped as the god itself or as his symbol even by the priests, is doubtful; but for a short period in the history of Egypt about thirteen hundred years before the Christian era, King Akhnaton, or Akh-en-Aten—signifying "The Blessed of the Disk"—the Sun god was certainly worshipped as the one and only god, and the belief was, therefore, monotheistic. The finest expression in Egyptian literature is found in Akhnaton's "Hymn to the Sun Disk". Similar hymns are found in the "Rig-veda", one of the four sacred books of the Hindu scriptures, where light is associated with moral and intellectual values, as well as with physical properties.

Astronomy was thus studied by early peoples not only for practical purposes but also for religious observances. The gods or natural forces which determined the movements of celestial bodies were regarded as also ruling human nature. Astronomy and astrology were then combined in a single study. In the sixth century before the Christian era, Greek philosophers separated the conceptions of the influence of gods from the study of impersonal Nature, the laws of which were discoverable by the proper and methodical application of the human intellect. They first introduced the word φυσις, denoting *Nature*, to signify natural philosophy as apart from theology and mythology. The Hebrews also made a distinction between the worship of God and His works; but they saw all things as testimonies to the wisdom and power of the Almighty—as subjects of wonder and spiritual exaltation rather than as matters of intellectual inquiry.

There are many references to astronomical objects and phenomena in classical Greek literature from the sixth century B.C. onwards. The earliest Greek work on astronomy is that of Eudoxus transmitted in verse by Aratus—third century B.C.—who mentions forty-four constellations. A commentary upon their works was written by Hipparchus, who was as great an astronomer as Aratus was a poet. Ptolemy (A.D. 100–178), who was the definitive authority on astronomy of the ancient world, enumerates forty-eight constellations; and these with few changes, are still used by astronomers to mark the grouping of stars in the sky.

Aratus's astronomical poem was esteemed by both Christian and pagan philosophers. When the Apostle Paul spoke to men of Athens on Mars' Hill he referred to Aratus when he remarked "as certain also of your poets have said: For we are also his offspring". The words used by St. Paul follow very closely passages in the text of the poem of Aratus. Cicero and other writers translated Aratus's poem into Latin; and several Roman poets, including Virgil, quoted largely from it. In his great didactic poem, the "Georgics", Virgil brings man into intimate contact with Nature by describing the relationship between agricultural operations and the constellations visible at different seasons. In the same period, Lucretius produced his great work "On the Nature of Things", which is more remarkable for its anticipation of modern views as to atoms and their relationship to space than for its description of scenes or actions in the celestial drama as viewed from the earth. His purpose was to present a theory or theories which would explain natural things and laws without assuming the existence of deities as legislators.

During the period from the ninth to the fourteenth century, when the study of natural knowledge was cultivated by the Arabs with conspicuous success astronomy was given particular attention and Arabic works upon it translated into Latin were afterwards widely read Omar Khayyam who lived in the latter half of the eleventh century was an astronomer as well as a poet though there are few astronomical references in his Rubaiyat He lived in the golden age of Arabic science and the next great poetic genius was Dante who made detailed and accurate use of the scientific knowledge of the times Dante derived his knowledge of celestial objects and movements from a celebrated Arabic astronomer Alfraganus who flourished at the beginning of the ninth century and wrote a number of works on the sundial the astrolabe and other astronomical subjects Chaucer was another astronomer poet who was indebted to Arabian science for much of the astronomical knowledge revealed in his works He was the first great master of English verse and his poems contain many references to celestial subjects chiefly from the point of view of their relationships to human life and events

Three centuries after Dante Milton in Paradise Lost described many astronomical objects and phenomena Milton met Galileo and in well known lines refers to the astronomer s observations of the moon and the Milky Way He knew the Copernican system of the universe which was established by Galileo s observations and described the differences between it and the Ptolemaic system which was then generally accepted but he left the question unanswered as to which system should be accepted as true Even Francis Bacon persistently rejected the Copernican theory though there were eminent men astronomers and others anterior to or contemporary with him who adopted and taught it The theory had been before the world for nearly eighty years before Bacon s Novum Organum was published and he gave great attention to the methods by which astronomy ought to be studied yet he refused to accept the theory and constructed an elaborate celestial system of his own Even after the discovery of the satellites of Jupiter by Galileo in 1609 seventeen years before his death Bacon opposed the Copernican view that the earth moved in an annual orbit around the sun It is unfortunate that a philosopher with such a wide range of knowledge whose object was to show others how science could be advanced did not appreciate the simplicity of the Copernican theory as an explanation of celestial movements In this respect however his attitude was that of many of his contemporaries including those not influenced by theological prejudices as well as Catholics and Protestants.

The adoption of the Copernican theory meant that the foundations of belief in the earth and man as centres of the universe were destroyed Later when Newton had shown that the law of gravitation was sufficient to account not only for the movements of the planets but also for the paths of comets it was no longer reasonable to believe that these were sent as signs or warnings to the human race The intellectual expansion thus brought about together with the sense of justice which resulted from the existence and permanence of law in Nature profoundly influenced human thought and resulted in social changes which had the greatest civilizing effects

A similar revolutionary adjustment of thought had to be faced when three centuries after Copernicus man was placed in a new relationship to the rest of living creatures and shown to have a sub human ancestry The principle of evolution gives new hope to life and the promise of a golden age in the future instead of the past if man follows his highest ideals for as T H Huxley pointed out evolution embodies the idea of progressive social and ethical standards as well as development of physical structure Any nation or people which separates itself from the rest of the world in the name of race or religion and cultivates ideals of conquest by force in order to assert its claims is reverting to the law of the jungle and retarding the higher evolution of mankind

The view that the sole function of science is the discovery and study of natural facts and principles without regard to the social implications of the knowledge gained can no longer be maintained It is being widely recognized that science cannot be divorced from ethics or rightly absolve itself from the human responsibilities in the application of its discoveries to destructive purposes in war or economic disturbances in times of peace Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the materials provided by them and which their discoveries may be used to destroy It is their duty to assist in the establishment of a rational harmonious social order out of the welter of human conflict into which the world has been thrown through the prostitution of the rich gifts with which they have endowed the human race Science has made the world one through the facilities of transport and communication now available and it recognizes no political or racial boundaries in the fields of knowledge By the wise use of this knowledge the earth could indeed become a celestial dwelling place instead of a world of dust and ashes which prevailing conditions seem to be making its destiny

The Electron Microscope

By Prof L. C Martin, Imperial College, London

INTRODUCTORY

IT has been known for many years that cathode rays can be deflected by electric and magnetic fields but in 1926 Busch showed that axially symmetrical fields would have the power of focusing such rays much as light is focused by a lens

Any axially symmetrical lens system will produce a fairly sharp optical image of objects near the axis provided that the aperture is so far reduced that only rays travelling very close to the axis are allowed to pass through the system and provided moreover that strictly monochromatic light is employed This reduction of the aperture is essential in general to avoid the spherical aberration of the rays which make larger angles with the axis and the consequent deterioration of the definition of the image but on the other hand the finite wave length of light causes a spreading of each image point such that the spread is inversely proportional to the aperture of the lens system This tendency makes it impossible to retain very sharp images with optical lenses of smaller and smaller angular aperture and highly complicated lens systems have to be used to allow of the attainment of large apertures without concurrent spherical aberration Thus in the relatively simple case of the ultra violet microscope objective (numerical aperture 1 2) five or six specially shaped lenses mounted with the greatest care have to be used but the resolving limit cannot be brought much below about 0 15 μ without great difficulty In other words the closest approach of two object points compatible with the separation of their images is about one seven thousandth part of a millimetre

POSSIBILITIES OF THE ELECTRON MICROSCOPE

Until the origin of the electron microscope it did not seem possible that this limit would ever be lowered very considerably but once the possibility of forming images with electrons was realized it became apparent that further progress was possible The experiments of Prof G P Thomson and others had shown that the wave lengths of the waves associated with medium velocity electrons are only about a hundred thousandth part of the wave length of ultra violet light, and therefore the relative aperture of an electron optical system could be lowered drastically in order to avoid spherical aberration without incurring any considerable spreading of the elementary image points Such lenses have now been made which work at numerical apertures of much less than 0 1 but the residual spreading of the image is almost entirely due to other causes that is to chromatic aberration (due to the presence of electrons with differing velocities) to spherical aberration and to faulty centration together with the characteristic aberrations of extra axial image points The best of such images appear to have resolving limits of approximately 0 01 μ and will bear magnifications up to 20 000 or more without losing apparent sharpness

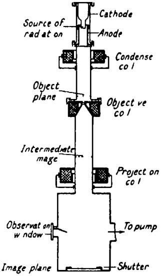


FIG 1

KNOLL AND RUSKA'S ELECTRON MICROSCOPE

The pioneer work in building such instruments was due to Knoll and Ruska working in Berlin (1932) They employed a cold cathode discharge tube as a source of electrons which were projected through a very small aperture along the axis of a highly evacuated tube (Fig 1) The electron beam passed in succession through ironclad coils representing the condenser the objective and the projection eyepiece of a microscope, and finally fell upon a fluorescent screen or photographic plate for the registration of the image The first pictures obtained were 'silhouette images of fibres perforated metal foils, and the like Then in Brussels

Marton made early experiments on the electron-photography of biological tissues impregnated with osmium, and of bacteria mounted on very thin films of nitro-cellulose In Great Britain an instrument was designed by the present writer and his colleagues in co-operation with Messrs Metropolitan-Vickers Electrical Co, Ltd, by whom it was made (Fig 2) It is intended to give special facilities in the microscopy of objects alternatively by light or the electron beam, and experiments with it have been in progress for the past two years The resolving limit attained is already better than that of the ultra-violet microscope, and Prof G P Thomson is directing a systematic investigation of various troubles preventing better definition Hot-cathode discharges are now being employed by the German workers

The results so far obtained on the Continent are wonderfully promising, although claims have been made in a few cases which do not appear to be justified by the photographs reproduced Exceptionally striking pictures of colloidal structures, for example, threads of nickel carbonyl, and particles of colloidal gold in a film of lithium borate, have been published by Beischer and Krause, after which the resolution of *Amphipleura pellucida* in dots seems a pedestrian performance In order to photograph bacteria, they are dried by a special process on an extremely thin film of collodion, and can be photographed without any other special treatment Photographs have been published (notably by von Borries, E Ruska, and H Ruska) showing various organisms such as *Micrococcus flavus* under extraordinarily high magnification, such as 16,000, one picture exhibits a fine structure, whatever its nature or origin, on the film around the dried bacteria, which could not possibly be observed in optical pictures (Fig 3)

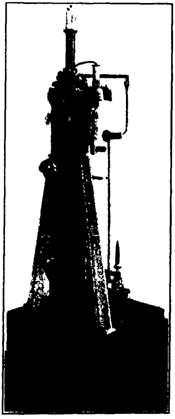


Fig 2

Electron microscope at the Imperial College, London

Fig 3

Micrococcus flavus, electron optical magnification, 16,000 Structures near the cocci do not occur in the supporting film, photographs of plain films show a completely clear ground Photograph by von Borries, E Ruska and H Ruska, reproduced by courtesy of Herr E Ruska, of Siemens und Halske A G

Delicate objects placed in an intense electron beam may of course suffer damage by heating and further by becoming so highly charged that electrostatic repulsive forces disintegrate the structure, it will therefore be understood that there is a great deal of special technique to be developed The necessity of mounting the objects in a high vacuum is naturally a severe complication

Thermionic Emission

The term 'electron microscope' has also been given to electron-optical systems designed to give images of surfaces which are self-emitters of electrons either by thermionic or by photo-electric action Thus, for example, suitably activated surfaces of iron and nickel vary greatly in emissivity according to their crystalline state, and the changes in structure with change of temperature can be followed in an interesting way by projecting the images of such surfaces with suitable magnetic or electrostatic lenses, although the magnifications employed are not usually greater than one hundred, and there is little question of high resolution The present article will not attempt to deal with these systems

PROBLEMS IN ELECTRON MICROSCOPY

Having briefly noticed the present state of progress in the subject it may be of interest to indicate some of the problems which have to be faced in any attempt at further progress

In an ordinary photomicrograph a picture' of an opaque object is formed by absorption of the light, but when the object is only distinguished by a variation of refractive index with respect to the surrounding medium, the contrast in the image is secured, in many cases, because some of the light from particular regions of the object is deflected outside the aperture of the objective and thus fails to reach the corresponding part of the image

In the case of the electron radiation passing through a thin layer of matter, a large proportion of the moving electrons may not pass sufficiently close to any of the electrons or nuclei in the atoms of the film to suffer perceptible changes in energy or direction, since, as we now understand, the particles conceived as forming an atom occupy effectively but a small part of its dimensions as usually estimated Other electrons may pass comparatively close to a relatively massive nucleus and swing around it in a hyperbolic orbit, suffering a comparatively large change of direction but, in comparatively many cases, inappreciable change of energy such collisions would be said to be of the 'elastic type

As has been shown by Bohr, however, the effect of the electrons present in the atom cannot be neglected , they are not to be regarded, in this connexion, as fixed, and thus can take up more or less kinetic energy from the particle in quantum units In some cases the moving electron interacts so violently that one or more electrons are completely removed from the atom , the loss of kinetic energy may then be comparatively great and accompanied by a large change in direction of the incident particle The collision is of the 'inelastic' type In some cases (fluorescence) the energy levels of the electrons of the material may be altered and light is emitted as they return to the normal configurations In very thin films of matter the electrons are not likely to encounter more than a single nucleus sufficiently closely for appreciable scattering, and the most probable angle of deflection is proportional to the square root of the thickness, but with increasing thickness or with the presence of heavier atoms at particular regions, the mean scattering angle may be increased, sometimes by successive encounters Some electrons may be completely trapped by the film and if it is a non conductor they remain as a charge on the surface

In preparing objects such as bacteria for the electron microscope, they are usually mounted on very thin films of nitro cellulose, and it is fortunate that the amount of scattering and spread of velocity caused by the film does not seem to be so great as to introduce serious trouble with spherical and 'chromatic' aberration Potentials of about 75 kv have usually been employed for this work If an object is mounted on a film, it will scatter the radiation to a greater extent than the film support, and, as widely scattered electrons will fail to enter the narrow aperture of the objective, the object will show up as a dark region in the image We have to remember, however, that the velocity spread caused by the mount may interfere to some degree with the definition, and the image will then differ to some degree from purely silhouette effects Thus the probability of detecting an object or separating the images of two objects depends on the relative scattering power as distinct from the support if any

If it were possible to produce electron images free from spherical and 'chromatic' aberration the only factor controlling the resolving limit would apparently be the wave length of the de Broglie waves Assuming the aperture of the corrected lens to be 0 1, a limit of less than 10^{-7} cm might apparently be attained Apart from the questions raised above there are however, serious difficulties It does not seem possible to secure 'achromatism' of the electron lenses, and the only alternative is to make the incident radiation as homogeneous in velocity as possible Various factors require a voltage of 50,000 or more, and it is difficult to maintain a perfectly steady electrical pressure of this magnitude The usual circuits employ a transformer with valves to produce half-wave or full-wave rectification, together with as large a reservoir condenser as possible The residual ripple can be reduced to one tenth of one per cent without undue trouble, and may be further reduced by filters

When cold cathode discharges are used, the current can be stabilized by a saturated diode valve, and the inhomogeneity is reduced to that caused by collision effects, etc , in the discharge tube supplying the electron stream In all cases the perfection of the vacuum technique is essential, and conditions of the utmost constancy must be obtained If necessary complete stabilization of the supply for hot cathode work can be attained by the use of a battery but the high initial cost maintenance and rapid depreciation of such a battery present difficulties which will be well understood

Assuming that the voltage spread can be sufficiently reduced the question of the spherical aberration of the lenses comes into prominence It is apparently not possible to design magnetic or electrostatic lenses which are free from this defect and no known arrangement seems to do more than approach a certain minimum value This question has been studied theoretically by Scherzer and also on the basis of numerical calculations by Rebsch who reaches the conclusion that the limit of resolving power of electron optical systems will always be set in this way at about ten to one hundred times the electron wave length instead of going below the wave length itself as might be inferred from Abbe s optical formula Whether or not this conclusion is just the implied limitation does not exclude the possibility of opening up still further new fields in high power microscopy

Just as in ordinary optics however where more than half the serious troubles are due to faulty construction and lack of symmetry of the parts the electron microscope is by no means easy to perfect in such respects In the first place the present instruments are given a length of about two metres in order to reach the required magnification in two stages and moreover a complicated object holder chamber and adjustable coils have to be included in the apparatus It is thus scarcely practicable to secure a geometrical symmetry by merely screwing together a set of lathe turned parts as is done in the telescope Even if this were done the electron beam would still be appreciably curved unless the axis of symmetry coincided with the direction of the earth s magnetic field Again it is by no means easy to make an ironclad magnetic coil truly symmetrical in the magnetic sense about its mechanical axis The residual irregularities in the winding and probably especially the variation of magnetic resistance in the gaps of the soft iron sheathing produce a lack of symmetry in the field even more troublesome is the fact that the asymmetry varies with the varying current especially when the magnetism of the sheath is approaching saturation The perfection of such coils is an interesting problem

For a number of reasons therefore the early instruments were built up with components arranged as symmetrically as possible and the beam was sometimes persuaded along its required path by judicious use of bar magnets ! In the instrument described by Martin Whelpton and Parnum the necessary control was obtained in a less objectionable way by the use of paired coils in the Helmholtz manner This instrument in use at the Imperial College is now so arranged that the objective coil can be adjusted both in tilt and lateral position and further the condenser and projection coils can be adjusted laterally all from outside the vacuum

Neglecting the residual asymmetry of a coil which is not after all very large the system of initial adjustment depends on the fact that if any object is not on the axis of a coil the image will move in a radial direction around the axis when the current in the coil is varied The finer centring adjustments may require the deliberate use of inhomogeneity in the beam velocities Failing perfect centration very serious aberrations in the image will correspond to lateral chromatic spreading of the image points and coma even in the centre of the picture

A major part of the experimental work at the Imperial College has been devoted to a study of the optical adjustments of the system in the above sense and it is hoped that when more perfect electrical equipment is available the experience thus gained will make it possible to obtain the optimum results

A word may be added as to the relations of the electron microscope to the research methods of X ray and electron diffraction analysis It is true that where some degree of regularity exists in the structure of matter these powerful and beautiful methods can be used with confidence to elucidate the atomic pattern just as diffraction spectra appearing in the optical microscope may prove the existence of a structure which still cannot be resolved by the instrument It is the possibility that the electron microscope may prove a means of examining irregularities and discontinuities in structures which makes it seem so promising even if the method cannot deal with elements so small as those of crystal lattices

On the analogy of the Abbe principle it may be said that if the aperture and corrections of the lenses could be so far improved as to include the electron diffraction maxima from a crystalline structure without incurring appreciable aberration the very elements of the lattice would be resolved in the picture That achievement may at present be quite outside the limits of apparent probability but the subject is still in its infancy and at a stage corresponding to the period in the history of the optical microscope before the achromatic lens was invented We may learn from the experience of those days not to be over confident in setting limitations to what is possible

Obituary Notices

Sir Thomas Callender

SIR THOMAS OCTAVIUS CALLENDER who died at his home at Bidborough Court Kent on December 2 at the age of eighty two years spent a long and very busy life in promoting the electrical industry He was the eldest son of the late W O Callender of Bournemouth and was born in Glasgow in April 1855 He was educated at Greenock in London and later at Boulogne sur Mer The outbreak of the Franco Prussian War made it necessary for him to leave France and later he entered his father s office in London devoting himself to the asphalt paving and bitumen refining business of which W O Callender was founder Having acquired an interest in part of the Trinidad Lake W O Callender and two of his sons founded the business of Callender and Sons in 1877 for the supply of Trinidad bitumen Large quantities of bitumen were refined and used for road making and building purposes but it was felt that further developments were possible and its uses for electrical work were constantly considered

When Callenders started carrying out complete contracts for both the making and laying of underground mains their practical knowledge of road making proved of great value In the early days, the only output for insulated wires was in connexion with the electric telegraph When Edison and Swan brought into practical use the electric glow lamp it became clear that some materials such as Callenders were making could be usefully employed for the heavy mains which would evidently be required Bitumen in its natural state was useless as it is easily affected by heat and consequently unstable After many experiments it was discovered that a combination of certain palm oil residues with bitumen produced a material that could be vulcanized and so could be employed as a covering for both heavy electric cables and light electric telegraph wires For this experimental work Letters Patent (No 4409) were granted to Mr W O Callender in October 1881 Mr Tom Callender was elected manager of Callender s Bitumen Telegraph and Waterproof Company formed to develop this discovery Sir Samuel Canning (who with Lord Kelvin was famous for his Atlantic cable experience) was appointed consulting engineer to the company

In 1894 the directors were able to report that out of eighty two electric light stations then in existence or under construction in Great Britain their Company had supplied mains to thirty eight In July 1896 Callender s Cable and Construction Co was formed and took over the entire interests and contracts of the old company Mr Tom Callender was appointed managing director and controlled the business with conspicuous success almost up to the day of his death

Tom Callender was a great traveller Shortly after he joined his father s paving and bitumen business he spent nearly a year in Rumania repaving the entire city of Jassy His journey to St Petersburg in 1880 concentrated his interest in electrical work The illumination produced by an immense number of Jablochkoff candles at the Opera House astounded him Three years later Callenders installed the necessary underground mains when Covent Garden Opera House London was electrically illuminated On a later occasion he went to the United States by the Cunard S S *Scythia* which was lighted by paraffin lamps and returned by the Cunard S S *Servia* the first large liner to be equipped with an effective electrical installation He was so impressed that on his return he urged his company to devote all possible attention to electrical development In 1930 Callenders acquired a new research laboratory in which is installed the most modern electro technical apparatus It is mainly employed in performing experiments with the object of elucidating the trend of future evolution in the cable industry In opening it Lord Rutherford made a very appreciative speech on the work it was doing under the superintendence of Mr P V Hunter

Tom Callender married in 1885 Bessie the eldest daughter of Mr William Pinnock of Belvedere Kent, and had one son Mr T O Callender who has been a director of the present company since 1932 The controlling genius of the extensive Callender interests was honoured by knighthood in June 1918 This well deserved recognition gave the greatest pleasure both to the numerous friends of Sir Thomas and Lady Callender and also to the company s large staff in all parts of the world The company published a memorial volume The Story of Callender s 1882 1932 to celebrate its fiftieth anniversary It gives biographical sketches of all the distinguished members of the staff and also an account with photographs of the works the company has done and is doing in almost every part of the world Among them are Windsor Castle (1907) Keble College Oxford (1909) Birmingham (1890) Bombay (1908) Agra (1924) Hong Kong (1904) the City and South London Railway (1889) and Banhida Hungary (1928)

A R

Prof J W Bews

J W BEWS was born at Kirkwall, in the Orkney Islands, in 1884 being the younger son of the late James Bews, of Berry Hill Scapa Orkney From the Kirkwall Burgh School he entered the University of Edinburgh as Earl of Zetland bursar in 1902 After graduating he was appointed lecturer in economic botany in the University of Manchester, but returned to Edinburgh in 1908 as lecturer in plant physiology and assistant professor of botany

In 1910 Bews was appointed professor of botany in the Natal University College with which he has since been associated except for the period 1925–27, when he occupied the chair of botany at Armstrong College, University of Durham

As soon as Prof Bews arrived in Natal he began his investigations of the vegetation and within a short period had published a number of important papers on the plant ecology of Natal and of South Africa He was a pioneer of plant ecology in South Africa, and in addition to making many important contributions to the science of ecology, his work has had an important bearing on many economic questions, such as soil erosion veld burning, over grazing afforestation and weed control In particular, his work on the grasses and grasslands of South Africa has stimulated much research which is now being carried out in various parts of the country, and is producing many important changes in some aspects of agricultural practice

In 1921 Bews completed a Flora of Natal and Zululand , and later investigated the origin, evolution and migrations of the South African flora After publishing several papers on this subject he issued his conclusions in a more extended form in a book on 'Plant Forms in 1925 This led naturally to a wider study of the classification and evolution of plant growth forms and the results were summarized in another book on The Ecological Evolution of Angiosperms

During his short but successful, stay at Armstrong College, Newcastle upon Tyne Prof Bews worked assiduously at the grasses, with the result that in 1929 his World's Grasses' was published This important work is accepted as standard throughout the British Empire and the United States

In 1930 Prof Bews was appointed first principal of the Natal University College and has been responsible for organizing and guiding the recent rapid developments which university work in Natal has undergone and for laying the foundations of the future University of Natal During this period in spite of heavy administrative responsibilities he found time to apply himself to a study of man and some of the problems confronting mankind He approached these also from the ecological point of view and wrote two books on the subject— Human Ecology published in 1935 and Life as a Whole in 1937 His synthetic approach to these problems was along new lines, and he considered these books merely as a preliminary survey of the field In addition to his scientific research work, which is contained in numerous published papers, as well as in his books, Prof Bews built up a strong department of botany at the Natal University College, and achieved much success both as a teacher and as a director of student research

Prof Bews occupied an important and prominent place in the administration of university and scientific affairs in South Africa He was a member of the Council of the University of the Cape of Good Hope, and of the University of South Africa several times chairman of Senate of the University of South Africa, and a fellow of the Royal Society of South Africa. In 1931, he was president of the South African Association for the Advancement of Science, and in 1932 was the recipient of the South African Medal, which is the Association's premier award In 1932 he was also one of a small deputation of eminent men of science chosen to represent South Africa at the centenary meeting of the British Association

Great as Prof Bews was as a scientist and administrator, he was equally successful in attracting a circle of appreciative friends both in South Africa and at home He was only two years with us in Newcastle yet those of us who were fortunate enough to gain his friendship will never forget it or the genial placidity with which he confidently faced all difficulties

We all feel the better for having enjoyed the privilege of knowing him

J W HESLOP HARRISON

Mr J J Kneen

We regret to record the death of Mr J J Kneen distinguished as an authority on the antiquities and language of the Isle of Man which took place on November 21 at the age of sixty six years

John Joseph Kneen was born on September 12 1872, and educated at St George's School Douglas Isle of Man His lifelong devotion to Manx studies received recognition not only within the island but also from outside He was past president and secretary of the Manx Society which exists for the preservation of the language literature and music of the Isle of Man and a member of the executive of the World Manx Association for the federation of Manx people throughout the world, as well as of the Manx National Assembly In 1930–31 he was president of the Manx Natural History and Antiquarian Society The University of Liverpool conferred upon him the honorary degree of M A in 1929 , and four years later he was made Ridder of the First Class of the Order of St Olaf of Norway His most signal distinction however was a grant of £200 from the trustees of the Fridtjof Nansen Fund to the trustees of the Manx Museum and Ancient Monuments for the purpose of enabling him to continue his researches on Manx place names and more especially of recording the true local pronunciation of these names before precise knowledge of the Manx tongue had died away

We regret to announce the following deaths

Andre Blondel since 1913 a free member of the Paris Academy of Sciences and a distinguished electrical engineer known for his work on alternating current theory and for the development of the oscillograph and of the radio beacon on November 15, aged seventy five years

The Right Hon Lord Chalmers, Governor of Ceylon from 1913 until 1916, a trustee of the British Museum during 1924–31, and president of the Asiatic Society during 1922–25, on November 18 aged eighty years

Dr F W Goodbody, lecturer in medical chemistry in University College, London on November 30, aged sixty eight years

Sir Brajendranath Seal, formerly vice chancellor of the University of Mysore, known for his work in education and Bengali philosophy, on December 3, aged seventy four years

News and Views

Pilgrim Trust Lecture

THE first Pilgrim Trust Lecture was delivered on December 8 before the Royal Society meeting in the historic lecture theatre of the Royal Institution by Dr Irving Langmuir of the Research Laboratories of the General Electric Company Schenectady N Y A brief account of the substance of the lecture appears on p 1085 It will be recalled that the announcement of the institution of this lecture was made by Sir William Bragg in his presidential address last year to the Royal Society The scheme for the lectures was drawn up by the Royal Society and the U S National Academy of Sciences and the Pilgrim Trust very generously agreed to provide an honorarium of 250 guineas a year for six years The lectures are to be delivered in alternate years in London and Washington by an American and a British man of science respectively Sir William Bragg suggested when referring to the lectures that they might be used to transmit new ideas which have begun to bear useful fruit and give promise of wide expansion, rather than to record past achievements and Dr Langmuir's choice of subject and his method of handling it must have been gratifying to Sir William Dr Langmuir himself must be congratulated on giving a most inspiring lecture on a difficult subject and on the fact that he had the courage to begin with the very elementary facts Thus the first link in another chain binding together the peoples of Great Britain and the United States has been well forged and it should not be impossible to find means to make the lecture a permanent institution Such international contacts are of vital importance in these days of strife and world unrest and every effort should be made to promote active co-operation between the scientific workers of different countries It is much to be hoped that the approach made by Dr Bosch president of the Kaiser Wilhelm Gesellschaft to the Royal Society, which was referred to by Sir William Bragg in his presidential address on November 30 last may be the beginning of yet another of these international bonds

Prof J W Cobb, C B E

PROF J W COBB retired recently from the Livesey professorship of coal gas and fuel industries in the University of Leeds—a chair which he had held since 1912, shortly after its foundation, when it was the only university chair in fuel technology in Great Britain In response to a circular of appeal, a sum of about £850 has been contributed to signalize his services to the University and to industry, notably the British gas industry Of this sum £583 was contributed through the Institution of Gas Engineers On December 9, at the University of Leeds, with Major G H Kitson in the chair, certain presentations were made and the balance—£750 was presented to the University of Leeds In accordance with the wishes of Prof Cobb it is proposed that the income from it be used to assist students of the Department of Coal Gas and Fuel Industries with Metallurgy to meet the cost of maintenance while at the University or to cover other expenditure necessary for their studies or researches Mr R Robertson president of the Institution of Gas Engineers said Prof Cobb is held in the highest esteem by everyone in the gas industry He is already an honorary member of the Institution of Gas Engineers but from now on he can regard himself as an honorary member of the gas industry at large Mr H J Hodsman speaking for the Department said that nowadays fuel research is a comparatively fashionable branch of science, but when Prof Cobb arrived in 1912 the Department was the only one of its kind in the country and it had very few students Its present position was therefore a measure of Prof Cobb's achievements Prof J H Priestley and the Vice Chancellor also added their praises of Prof Cobb and his work for the University

Wladimir Markownikoff (1838 1904)

ON December 22 occurs the centenary of the birth of the Russian chemist Wladimir Markownikoff whose investigations in the latter part of last century were of great importance to the petroleum industry He was born in the neighbourhood of Nijni Novgorod and was a student at the University of Kasan where he came into contact with Alexander Mikhailovitch Butlerow (1828 1886) whom he succeeded in 1869 when the latter had been transferred to the chair of chemistry in the University of St Petersburg Meanwhile Markownikoff had been sent to Germany, where he worked under Kopp Baeyer and Kolbe After his return to Kasan he published his memoir Ueber die reciproke Beeinflussung der Atome im Molecule In 1871, with five colleagues he resigned his post for political reasons but received an invitation to the chair of chemistry at Odessa whence he was transferred to Moscow in 1873 Here he began his long and arduous investigations of Caucasian petroleum In 1893 without any reason being assigned he was deprived of his chair, his emoluments and his official residence, but nevertheless he continued to carry on his researches in his own house, assisted by his faithful servant Mikhailo He died suddenly on February 11, 1904 He wrote some sixty memoirs relating to petroleum, army disinfection practice, the plague and the chemical industry in Russia In 1898 he was elected a foreign member of the Chemical Society, in the *Proceedings* of which E J Mills wrote of him as a conscientious man of science of unremitting industry, and in political affairs an outspoken patriot

Queen Mary College

QUEEN MARY COLLEGE celebrated this week the anniversary of the presentation of a Royal Charter to the College by Her Majesty Queen Mary the Patron of the College on December 12 1934 The proceedings culminated in a reception on the evening of December 16 when the principal of the College Prof G M Bennett, Prof J T MacGregor Morris Miss Florence Rich and Sir John Russell are being admitted as fellows of the College The College which owes so much to the insight and wise guidance of its late principal Mr J L S Hatton and its present principal Sir Frederick Maurice occupies a unique position in the scheme of the University of London Situated a mile and a half east of Aldgate Pump, it provides a university course of training for students drawn in the main from the population of Essex and Middlesex but not from these regions only for within its walls are to be found students coming from all parts of Great Britain and of the Empire

QUEEN MARY COLLEGE which has grown steadily from a small beginning as the Technical School of the People's Palace has for some time past realized the urgent need for the extension of the housing of its Faculties of Art Science and Engineering and for the provision of hostels and athletic grounds for its students It has courageously embarked on a building scheme under which the Engineering Departments the Chemistry Department the Aeronautical Department and the Botany Geology and Geography Departments have been extended or reconstructed new Zoology and Arts Departments have been built and a high voltage laboratory the first of its kind in London has been equipped The cost of this completed portion of the programme is some £118 000 of which £113 000 has been received or promised A great deal however remains to be accomplished and the College is now considering the building of a college hall dining hall and kitchens the reconstruction of the Students Union rooms the rehousing of the administrative offices and an urgently needed extension of the Physics Department The cost of this last part of the building scheme is estimated at £125,000 and all interested in college and university life in London will wish the Governors of Queen Mary College an early success in their attempt to provide a college which shall in its material equipment be worthy of the traditions which it has established in its thirty one years of life as a School of the University of London

Birkbeck College

BIRKBECK COLLEGE, University of London celebrated on December 7 its 115th anniversary with an eloquent oration on Ends and Means by Sir Richard Livingstone, president of Corpus Christi College Oxford The Foundation oration dealt with the underlying principles of morality in individual and social intercourse in contrast with the present unrest in world affairs In his report, which was followed by the presentation of graduates, Dr George Senter, principal of the College, mentioned various details about its progress the plan for moving it to the Bloomsbury site the distinctions gained by the staff and the activities of the various College societies During the last academic year there were 971 students registered 122 having graduated Statistics show that 430 students were teachers 176 clerks and 132 chemists Considerable progress was made during the year with the plans for new College buildings on the Bloomsbury site Towards the end of the session instructions were given for the clearance of the site and it was expected that the detailed plans would be submitted soon to the Governors A notable appointment to the academic staff was that of Prof J D Bernal who succeeded Prof P M S Blackett in the chair of physics Prof Bernal's work is mainly concerned with structural investigations by means of X rays and is of great interest to chemists and biologists as well as to physicists

German Native Policy and Racial Theory

DISCUSSION of German colonial claims will be clarified by a statement of the policy which would be applied in native administration under racial doctrine appearing in an official publication of the National Socialist Party The Colonial Question and Racial Thought by Dr Gunther Hecht an expert of the party on racial problems As might be anticipated the principle of segregation it would appear from a summary of the provisions by the Berlin correspondent of *The Times* in the issue of December 12 is to be applied stringently and any attempt to Europeanize or divorce the native from his culture is abrogated he will neither be baptized nor will his equality with Europeans be preached No native will be allowed to leave the German colonies for Europe as either servant worker soldier or student but on the other hand coloured people will be allowed their full rights of existence in their own homeland and no more will be demanded from them than they can achieve No native will be allowed to become a German citizen but they will nevertheless possess more rights than have been merely promised to them in other colonies No European matter will be taught in native schools lest Europe should be presented to them as the peak of cultural development and they should lose faith in their own powers Local culture therefore will be fostered but side by side with it there will be an introduction to an understanding of European civilization In principle higher schools and universities will be closed to natives Without entering into extended comment on the principles of this policy beyond noting a commendable adherence to the development of the native through his own culture it may be questioned what opportunities will be afforded for development towards that self determination however remote it may be and whatever its form which has been formulated as the end of native administration under mandatory policy

Systematics in General Biology

THE annual general meeting of the Association for the Study of Systematics in General Biology was held in the rooms of the Linnean Society, Burlington

House, Piccadilly, London, on December 15 The inaugural meeting of this newly established association was referred to in NATURE of July 24, 1937, p. 163. At its inception, 53 biologists joined the Association, and since then the membership has increased to 162 The aims of the Association, among others, are to study the bases and practical aims of taxonomy, to examine criteria employed in defining species and other systematic categories; to consider any modification of existing classification in the light of cytogenetic, ecological, physiological, embryological, biochemical and palæontological data, to press for increased attention to taxonomy in museums and other institutions, to organize research, to aid the production of handbooks on British animals and plants, and eventually to produce a British Fauna and Flora on uniform biological lines, to investigate methods of teaching systematics, to promote co-operation between workers in different branches of biology on problems of taxonomic interest The Taxonomic Principles Committee has already considered several important problems, and has decided to prepare an index of all terms which have been used to designate groups below the rank of species This should prove of value, especially to young research workers in taxonomy The Committee on Comparative Systematics has examined the sources from which data for research on variability and other problems may be drawn The Research Committee has initiated or assisted in the launching of twelve lines of research, and a list of institutions where such work may be done has been prepared Work has been started on a book on the anatomy of Dicotyledons. The Committee on Handbooks is now compiling a review of existing taxonomic literature on the British flora and fauna The provision of a check list of the British flora and fauna is being dealt with in collaboration with the Association of British Zoologists. Cheap systematic handbooks are also being considered

THE Committee for Co-ordinating the Work of Natural History Societies has been aided in its exacting task by the British Association The pioneer work of these various committees is commendable, and all biologists, whether directly interested in systematics or not, will be grateful for the results of their work Various publications, such as articles in NATURE and *Chronica Botanica*, have been sponsored by the Association, and others are projected Discussions and symposia on taxonomic subjects have been supported by the Association at meetings of the British Association and of the Linnean, Zoological and Genetical Societies The Association has no constitution yet, but it has since worked with enthusiasm It is considered that with a minimum membership of five hundred, each member paying the modest sum of £1 for life-membership, the Association could achieve all its aims. We hope that this enrolment will be achieved and even exceeded, for the Association has, in a very short time, showed that it is providing an essential service to biology, and considering its present projects, its usefulness will certainly continue to increase. Not only specialized systematists but also all other biologists would prove useful to this Association, which clearly deserves all the support it can get Information concerning the Association can be obtained from either Mr J. S L Gilmour, Royal Botanic Gardens, Kew, Surrey, or Mr. H W. Parker, British Museum (Natural History), South Kensington, London, S W 7

Palæolithic Finds in Bulgaria

DR DOROTHY GARROD's account of her recent excavation of the cave of Batcho Kiro, near Drevono, in Bulgaria, given before the Society of Antiquaries of London on December 8, adds a link of no little importance to the chain of evidence of the distribution of cultures of the later periods of the palæolithic age in eastern Europe and adjacent regions Dr Garrod's excavations were carried out in the summer of 1938, when she had the assistance of Mr James Gaul and Mr Bruce Howe of Harvard University, by permission of the Bulgarian Government and with the co-operation of the National Museum of Sophia The cave is very large with an intricate system of corridors running at least a kilometre into the rock Flint implements had already been discovered here in association with bones of the cave bear by a local engineer The present excavations were confined in the main to the principal chamber; and here for the first time in Bulgaria a stratified sequence of palæolithic deposits has been found At the bottom of the section was a Mousterian level, in which the implements were made chiefly from pebbles of volcanic rock from a stream near by. Above this level were layers of deposits belonging to the Upper Palæolithic, in which the industries were more or less of Aurignacian type, and the implements were made of flint They were associated with animal bones, among which were cave bear, cave hyena, and in the lowest levels woolly rhinoceros These levels, corresponding to others of the same kind in other parts of Europe, are to be assigned to the last stage of the Quaternary Ice Age

Prehistoric "Harpoon" from Scotland

A REMARKABLE barbed point of red deer antler found in the bed of the River Irvine below Shewalton Sands, Ayrshire, was described by Mr A. D Lacaille at a meeting of the Society of Antiquaries of Scotland in Edinburgh on December 12. The point, which may have been part of a harpoon or multi-pronged fish-spear, is believed to be the largest prehistoric point of its kind as yet recorded in the British Isles It measures 7⅜ inches long, and is rhombic in section It has five pairs of barbs. A groove appears on each side of a pronounced mid-rib at the tip. It has been skilfully fashioned, evidently by stone tools The dating of the point is uncertain; but it is conjectured that it was made by settlers on Shewalton Moor, a locality rich in prehistoric and other antiquities Both its form in section and the grooves mark a considerable technical advance on the Azilian type of barbed harpoon. Nevertheless, the Shewalton point, it is indicated, bears a general resemblance to the harpoons of antler and bone previously found in Scotland at Oban, Oronsay and Kirkcudbright The present find is figured in *The Times* of December 13

Indian Cultural Studies at Oxford

WHILE the range and character of the collections of the India Museum at South Kensington will always give London a predominant position as a centre of Indian cultural studies, it should not be overlooked that the University of Oxford is not unconscious of its obligations in this direction The report of the curators of the Indian Institute for the academic year 1937–38 states that during this period the museum has undergone a much needed reorganization, thanks to a substantial grant from the Max Muller Memorial Fund and a generous gift from Mr and Mrs Spalding The aim of the reorganization is not only to raise the character of the exhibits, but also to serve the needs of the studies carried on in the Institute, and more especially to stimulate interest in the antiquities and art of India Among gifts and bequests, upon which the museum has to rely to a large extent, recent additions include a Buddhist shrine on loan from Mrs Alexander Scott, which shows excellent specimens of the work of Newari and Tibetan artists, while Dr Stella Kramrisch has lent a valuable collection of Hindu sculpture Some interesting terra cottas have come from the Royal Asiatic Society, and a collection of Siamese sculpture, the property of Dr Reginald Le May, is especially instructive as a demonstration of the influence of Indian art and civilization on south eastern Asia Further facilities for the study of the cultural relations of south eastern Asia will also be afforded members of the University by the valuable collection of Malayan books formed by Mr W W Skeat, author of ' Malay Magic ' and, with Dr C Otto Blagdon, of Pagan Tribes of the Malay Peninsula This collection has been accepted by the University as a gift from Captain W Ogilvy by whom they were purchased for that purpose Volumes additional to those purchased have been added by Mr Skeat in order to enhance the value of the collection for anthropological students

Cultivation of Plants without Soil

FOR many years it has been known that plants can be grown in nutrient solution culture, without soil, provided that the medium contains the necessary elements for growth in sufficient quantity While this method is widely used in teaching and research work, it is only recently that attempts have been made to utilize it on the commercial scale, the idea originating in the United States Considerable interest has been aroused by the apparent success of the methods employed in the United States, and an account of their four chief methods, namely, (1) solution culture, (2) sand culture, (3) sub irrigation, and (4) drip culture, is given in the November issue of the *Journal of the Ministry of Agriculture* Experiments carried out at the Jealott's Hill Research Station to determine the results of such methods under English conditions are also described These latter tests were confined to tomatoes, and showed that some varieties are more suited to solution culture than others There is as yet no proof that yields are as good as those obtained under the best soil conditions but it must be borne in mind that the method, as a commercial system, is still in its infancy Advantages claimed for the method are the elimination of soil borne diseases, the greater control over the type and amount of growth by judicious regulation of the culture medium and reduction in manual labour However the cost of equipment is a heavy item and the technique is not yet fully worked out The experiments are to be continued, the work being extended to other crops The results will be awaited with interest

Smithsonian Institution Anthropological Publications

A NEW departure in publication is a series of Anthropological Papers consisting of articles less extended in length than the usual report on the explorations of the Smithsonian Institution which will be numbered consecutively and will be collected from time to time in bulletin form as occasion requires The first issue (*Bull* 119 , 1938) contains six articles of which the first and most considerable is a preliminary report by Mr A R Kelly on the first four seasons work of excavation on mound sites in the Ocmulgee Basin near Macon, Georgia These excavations were undertaken originally as a measure of unemployment relief under the Civil Works Administration The site has yielded an unanticipated wealth of material, and exploration is still in progress Cultural development here appears so far as present knowledge goes to be of an extremely localized type, in which a pottery of characteristically primitive appearance is associated with an unusual type of underground house and early evidence of agriculture Whether this represents an archaic horizon in the south east is a moot question , but at several points it exhibits generalized resemblances with regions geographically so far distant as the Great Plains and the south west The remaining papers deal with a pipe ceremonial of the Arapahoes (Mr John M Carter), the Caribs of Dominica (Mr Douglas Taylor), a Sauk sacred pack (Mr Truman Michelson), the physical therapy of Soshoni of Idaho upon which Mr Julian H Steward reports, and a biographical account of an Owens Valley Paiute by the same author

Scientific Publications in Japan

A THIRD edition of a Catalogue of Foreign Scientific Serial Publications in the Various Institutions in Japan has just been published by the National Research Council of the Department of Education, Tokyo The general arrangement of the work is very similar to most Union catalogues, except that whilst other publications give the holdings of each institution and an abbreviation to denote if a set is imperfect, this volume gives full particulars of the actual parts, volumes or years lacking This feature should be of considerable service to Japanese research workers by saving them fruitless journeys, particularly as the large number of imperfections listed suggests that the proportion of incomplete series is somewhat high While the method of alphabetization adopted is strictly correct it may prove in practice to be less convenient than the catchword method used in the World List as a research worker frequently depends upon short abbreviations and is unacquainted with unimportant particles on which the alphabetical order depends In addition the adoption of a strict alphabetical sequence tends to separate periodicals dealing with the same subject which a catchword method tends to bring together The volume is well printed in a clear type and although the titles of the periodicals are all in languages foreign to the place of publication the work is remarkably free from printer's errors This catalogue affords evidence of Japanese enterprise in the field of bibliography and it is obvious that very considerable care has been taken in its compilation It should be of much value to scientific workers resident in Japan

The Industrial Health Research Board

THE eighteenth annual report of the Industrial Health Research Board up to June 1938 (H M Stationery Office 1s net) contains a summary of the results of twenty years work and describes the work of the current year During its twenty years of activity an attempt has been made to discover new ways and means of improving working conditions in factories and workshops, and the results of shortening the hours of labour of splitting up shifts and of introducing rest pauses have been studied and the influence of environmental conditions and methods of work upon the output and the health of the workers has been investigated During the present year the Board has investigated the relation between illumination and industrial efficiency problems of noise and deafness dust and ill health toxic solvents, work at high temperatures and ventilation Vocational psychology applied to vocational selection and guidance in industry vocational tests for skilled and unskilled occupations and tests of accident proneness are other subjects to which considerable attention is now being directed

Principal Earthquakes during 1937

IN 1937 there were no really great earthquakes but damage was done by eight shocks and several others were felt by human beings in various parts of the world The eight which did damage were Guelma (Algeria) February 10 Rabaul 4° 10 S 152° 10 E (New Britain) May 28, Maltrata (Mexico), July 26 Tsao Tchéou (China), August 1, Manila (Philippines) August 20, Samarang (Java) September 27, Mexico City, December 23, and Oxapampa (Peru) December 29 These and others are discussed by Prof J P Rothé, of Strasbourg, in *Revue pour l'Étude des Calamités*, 1, No 2, 1938 under six regional headings continent of Europe, Mediterranean region, continent of Asia, Asiatic islands and circum Pacific coastlines the American continent and the African continent with Madagascar It is noteworthy that no disastrous earthquake was felt in Europe, and the only one reported from Britain was near Birmingham

The Philosophical Society

THE Philosophical Society of England celebrated its silver jubilee on December 7 with a luncheon at St Ermin's Restaurant London and a lecture by the Rev I Hartill a vice president of the Society, on John Milton Various speakers emphasized the useful purpose of the Society its steady development and its practical achievements Messages were sent by the American Ambassador Lord Gorell and Prof A I Heath who were unable to attend This Society was founded in 1913 by a group of persons interested in the moral sciences with the view of promoting the study of philosophy among the general public The Society publishes the *Philosopher* holds meetings and organizes lectures from time to time Also it encourages the formation of local centres and study circles and the introduction of matters of philosophical interest in schools and other educational institutions Its vice presidents include many distinguished philosophers and a number of eminent scholars from abroad are among its honorary fellows

Sir George Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund —the presidents treasurers and secretaries of the Institute of Chemistry the Society of Chemical Industry and the Institute of Metals respectively—have awarded one hundred guineas each to Dr F P Bowden and Dr Brynmor Jones Dr Bowden was educated at the Hutchins School Hobart and at the University of Tasmania He went to Cambridge in 1927 entered Gonville and Caius College and continued electrochemical work in the laboratory of physical chemistry with Prof F K Rideal and Prof T M Lowry In 1931 he was elected to a research fellowship at Caius College and was appointed University demonstrator in chemistry In 1937 he was appointed to the Humphrey Owen Jones lectureship in physical chemistry His electrochemical work has been mainly on over potential and the mechanism of electro deposition His other work on the physical properties of surfaces has an important bearing on the problems of friction, lubrication and wear Dr B Jones studied metallurgy during 1919–22 at University College, Cardiff under Prof A E Read From 1927 until 1929 he was attached to the Metallurgical Branch of the Research Department of Woolwich Arsenal, and afterwards was appointed lecturer in metallurgy at University College, Cardiff Dr Jones has devised many methods in metallurgical analyses His outstanding published work has been on the subject of the nitrogen hardening and on the heat treatment of steels, which has been appearing in the *Transactions of the Iron and Steel Institute*

Physical Society's Annual Meeting

THE twenty ninth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S W 7, on January 3–5 The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section The Research and Educational Section will contain contributions from research laboratories, and experiments of educational interest In addition, the work submitted for the Craftsmanship and Draughtsmanship Competition by apprentices and learners will be on view Discourses will be delivered at 7 45 on January 3 by Dr J D Cockcroft, on The Cyclotron and its Applications", and on January 4 by Mr C S Wright, on "Geophysical Research in Polar Regions Admission to the exhibition is by ticket only, obtainable from scientific societies or direct from the Exhibition Secretary, 1 Lowther Gardens, Exhibition Road, S W 7

British Association. Dundee Meeting

The annual meeting of the British Association will be held next year in Dundee from August 30 until September 6 under the presidency of Sir Albert Seward The following sectional presidents have been appointed Section A (Mathematical and Physical Sciences), Mr R S Whipple, Section B (Chemistry), Prof E K Rideal, Section C (Geology), Prof H H Read, Section D (Zoology), Prof J Ritchie, Section E (Geography), Mr A Stevens, Section F (Economics), Prof H O Meredith, Section G (Engineering), Mr H F Wimperis, Section H (Anthropology), Prof W E Le Gros Clark, Section I (Physiology), Prof D Burns, Section J (Psychology), Mr R J Bartlett, Section K (Botany), Prof D Thoday, Section L (Education), Dr A P M Fleming, Section M (Agriculture) Sir Thomas Middleton

Colonial Service Appointments

The following appointments and promotions in the Colonial Service have recently been made J E R Roe, veterinary officer Uganda, T Bell (Government Stock Farm and Agricultural Station, Acre, Palestine), agricultural superintendent, British Guiana, W A Gordon (assistant conservator of forests, Gold Coast), assistant conservator of forests, Cyprus, G W St Clair Thompson (assistant conservator of forests, Gold Coast), assistant conservator of forests, Uganda, J H Gibbons (chief inspector of mines, Northern Rhodesia), senior inspector of mines, Tanganyika Territory, K E Lee (assistant inspector of mines, Uganda), inspector of mines, Federated Malay States, L Humphrey (supervisor of physical training, Sierra Leone), meteorological assistant, Nigeria

Announcements

Sir John Forsdyke, director and principal librarian of the British Museum, and Mr John L Kirk, honorary director of the Castle Museum, York, have recently been elected honorary members of the Yorkshire Philosophical Society, York

At a reception on December 6 at the Belgian Embassy, Baron de Cartier de Marchienne, the Ambassador, presented a number of bronze medals awarded by King Leopold of the Belgians to various British scientific workers The medals, bearing on one side the head of King Leopold and on the other the name of the recipient, and the occasion of the award, were a token of appreciation for the help given by the various specialists in classifying the natural history collections which the King of the Belgians made in 1928–29 during his voyage to the East The recipients, most of whom were present at the Embassy, were Sir Guy Marshall, Dr K Jordan, Dr Isabella Gordon, Dr S Maulik, Dr W H Leigh Sharpe, Miss G Ricardo, Mr C L Collenette, Mrs L M I Macfadyn, Mr W H T Tams, Mr H E Andrewes, Miss I Meyrick (for her late father, Mr E Meyrick), Prof H Gordon Jackson, Dr H Hanitsch Mr C J Arrow, Dr Evelyn Cheesman, Dr Marie V Lebour, Dr Schwarz Mr L B Prout, Mr A J T Janse and Lieut Colonel F C Fraser

Dr Irving Langmuir will deliver an address before the Physical Society on December 20 at 5 15 The subject of Dr Langmuir's address will be "The Structure of Proteins'

An industrial fellowship has been established in the Mellon Institute, Pittsburgh by the American Air Filter Company, Inc, of Louisville Ky This fellowship will aid investigations on materials of value in the construction of filters for air conditioning systems Dr Frank F Rupert, who has been appointed to the fellowship, has been a member of the Mellon Institute since 1913 Since 1935 he has been associated with the fellowship on air hygiene in the Institute

Under the terms of administration of the Clough Memorial Research Fund of the Edinburgh Geological Society a sum of approximately £30 is available annually for the purpose of encouraging geological research in Scotland and the north of England The north of England is defined as comprising the counties of Northumberland Cumberland, Durham, Westmorland and Yorkshire Applications for grants are invited for the period April 1, 1939–March 31, 1940, and should reach the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than February 1, 1939

The fourth Oxford Farming Conference will be held at Oxford on January 3–5, under the auspices of the School of Rural Economy, the Agricultural Economics Research Institute and the Institute for Research in Agricultural Engineering of the University The general theme of the Conference will be 'The Business Organization of the Farm" Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford

The Cambridge University Press will publish early in the New Year "A Short History of the Steam Engine", by Mr H W Dickinson, formerly of the Science Museum, South Kensington The author, it is stated, discusses not only the inventions, but also the inventors.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents He cannot undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK S LETTERS APPEAR ON P 1081

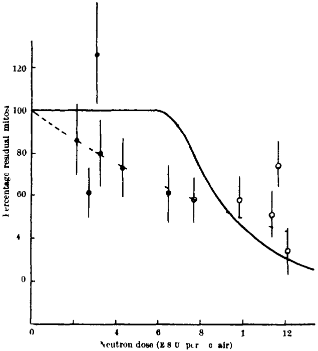
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Biological Effect of Fast Neutrons

CHICK embryo fibroblasts have been irradiated *in vitro* by 2 4 Mev neutrons produced by bombarding heavy wax with ~ 700 microamp of 300 kv deuterium ions This nuclear reaction gives rise to not more than 1 quantum of γ radiation per 200 neutrons [2] and the specimens were completely protected from stray X radiation They were thus exposed to a practically pure beam of fast neutrons The dose given to a culture was estimated from the radioactivity (having the decay period of radio silicon) induced in a tiny pellet of red phosphorus placed directly above it on the cover slip of the culture slide In a separate experiment this radioactivity was correlated with the ionization equivalent of the neutron energy absorbed per unit volume of air as measured by a suitable graphite ionization chamber

The chick fibroblasts were cultivated for five days in Cambridge and then conveyed to Northwood in a portable incubator There the cultures were assessed in terms of their mitotic activity and arranged in comparable batches of six cultures In each experiment the cultures of one batch were exposed one at a time to the neutron beam in a separate laboratory at room temperature and then returned to the incubator (at 37° C) for 80 minutes before being fixed and stained Controls were placed on the bench at room temperature for periods corresponding to the exposure times of the irradiated specimens One batch was placed inside the exposure box but remote from the target as a check on stray X radiation The biological effect was measured by counting all the mitotic cells in the exposed cultures and expressing the result as a percentage of the corresponding control counts The results of the two series of exposures are shown in the accompanying table

Comparable figures for γ radiation have been obtained by Canti and Spear[3] and Spear and Grimmett[4], from which one may calculate values of γ/N the ratio of the γ ray dose (in rontgens) to the neutron dose (in air ionization units) which produces the same biological effect in the same time Calculating this ratio for the *individual slides* using the γ ray data of Canti and Spear and averaging we obtain from Expt 1 (average residual mitosis 81 per cent) $\gamma/N = 22\ 5 \pm 2$ and from Expt 2 (average residual mitosis 54 per cent) $\gamma/N = 11\ 5 \pm 1$, where the probable errors refer to relative values of γ/N According to rough estimates, a ratio of 11 5 corresponds to the production of about the same number of ions per unit volume of tissue by neutrons and by



FULL CURVE γ RADIATION ASSUMING $\gamma/N = 11\ 5$ BROKEN CURVE EXPONENTIAL

	Number of slides exposed	Average neutron dose (E S U /c c of air)		Average duration of exposure (min)		Average mitotic count						Percentage residual mitosis	
						Irradiated slides		Control 1		Control 2			
Expt 1	6	2 15	3 5	41	49	104	98	110	11	107	12	86	81 ± 6
		2 6		62		74		2		1 4		61	
		3 10		40		153		118		94		126	
		3 26		49		9		159		182		80	
		4 73		31		87		94		110		7	
		6 50		53		74		185		102		61	
Expt 2	5	74	10 5	41	42	53	50	105	93	90	90	58	54 ± 5
		9 9		44		53		99		83		58	
		11 4		42		47		70		91		51	
		11 7		45		68		74		132		74	
		12 1		41		31		102		65		34	

Probable errors are estimated from the control data

γ rays This large value arises, of course, from the fact that neutron energy, by contrast with γ ray energy, is absorbed to a very much greater extent in material rich in hydrogen than in air

We can find no explanation for the large difference between the two experimental values of γ/N other than that the *shape* of the mitosis dose curve is not the same for neutrons and γ rays This is evident from the figure in which mitosis is plotted against dose for the individual slides The full curve shows Canti and Spear s results for γ radiation at comparable intensity, from which it is seen that if the neutron curve were of the same shape as the γ ray curve none of the doses delivered in Expt 1 should have produced any diminution in mitosis, whereas in fact five out of six slides showed marked reduction in mitosis, the average reduction being 19 ± 6 per cent So far as we are aware, this is the first occasion on which a difference between the mode of action of neutrons and γ rays has been reported

The neutron points appear to define an approximately exponential curve If this is interpreted as implying that mitosis is inhibited by the passage of a single proton through a specially vulnerable region, the diameter of this region can be estimated at about 3 μ Furthermore because the number of ion pairs per unit volume required to reduce mitosis to 50 per cent is approximately the same for neutrons and for γ rays it follows that provided approximately 1 500 ions are produced within this volume, it is immaterial whether the ions are produced along a straight track or at random That is the biological effect is not the result of the direct ionization by the proton or by secondary electrons of a group of molecules which are indispensable for the performance of mitosis

Obviously many more measurements are necessary to establish the exact shape of the neutron mitosis dose curve, but as we cannot continue the experiment for six months owing to the absence of one member (F G S), we wish to direct attention to the important conclusions which would follow if our provisional estimates are substantiated The effect of neutrons on the mitosis of bean root cells is being investigated at the Mount Vernon Hospital, in collaboration with Dr J C Mottram

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign towards the construction of the neutron generator

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Nov 14

[1] Kallmann and Kuhn *Naturwiss* **26** 106 (1938)

[2] Ruhlig *Phys Rev* **54** 308 (1938)

[3] Canti and Spear *Proc Roy Soc* B **102** 92 (1927)

[4] Spear and Grimmett *Brit J Rad* **6** 387 (1933)

Structure of the Crystals of Tomato Bushy Stunt Virus Preparations

WE have examined by X ray methods crystals of the protein material prepared by F C Bawden and N W Pirie[1] from tomato plants suffering from bushy stunt disease The crystals were in the form of isotropic rhombic dodecahedra of average diameter of only 0 01 mm Consequently, no attempt was made to take single crystal photographs Instead, powder photographs were taken of a suspension of the crystals in their mother liquor With a monochromatic beam of copper $K\alpha$ radiation at 40 cm plate distance and long exposure, two lines were observed of spacings 279 A and 160 A respectively The ratio of these spacings is $\sqrt{3}$ 1, corresponding to the (110) and (112) spacings of a body centred cubic lattice of side 394 A This would correspond to a particle diameter of 340 A or a radius of 17 mμ Although the (200) reflection and higher order reflections are not observed the attribution of a body centred cell is probable as it accords with the dodecahedral habit by Fedorov s law

The density of the crystals in solution was determined as 1 286, the wet molecular weight is therefore assuming two particles per cell 24 000 000 On drying and rewetting the crystals can be observed to shrink and swell reversibly The amount of shrinkage measured under the microscope was 80 per cent of the wet dimensions An X ray photograph of a specimen dried over phosphorus pentoxide showed a cell of side 318 A, giving almost exactly the same degree of shrinkage This is we believe the first time that the shrinkage of a crystal on drying has been shown to be the same as the change in the lattice dimensions measured by X rays If the density of 1 35 computed by A S McFarlane and R A Kekwick[2] is assumed to be that of the dry crystals, this would give a molecular weight of 12 800 000 This is considerably higher than the value of 8 800 000 found by them by the centrifuge method The discrepancy may be due to some of the water in the crystal being held zeolitically and lost without further shrinkage To obtain their molecular weight the density of the dry crystals would have to be 1 12 and the wet crystals would contain 63 per cent of water

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[1] Bawden F C and Pirie N W *Brit J Exp Path* **19** 251 (1938)

[2] McFarlane A S and Kekwick R A *Biochem J* **32** 1607 (1938)

Transformation of α- and β-forms of 3 6-Anhydro-methyl-Galactosides

THE transformation into α and β forms in equilibrium is the usual result of the digestion with methyl alcoholic hydrogen chloride of either an α or β methylglycoside This change is generally attributed to the initial hydrolysis to the free sugar followed by a mutarotation and the regeneration of the two forms of the methylglycoside

We have recently encountered an example of a substance which does not appear to conform to this interpretation of the isomeric change This substance is 2 4 dimethyl 3 6 anhydro α methyl *d* galactopyranoside, a liquid showing $[\alpha]_D + 73°$ in water and $+99°$ in ether It was prepared by methylation of 3 6 anhydro α methyl *d* galactopyranoside which was obtained by alkaline treatment of 6 tosyl α methylgalactopyranoside The anhydro compound is mentioned also by several other workers[1,2,3] We have found that the liquid dimethyl 3 . 6-anhydro-α-methyl-*d*-galactopyranoside changes, by a brief contact with air containing a trace of hydrogen chloride, to the corresponding crystalline β-form, namely, 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactopyranoside (m p 82°, $[\alpha]_D$ − 77° in water, − 87° in chloroform, − 81° in methyl alcohol) Both forms appear, by ebullioscopic methods, to be monomeric, and this is confirmed for the β-form by X-ray examination.

The same isomeric change from α- to β-form was effected by the addition of a drop of a solution of hydrogen chloride in ethyl alcohol or in ether The velocity of this change is apparent from the fact that with gaseous hydrogen chloride or hydrogen bromide the syrupy α-form appears to pass instantaneously into the crystalline β-form, although the solid mass of the product still contains some of the α-form Inasmuch as there is no loss of methyl from the glycosidic group during these transformations, it is clear that the mechanism does not admit of a stage which passes through the free sugar Moreover, we have prepared the same crystalline substance, namely, 2 . 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactopyranoside by following the procedure observed for the α-form, except that we started from β-methylgalactopyranoside It is evident, therefore, that the transformation product derived from the α-form is the true β-form When either the α- or the β-form is treated with methyl-alcoholic hydrogen chloride (2 per cent), at room temperature or at boiling point, polarimetric observations show the rapid establishment of equilibrium of the two forms, and fission, if any, of the 3 · 6-anhydro-ring does not occur to an appreciable extent The presence of the 2 . 4-dimethyl residues seems to stabilize the 3 : 6-anhydro-ring in the presence of acid reagents. The corresponding glucose derivative, 3 : 6-anhydromethylglucopyranoside, does not display with acid reagents instability of the anhydro-ring

Detailed examination of 3 6-anhydro-ring forms has recently assumed a new importance inasmuch as an enantiomorph in the *l*-galactose series has been isolated from a study of the hydrolytic products of agar-agar[3] [4]. Recognition of 2 . 4-dimethyl sugars in the form of their methylglycosides has become a live problem for the reason that we have required these sugars in order to identify the components having 1 : 3- and 1 . 6-glycosidic links which, in the course of our work during the past five years, have been found to occur in the polysaccharide derived from gum arabic Both the α- and β-forms of 2 4-dimethyl 3 : 6-anhydro-methyl-*d*-galactopyranoside are rapidly hydrolysed by dilute acids From the β-form, 2 · 4-dimethyl 3 . 6-anhydro-galactose, m p 112°, was isolated, and this gives the anilide, m p. 123°, and also, by oxidation, the corresponding 2 · 4-dimethyl 3 . 6-anhydro-galactonic acid and its amide, m.p 151°.

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[1] Valentin, *Coll. Czech. Chem. Comm.*, 4, 364 (1932)

[2] Ohle and Thiel, *Ber*, 66, 525 (1933)

[3] Percival, Somerville and Forbes, NATURE, 142, 797 (1938)

[4] Peat and Hands, *Chem. and Ind*, 57, 937 (1938), NATURE, 142, 797 (1938).

3 : 6-Anhydro-*l*-galactose in Agar

IN continuation of our former communication[1] we are now able to confirm that the substance (*X*) derived from agar is a derivative of 3 : 6-anhydro-*l*-galactose as recently advanced by Hands and Peat[2]. 3 : 6-Anhydro-β-methyl-*d*-galactoside, m p. 118°, $[\alpha]_D^{20°} = -113°$ in water has now been synthesized from the crystalline triacetyl 6-*p*-toluenesulphonyl α-*d*-galactosyl-1-bromide ($[\alpha]_D = +157°$) of Ohle and Thiel[3] by treatment with silver carbonate and methyl alcohol followed by deacylation with sodium hydroxide Methylation of this substance yielded quantitatively crystalline 2 . 4-dimethyl 3 . 6-anhydro-β-methyl-*d*-galactoside, m p 82°, $[\alpha]_D^{20°} = -77°$ in water, − 86° in chloroform, which is undoubtedly the enantiomorph of (*X*), since the properties are the same but the sign of the rotation is reversed (mixed m p 65°) We have obtained further confirmation of this point by the preparation of the anilides of the dimethyl anhydro sugars, 2 : 4-dimethyl 3 : 6-anhydro-*d*-galactose anilide having m p 118°, whilst the corresponding derivative from agar had m.p 117° strongly depressed on admixture with the *d*-anilide Furthermore, the properties and stability of the lactones produced on oxidation are in agreement with these findings, so that the substance (*X*) must be regarded as 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*l*-galactoside

The preparation of 2 : 4-dimethyl 3 : 6-anhydro-α-methyl-*d*-galactoside was described in our former letter[1] and isolated as an oil, $[\alpha]_D = +87°$ in chloroform, and both this oil and the crystalline substance synthesized above reach the same equilibrium ($[\alpha]_D^{18°} = +22°$) in cold *N*-sulphuric acid. It has also been found that this oily 2 : 4-dimethyl 3 : 6-anhydro-α-methyl-*d*-galactoside is very sensitive to traces of acid ; contact with cold methyl-alcoholic hydrogen chloride causes a remarkably rapid fall in optical rotation and the crystalline β-form can then be readily isolated.

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[1] Percival, Somerville and Forbes, NATURE, 142, 797 (1938)

[2] Hands and Peat, NATURE, 142, 797 (1938)

[3] Ohle and Thiel, *Ber*, 66, 525 (1933)

"Methyl Epiglucosamine" and 2-Amino α-Methylaltroside

DURING recent years, a series of papers from this laboratory have shown that derivatives of glucose may be converted smoothly into derivatives of altrose, galactose and gulose by means of optical inversion within the molecule[1]. In each case the key substance to such a conversion has been an anhydro-compound of the ethylene oxide type in which the ring is broken under the influence of alkali. For example, 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside or 2 : 3-anhydro 4 : 6-benzylidene α-methylmannoside, in our experience, invariably yield derivatives of altrose when treated with alcoholic caustic potash or sodium methoxide solution.

We are now able to report that an analogous series of reactions may be carried out with derivatives of galactose, and that various crystalline derivatives of idose have thus been obtained (Robertson and Tetlow, unpublished result).

As a natural consequence of this work, we extended our researches to the action of ammonia on 2 3 anhydro 4 6 benzylidene α methylmannoside and 2 3-anhydro 4 6 benzylidene α methylalloside The former, on treatment with ammonia gives a quantitative yield of 3 *amino* 4 6 *benzylidene* α *methyl altroside*, m p 188°, $[\alpha]_D$ + 88 9° in chloroform (c = 0 517) When the benzylidene residue is removed from the above substance by means of 1 per cent hydrochloric acid, 3 *amino* α *methylaltroside hydrochloride* is obtained in 76 per cent yield The substance has m p 209° with decomposition $[\alpha]_D$ − 149° in water (c = 1 028) and is identical with the methyl epiglucosamine hydrochloride prepared by Fischer, Bergmann and Schotte[2] who record m p 210–211° with decomposition, and $[\alpha]_D$ − 147° in water Fischer s methyl epiglucosamine has since been proved to be 3 amino α methylaltroside by Freudenberg, Burkhart and Braun[3]

In analogous fashion, 2 3 anhydro 4 6 benzylidene α methylalloside gives a quantitative yield of 2 *amino* 4 6 *benzylidene* α *methylaltroside* m p 168 $[\alpha]_D$ + 104 7 in chloroform (c 1 346) The above was in turn converted into 2 *amino* α *methylaltroside* m p 193°, $[\alpha]_D$ + 107° in chloroform (c 1 109) in 70 per cent yield The position assigned to the amino group in the above case has not yet been definitely proved, but from analogy with the action of alcoholic caustic potash and sodium methoxide solution on 2 3 anhydro 4 6 benzylidene α methylalloside there can be little doubt that the amino group is in position 2

Full details of the above transformations will be published shortly

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[1] Mathers and Robertson *J Chem Soc* 1076 (1933) Robertson and Griffith *J Chem Soc* 1193 (1935) Oldham and Robertson *J Chem Soc* 685 (193)

[2] *Ber* **53** 541 (1920)

[3] *Ber* **59** 714 (1926)

A New Synthesis of Aromatic Arsenic Compounds

IN the course of a systematic study of reactions between aryl diazonium chlorides and chemical elements, it has been found that aromatic arsenic compounds may be prepared by warming a diazonium chloride under acetone with arsenic powder and chalk With benzene diazonium chloride there is obtained a water soluble product from which tri phenylarsine sulphide has been obtained by precipitation with hydrogen sulphide

The reaction with arsenic is therefore analogous to that with antimony[1], which yielded triarylstibine dichlorides and other aromatic antimonials However, when antimony powder is used, the reaction sets in at 0°, but with arsenic powder there is no reaction in the cold There is a similar difference in degree of reactivity with the elements tellurium and selenium[2], which follow antimony and arsenic in the Periodic Table

The reaction with bismuth powder has also been investigated, but, although the bismuth is attacked when the mixture is heated, aromatic bismuthines do not seem to be formed They may, however, be unstable under the conditions of the reaction

Attention has already been directed to the theoretical significance of these reactions[3], and of the reactions with metals such as mercury and silver which may be attacked by free chlorine atoms but would not be affected if the decomposition of the aryl diazonium chloride took either a molecular or an ionic course A still more striking example of the reactivity of the chlorine has now been found gold powder is also attacked by benzene diazonium chloride under acetone kept neutral with chalk and auric chloride is formed in considerable quantities

In contrast it is rather curious that thallium metal seems to be inert for aromatic thallium compounds can easily be prepared

The scope of this new synthesis of aromatic arsenicals is under investigation in these laboratories

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Nov 15

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[1] Makin and Waters *J Chem S* 843 (1938

[2] Waters *J Chem Soc* 107 (1938)

[3] Waters NATURE **140** 466 (1937) *J Chem So* 200 (193)

Alimentary Exudative Diathesis

DURING the work on K avitaminosis in chicks it is often observed that in some animals large amounts of transparent fluid accumulate for example, in the subcutaneous connective tissue It has now been possible to produce this symptom systematically by using a diet from which the protein has been very thoroughly extracted by alcohol

The accumulations of fluid may be found in all parts of the body but most frequently on the breast and abdomen They are located in the subcutaneous connective tissue or under the skin and in some cases under the fasciæ of muscles Intra peritoneal accumulation is rare

The fluid has the same composition as blood plasma and it often clots when being removed by a pipette In some cases the coagulation has already taken place *in vivo*

Simultaneously with the accumulation of fluid hyperæmia slight hæmorrhage and accumulation of leucocytes occur in connective tissue chiefly in fat tissue under the skin in mesenteric fat or in fat tissue on the serosa of the gizzard A similar condition may also but less frequently be seen in muscle tissue Other tissue has not been observed to be affected The changes resemble a sterile inflammation It has not been possible to propagate any micro organism from the inflamed tissue or from the fluid

The fluid is supposed to originate by exudation from such inflamed tissue in which the capillary wall is rendered abnormally permeable The degree of permeability is such that the plasma may escape while the erythrocytes are only passing through to a limited extent

When chicks weighing 100–130 gm are fed the basal diet, 50–80 per cent of them will show the symptom after 6–30 days The exudates often disappear in about a week, even if the food is not changed, and some of the animals get several attacks during the experiment

Addition of hesperidin together with ascorbic acid to the diet does not prevent the symptom, and it is therefore not likely that the disease is due to deficiency in Szent Györgyi's vitamin P

Neither is it likely that the disease is due to lack of vitamin K, because it has been observed in chicks receiving 0 1 per cent of petrol ether extract of alfalfa in addition to the basal diet. Such a diet contains 20–30 units of vitamin K per gm, an amount which secures normal blood clotting and prevents the 'ordinary' hæmorrhage of K-avitaminosis 40 per cent of dried yeast in the diet gives no protection.

The resemblance of the symptom to an allergic reaction might suggest that the protein had been rendered toxic by the extraction process, for example, by being altered in such a way that a trace is absorbed without being broken down by the digestive enzymes

However, certain observations make it probable that the exudative diathesis is a deficiency disease. Thus the addition of 5 per cent dried alfalfa or 0·5 per cent petrol ether extract or alcohol extract of alfalfa afforded a very material reduction of the percentage of the animals showing the symptom, while 1 5 per cent aqueous alfalfa extract or 0 5 per cent alfalfa ash gave no protection

These and other observations suggest that the disease is prevented by a specific petrol ether- and alcohol-soluble factor occurring in dried alfalfa, but that this material is no powerful source It is therefore proposed to attempt to find a richer source of the protective factor and to concentrate and differentiate it in the usual way

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Trimethylamine Formation in Relation to the Viable Bacterial Population of Spoiling Fish Muscle

Suwa[1] and Poller and Linneweh[2] found that the trimethylamine oxide occurring in the muscle of certain sea fishes is reduced to the corresponding volatile amine during its spoilage by bacteria Recently, Beatty[3] has shown that it is fairly certain that at least 94 per cent of the trimethylamine found in decomposing cod fish muscle arises from the trimethylamine oxide present in this tissue, and not from the other possible precursors Sterile fish muscle[4] and muscle press juice[5] do not reduce the oxide

These, and similar observations made by other investigators, have led to the suggestion that the simple determination of the amount of trimethylamine in sea fish muscle might prove a convenient and accurate chemical test by which its stage of decomposition could be accurately judged[5,6,7], and attempts have been made to compare the viable bacterial counts (or the logarithms of these counts) with the amount of trimethylamine in cod fish muscle press juice[5] or in spoiling haddock muscle[7]

Recent work at this station[8] has shown that, while there is undoubtedly an increase in trimethylamine as the viable bacterial population of lightly smoked sea fish fillets increases, there is by no means a constant relationship between these two values. It seemed possible that not all bacteria occurring in spoiling fish muscle are capable of reducing trimethylamine oxide, and that the discrepancy noted above might well be due to an unequal distribution of the reducing and non-reducing organisms in different samples of fish

In order to investigate this possibility, thirty micro-organisms (15 micrococci, 4 flavobacteria, 6 achromobacteria and 5 yeasts) were isolated at random from fresh halibut and red cod muscle, and from smoked fillets of halibut, red cod and grey cod. Only three of these organisms (2 species of micrococci and 1 achromobacter) formed trimethylamine when grown in dilute aqueous halibut muscle extract sterilized by filtration, or when washed suspensions of their cells were incubated anærobically in Thunberg tubes in the presence of halibut muscle juice, with or without added trimethylamine oxide, at pH 7·0 for 16 hours at 25° C. Under the last-named conditions, the reduction of the oxide by the three cultures capable of effecting its reduction was found to be linear and practically quantitative, suggesting the presence of a specific dehydrogenase enzyme (or enzymes) catalysing the reaction By inoculation of aseptically excised cod fish muscle with trimethylamine-forming and non-trimethylamine-forming species of *Micrococcus*, samples of fish with either high or negligible quantities of trimethylamine, but with high bacterial counts in both instances, have been obtained

From these results, it would seem unlikely that the trimethylamine content alone will prove to be a satisfactory criterion of the degree of bacterial contamination of sea fish muscle, unless the population of trimethylamine-forming to non-trimethylamine-forming bacteria proves to be fairly constant in all cases As yet the full mechanism of the bacterial reduction of trimethylamine oxide to trimethylamine remains to be determined, though recent work by Watson[9] suggests that the lactic or pyruvic dehydrogenase systems are capable of catalysing this reaction

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[2] Poller, K, and Linneweh, W, *Ber*, 59, 1362 (1926)

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[7] Shewan J M, Rep Director Food Invest Bd (London), Sec 4 p 75 (1937)

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A Correlation between the Chemical Constituents and Morphological Structure of certain *Thesium* Species

A CHEMICAL examination of *Thesium virgatum* has been carried out, and two characteristic constituents of the plant tissues have been isolated—a phlobatannin, and an amorphous substance which yields glucose and a steam-volatile oil on hydrolysis These constituents are readily detected in the plant material by a test tube reaction, the phlobatannin with mineral acids yielding a red phlobaphene, and the glycosidic material the free essential oil.

Three of the four sections of the *Thesium* genus mentioned in the "Flora Capensis" are represented in the Cape Peninsula In general, these sections are well defined; but the boundaries between them are not absolute. In an attempt to follow the gradation from group to group chemically, the above qualitative test has been applied to the vegetative portions of a number of *Thesium* species. Arranging the species roughly in the order of evolutionary development as given in the Flora Capensis , the following results were obtained

Section I Imberbia, comprising the species *crassifolium corymbuligerium, ericæfolium, nigromontanum commutatum, virgatum, strictum* All those contained the essential oil glycoside and the phlobatannin Section II Barbata, comprising the species *paniculatum euphrasioides, cuspidatum, acuminatum scabrum pubescens, capitatum* Only *paniculatum* contained the essential oil glycoside, but all except *scabrum, pubescens* and *capitatum* contained phlobatannin Section IV Annulata comprising the species *funale aggregatum, spicatum*, none of which contained either substance.

Although complete seasonal variations have not yet been studied, there seems to be a definite correlation between the structure of the *Thesium* flower and the chemical constituents of the plant In Section I, we have the open type of flower, and with progression to the closed type there is gradual disappearance of the essential oil glycoside and phlobatannin through intermediate types such as *T cuspidatum* and *T euphrasioides* which contain phlobatannin alone

A more detailed account of an examination of the essential oil derived from the glycosidic extract from *T virgatum* will be published elsewhere

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Double Ovaries in Some Chinese Birds of Prey

IT is generally believed that, in the normal condition, there persists only a single gonad the left ovary in female birds But bilateral ovaries are not uncommon in hawks and some species of other birds The finding of such paired ovaries in European and American birds, and even in African birds has already been recorded So far as I know however very little has been recorded on the bilateral development of ovaries in Oriental birds The following is a list of birds of prey which were collected in the Western Hills, near Peiping (Peking) China and examined by me in October last It may be of interest to students of embryology and comparative anatomy as well as to those who are engaged in the study of birds

Name of Species	No of females examined	No of ovaries
Circus cyaneus cyaneus (Linn)	13	2
Accipiter nisus nisosimilis (Tickell)	2	2
Buteo hemilasius (Temminck and Schlegel)	2	1
Buteo burmanicus burmanicus Hume	2	1
Aquila clanga fulvescens Gray	1	2
Milvus lineatus lineatus (Gray)	1	1
Cerchneis tinnunculus japonicus (Tichurst)	–	1

Of the seven species examined, three species only possess two ovaries, and the remaining four species have only a single ovary

There was no exception in species with paired gonads. Of the thirteen specimens of hen harrier (*Circus cyaneus cyaneus*) examined, all had two ovaries This is also true in the case of the Asiatic sparrow hawk (*Accipiter nisus nisosimilis*) and great spotted eagle (*Aquila clanga fulvescens*)

The materials thus studied were secured during the autumn migration, so that the gonads are not well developed All the eggs are more or less uniform in size, and generally speaking, they are rather small

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Effect of Collisions on the Intensities of Nebular Lines

MENZEL[1] has recently stated that There appears to be a widespread misconception concerning the effect of electron collisions on the intensities of forbidden lines In the conventional treatment to which the above statement objects the intensity is given by the formula

$$I = \frac{MA_{21}h\nu}{A_{21}+b_{21}} = \frac{Mh\nu}{1+b_{21}/A_{21}} \qquad (1)$$

where M is the number of atoms excited to the upper state per unit of time A_{21} is the probability of spontaneous emission and b_{21} is the probability of removal from the upper state by collision with electrons atoms molecules etc b_{21} in general increases with the density of these particles and is proportional to the density if the composition and velocity distribution are not altered In this case I remains approximately at the value $Mh\nu$ as long as the density is so low that $b_{21} < A_{21}$ When $b_{21} \gg A_{21}$ however $I = MA_{21}h\nu/b_{21}$ that is I falls off inversely as the density if M the rate of excitation of atoms excited to the upper state, is held constant

Menzel considers there is a fallacy in holding the rate of excitation M constant and proposes the use of the formula for I

$$I = N_1\frac{\omega_2}{\omega_1}e^{-h\nu/kT}\left(\frac{1}{1+A_{21}/b_{21}}\right)A_{21}h\nu \qquad (2)$$

By the use of this formula, Menzel postulates that the rate of excitation M of atoms to the upper state is proportional to the electron density With this assumption the intensity increases with the density at densities that are so low that $b_{21} \lesssim A_{21}$ and asymptotically approaches a constant value at higher densities where $b_{21} \gg A_{21}$ Thus as Menzel states I reaches a maximum when the electron density is high

Formula (2) gives the intensity for the case in which both the excitation and de excitation of N_1 atoms is caused by impacts with an electron gas having a Maxwellian velocity distribution corresponding to a temperature T The formula is not sufficient to discuss the conditions under which thermodynamical equilibrium is reached, since the effects of absorption and induced emission are neglected If they are included, it can easily be seen that, for any finite value of the electron density and the transition probability, the bracketed factor in (2) becomes unity only when the radiation density has the value prescribed by Planck s law for the temperature T Only the Boltzmann factor appears then in (2) This, of course, is merely an example of the well known fact that in complete thermodynamic equilibrium the density of radiation at any wave length is a function of temperature alone and is independent of the probability of spontaneous emission of any line that happens to fall at the wave length, and of the electron density The formula does not apply to any laboratory case since it neglects the effect of de-excitation by atoms, molecules, walls of discharge tubes, etc., which play a major part in laboratory sources. Even in astronomical sources its applicability is very limited, since it requires that the energy available for excitation must increase in a prescribed way as the density is increased

Comparing the density of radiation given by the mechanism postulated by (2) with that of complete thermodynamic equilibrium, it is evident that at low electron densities the permitted (A_{21} large) and forbidden (A_{21} small) lines depart equally from the equilibrium case. At high electron densities, however, de-excitation by collision causes the forbidden lines to depart much farther from the equilibrium case than the permitted lines.

Which of these treatments, M constant or M proportional to density, one uses is largely a matter of personal preference, since neither can lay claim to any uniqueness in describing either astronomical or laboratory phenomena Indeed equally strong claims can be made for considering the intensity coming from unit volume, in which case the number of atoms capable of being excited (N_1 in 2) also increases with the density M then becomes roughly proportional to the square of the density, and an even greater increase of I with the density is obtained than that given by (2)

The important facts which hold true in all of these cases are:

(1) At low densities where de-excitation by collision is negligible, the number of quanta emitted is practically equal to the number of atoms excited regardless of whether the lines are permitted or forbidden Because of the lower excitation potential of the forbidden lines, they become under these conditions the true resonance lines of the atoms or ions concerned. The forbidden lines therefore take a very major role since a large part of the available energy is transferred to them

(2) At high densities the excitation of the forbidden lines remains large. Because, however, of the very high probability of de-excitation by collision compared to the probability of spontaneous emission, only a negligible fraction of the atoms excited succeeds in emitting forbidden lines. Under these conditions, therefore, practically all of the available energy appears in the permitted lines.

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[1] NATURE, 142, 644 (1938)

Photochemistry of Ammonia

THE mechanism of the photochemical decomposition of ammonia has been the subject of considerable discussion lately[1], from which it would appear that the nature of the reaction is almost completely elucidated. The experiments to be mentioned below were designed to settle the few remaining uncertain points regarding the reaction. In point of fact, however, they have opened the results to a new interpretation.

The relevant experimental evidence, discussed in the references cited above, may be summarized thus. From the diffuse nature of the absorption spectrum and the absence of fluorescence, it was concluded that each molecule on absorbing a quantum dissociated into NH_2 and H. The low quantum yield—for example, 0·3 at 20° C. and 100 mm. pressure—was interpreted as due to a back reaction, which was supported by the fact that atomic hydrogen inhibited the reaction Using para hydrogen to measure the stationary concentration of atomic hydrogen, it was found that this concentration was much smaller than that calculated on the assumption that H atoms disappear by the reactions $H + H + X \rightarrow H_2 + X$ and $H + NH_2 + X \rightarrow NH_3 + X$, where X is a third body This anomaly was explained by assuming that NH_2 radicals combine to form hydrazine, which in turn rapidly reacts with atomic hydrogen, thereby maintaining a low stationary atom concentration.

In order to compute the magnitude of this latter process, the effect has been measured of hydrazine on the stationary atomic hydrogen concentration (estimated by para hydrogen conversion) produced by photo-excited mercury atoms The results showed that the low concentration is not due to hydrazine, for the pressure of hydrazine required to account for the low concentration of hydrogen atoms could not possibly be formed during the course of a normal ammonia experiment

This point was made doubly sure in the following way If hydrazine is responsible for the low concentration, then ammonia *undergoing photo-dissociation* should also inhibit the para hydrogen conversion photo-sensitized by mercury atoms A mixture of ammonia and para hydrogen was therefore exposed first to a mercury resonance lamp and then simultaneously to the lamp and to a zinc spark which dissociated the ammonia There was no appreciable inhibition of para conversion when the ammonia was being dissociated, even though conditions were such that inhibition of ammonia decomposition by atomic hydrogen could be detected

The conclusions to be drawn from these experiments are that the low hydrogen atom concentration is not due to the presence of hydrazine, which substance plays no significant part in the photo-chemistry of ammonia, except under special conditions, and that the secondary reactions only involve $H + H \rightarrow H_2$, $NH_2 + NH_2 \rightarrow 2H_2 + N_2$ and $H + NH_2 \rightarrow NH_3$

Another series of experiments gave the probable clue to the dilemma Using the same intensity of radiation for exciting mercury atoms and for dissociating ammonia, it was observed that the ratio of the rates of para hydrogen conversion is very nearly equal to that expected if only one quarter of the ammonia molecules absorbing light yield the products NH_2 and H

These experiments therefore suggest that only a fraction (given approximately by the quantum yield) of the ammonia molecules undergo primary dissociation to H and NH_2, which react in the fashion mentioned above. The remainder lose their energy by chemically ineffective processes.

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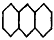
[1] Taylor, H. S, *J Phys Chem.*, 42, 783 (1938). Leighton, P A, "The Determination of the Mechanism of Photochemical Reactions", 27 (Paris: Hermann et Cie)

Fluorescence of Solids

THE following observations may be of interest in view of the present interest in problems of fluorescence of solids Anthracene (I) in the solid state fluoresces blue with a high efficiency, the absorption band lying at wave lengths shorter than 3800 A Solid naphthacene (II) is yellow in colour and fluoresces very faintly, and solid pentacene (III) is dark bluish and does not fluoresce appreciably In dilute solid solution in anthracene, however, the latter hydrocarbons fluoresce vividly, the former greenish yellow and the latter red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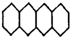
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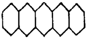
III

The chief point of interest is that this fluorescence is stimulated by light absorbed by the anthracene, while the blue anthracene fluorescence is almost entirely suppressed These phenomena closely resemble those observed with a typical inorganic fluorescent solid such as zinc sulphide, the emission of which is completely changed by minute additions of copper, etc

It seems one must suppose, that an electron free to move is liberated by absorption of light within the anthracene crystal, and that the positively charged anthracene molecule quickly regains an electron (without emission) by an exchange through the crystal from a distant naphthacene or pentacene molecule The latter molecule, now minus an electron emits its characteristic fluorescence when a free electron returns to it Since the crystal structure of anthracene is well understood it is possible that these phenomena are capable of theoretical treatment

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Points from Foregoing Letters

Dr F G Spear Dr L H Gray and Dr J Read report that the relation between the dose and the percentage residual mitosis in *in vitro* cultures of chick embryo fibroblasts after irradiation with D D neutrons is not the same as the sigmoid relation found for γ radiation but is more nearly exponential An exponential relation would be anticipated in the case of neutron irradiation if inhibition of mitosis resulted from the production of about 1 500 ion pairs in a volume of about 3 μ in diameter

X ray study of crystals obtained from tomato bushy stunt virus preparations indicate according to Prof J D Bernal I Fankuchen and D P Riley a particle size of 340 A diameter and a molecular weight of 24 million, for the wet particle of density 1 286 If the density of 1 35 computed by McFarlane and Kekwick is assumed to be that of the dry crystals, it would give for these a molecular weight of 12 8 million, a substantially larger figure than the value of 8 8 millions derived from experiments with the ultracentrifuge

The almost instantaneous change of the syrupy alpha form into the crystalline beta form of the 2 4 dimethyl 3 6 anhydro methyl *d* galactopyranoside in presence of traces of gaseous hydrochloric acid indicates according to Prof W N Haworth J Jackson and Dr F Smith, that the usual mechanism assumed for such transformation namely initial hydrolysis to the free sugar followed by a mutarotation and the regeneration of the two forms of the methylglycoside, does not apply in this case

Dr E G V Percival and I A Forbes confirm that the substance recently isolated from agar is a derivative of 3 6 anhydro *l* galactose They have synthesized its enantiomorph 2 4 dimethyl 3 6 anhydro β methyl-*d* galactoside, which has the same properties but opposite optical rotation

Various crystalline derivatives of idose have been prepared from galactose derivatives by Dr G J Robertson, W H Myers and W E Tetlow by employing an anhydro compound of the ethylene oxide type in which the ring is broken under the influence of alkali They have further prepared 2 amino α methyl altroside and 3 amino α methylaltroside hydrochloride the latter identical with methyl epiglucosamine hydrochloride

Dr W A Waters reports that aromatic arsenic compounds are formed when arsenic powder is warmed with an aryl diazonium chloride under acetone containing chalk Under the same conditions gold is also attacked and yields auric chloride but thallium seems to be inert

Chicken fed upon a diet in which the protein has been very thoroughly extracted by alcohol may develop in the connective tissues large accumulations of transparent fluid of the same composition as the blood plasma Dr H Dam and J Glavind consider that this is the effect of a deficiency disease

It is stated by Dr H L A Tarr that only certain and probably a small proportion of the micro organisms which are commonly associated with decomposing sea fish muscle are able to reduce the trimethylamine oxide occurring therein to trimethylamine This fact probably accounts for the finding that there does not always appear to be a close correlation between the viable bacteria count and amount of trimethylamine in this medium

P C de Kock and Prof W S Rapson find that in various species of the South African genus *Thesium* the presence or absence of the easily identifiable chemical constituents phlobatannin and/or glycosidic material, corresponds to the grouping of those species according to the structure of their flowers and other morphological characters

Prof I S Bowen and Dr R Minkowski suggest that Menzel s recent discussion of the effect of collisions on the intensities of nebular lines is based on a special case, in which the apparent increase in intensity of forbidden lines with density is a result of the assumption that the rate of excitation increases with the density They emphasize that, while forbidden lines take a major role at low densities, de excitation by collisions prevents them from emitting an appreciable fraction of the available energy at high densities

Research Items

Jades from Central America

A NUMBER of the jades bequeathed to the British Museum by the late Mr T W Gann are figured and described by Mr T A Joyce in the *British Museum Quarterly* 12 4 1938 This collection of Central American carvings in jadeite and basalt is said to be one of the finest ever acquired over a number of years by a single individual The sites from which they were obtained are unfortunately not defined with accuracy but they obviously come from the Central Maya area and in the main from British Honduras They illustrate the extraordinary facility with which the early inhabitants of Central America ignorant of the use of iron could carve hard stone The finest piece a jadeite plaque represents a seated chief in full regalia with an attendant in the style which is associated with Copan and recalls the seated figures represented on a lintel from that site now in the British Museum It is clear that the plaque has been trimmed possibly owing to an accidental breakage in early times Ornaments of this class were regarded as heirlooms and much treasured by later generations owing to the fact that jadeite seems to have become exceedingly rare A basalt mask exhibiting a high degree of skill in modelling was evidently inlaid with other materials to represent eyes and teeth but as in most other examples the inlay has disappeared Incised lines on cheeks and chin probably represent designs painted on the face Some of the pendants representing a human head enclosed in the jaws of a monster are symbolical of the earth which swallows the sun every evening There are no glyphs to give a clue to the dating of the pieces but evidently they antedate considerably the discovery of America An eccentric flint from the collection is described as the most remarkable example of stone flaking technique which has yet come from Central America

Studies in Alcohol

W W JETTEN (*Amer J Med Sci* 196 475 487 1938) carried out two series of observations The first which was concerned with the diagnosis of acute alcoholic intoxication by a correlation of clinical and chemical findings was made on 1 159 consecutive persons admitted to hospital with a diagnosis of acute alcoholism In 1,150 cases blood was obtained for analysis and in 381 the urine was also examined The results were as follows Alcohol was found in the blood of 1 000 cases and in all the 381 cases in which the urine was examined Of the 1 000 cases with alcohol in the blood 779 (77 9 per cent) were found in the concentration groups of 0 15 to 0 30 per cent alcohol inclusive and of the 381 cases in which the urine was examined 266 (70 per cent) showed a concentration of 0 20 to 0 35 per cent alcohol inclusive Clinical intoxication was found in the blood series in approximately 10 per cent of the cases with a concentration of 0 05 per cent alcohol in 18 per cent at 0 10 per cent alcohol, in 47 per cent at 0 15 per cent alcohol , in 83 per cent at 0 20 per cent alcohol , in 90 per cent at 0 25 per cent alcohol , in 95 per cent at 0 30 per cent alcohol and in 100 per cent in a concentration group of 0 45 per cent alcohol The second group of observations consisted in the determination of the alcohol content of the blood at regular intervals following ingestion of 1, 1 25 1 5 and 2 c c of alcohol per kgm of body weight in twenty non alcoholic individuals that is occasional drinkers or total abstainers Jetten found that acute clinical intoxication occurred in 50 per cent of the cases in which the alcohol concentration in the blood ranged from 0 075 to 0 125 per cent in 57 per cent in concentrations from 0 125 to 0 175 per cent and in 100 per cent in concentrations from 0 175 to 0 225 per cent alcohol The incidence of acute clinical intoxication in these non alcoholic individuals at low alcoholic concentrations was much higher than the incidence at similar concentrations in a larger group of chronic alcoholics

Conjugal Tuberculosis

H COUETOUX (*Thèse de Paris* No 387 1938) has made a study at two dispensaries in Nantes of 816 married couples of whom one at least was tuberculous and found that in 112 (13 72 per cent) the other partner was also affected In the adult population of Nantes calculation of probabilities showed that if there were no question of contagion between husband and wife the rate of tuberculous infection among couples would be 1 69 per cent Comparison of these two figures shows that the first member of the married couple to contract tuberculosis is responsible for infection of the second in 12 03 per cent of the couples in which tuberculosis is present Conjugal contagion therefore is the most important factor in the causation of tuberculosis in the second member of a married couple

Eggs of the Komodo Lizard

IN the Sourabaya Botanical and Zoological Gardens in the Dutch East Indies are four specimens of the giant lizard *Varanus komodœnsis* two of which have been there since 1927 and two since 1935 In July 4 1937 individuals were seen in copulation and by August 13 it was discovered that the female which had been placed in an enclosure with abundance of humus had laid two eggs which turned out to be addled (*Treubia* 16 365 August 1938) Later, a nest of eggs was found in the heap of humus , one egg was extracted and found to weigh 136 grams but the others did not hatch and when the nest was opened in January 1938, only 14 desiccated parchment like egg shells were revealed This excavation however revealed a second nest with 10 eggs One of these was examined at the time and contained a living embryo which had not become immersed in the mass of light yellow yolk The remainder left to develop were found five weeks later to be shrivelled but six contained embryos in various stages of development the largest measuring 27 cm from snout to tip of tail The authors E L Tänzer and Jhr W C van Heurn, consider that the embryos died at an early stage of development, and that the cause of death was some deficiency in the humus environment It is to be hoped that future results will be more successful, for the development of a skull so curious as that of the Komodo lizard is a matter of great interest

Brackish-water Fauna of Orkney

THE lochs of Stenness and Harray present an interesting biological problem, for while they are connected with each other and, by way of Stenness, open into the sea, they present very different aspects of brackish water conditions. Both receive fresh water streams, but the former is partly tidal and its fauna and flora have a predominantly brackish character throughout an area which at the time of examination by Dr. Edith A. T. Nicol showed salinities varying from 9 to 26·8 parts per thousand (*Proc. Roy. Soc. Edinburgh*, 58, 181; 1938). On the other hand the Loch of Harray receives a contribution of sea water only at spring tides, and as a consequence is almost fresh (salinity 0·6–4·3 parts per thousand) and possesses a fauna and flora almost wholly composed of freshwater species. The two lochs are the only Scottish localities for the mollusc *Neritina fluviatiles*, and the dwarfing effect of brackish conditions is seen in the miniature size of this species and of *Mya arenaria*. *Hydrobia jenkinsi*, present in both lochs, appears to be a recent immigrant.

Sheep Population of South Australia

THE number of sheep present in South Australia has been recorded yearly since the foundation of the Province in 1836. Dr. J. Davidson has analysed these records and compared the data with the Verhulst-Pearl logistic curve expressing the course of the growth of a natural population (*Trans. Roy. Soc. S. Australia*, 62, 141; 1938). The progress of sheep numbers during the past hundred years, while showing for the first forty years a rapid and steady increase which coincided with the theoretical growth of a population, began to exhibit marked fluctuations from the normal curve so soon as the limit of density was approached. Saturation density of the sheep population which a natural pasture can carry is determined in the main by the feeding value of the pasture and the regrowth of plants eaten by the sheep. When the density exceeds this value the balance is upset and the carrying capacity of the area will decline. Recovery of numbers depends upon the degree of overgrazing and the power of the pasture to recover. In the arid climate of South Australia recovery is mainly dependent upon rainfall, and may be considerably delayed.

Role of Fructosans in Carbohydrate Metabolism

IN a recent study of the interrelationship of sucrose, glucose and fructose (including fructosans) in the barley plant (Archbold, H. K., *Ann. Bot.*, N.S., 2, 183, 403; 1938), attention is once more focused on the question of interconversion of these sugars in stems and leaves. The methods of sugar determination are reviewed in the first paper, and the results presented in the second. The observation that, while the concentration of reducing sugars decreases from apex to base in the stem, that of fructosan and of sucrose rises, entirely supports the view that fructosans are secondary in origin, in spite of the fact that they are here found in leaves; and that they arise from reducing sugars and not from sucrose. Any condition which limits the demand for soluble sugars (for example, removal of ears, nitrogen deficiency, etc.) causes an increased accumulation of fructosan in the leaves, where under normal conditions it is present only in small amounts. It is shown that in leaves no conversion of fructose to glucose is necessary to account for polysaccharide production, provided that fructose is the sole source of carbon for respiration, and largely for protein synthesis. In stems, however, such a conversion does seem necessary. On the other hand, the formation of fructose from temporarily immobilized sugar seems to necessitate conversion of glucose to fructose, a process which may be reversed when sugars are again in demand.

Morphology of *Sorghum* Species

A STUDY of the internode and sheath lengths of *Sorghum* species by Rangaswami Ayyangar and his co-workers has shown that, in general, the longer the species is in reaching maturity, the taller the plants and the greater the number of internodes (*Proc. Ind. Acad. Sci.*, 7, 1938). On the basis of these measurements, they divide the *Sorghum* species into three groups; in group 1, including the early species, the internode length shows a steady increase from the base of the plant to the peduncle; in group 2, the medium species as regards maturity, the internode length increases up to a peak, then falls before increasing again to the peduncle; whilst in group 3, the late species, the internode length rises to two peaks before finally rising to the peduncle. Thus groups 2 and 3 show a unimodal and bimodal distribution of internode lengths respectively. The internodes are apparently measured from ground level; for greater exactitude, it would have been useful to indicate the position of the first internode measured relative to the internodes produced by the shoot above the coleoptile. The sheath lengths give the same general distribution as internode lengths, but to a less marked extent. The tillers do not necessarily show the same internode distribution as the main axis; in some bimodal species, the tillers, with their shorter growing period, have a unimodal distribution. In breeding, short stems, early maturity, coupled with unimodal distribution, behave as simple dominants to tall stems, late maturity and a bimodal distribution of internode lengths.

Mould Fungi of the Punjab

H. CHAUDHURI has recently published a detailed annotated list of moulds of the Punjab (*Proc. Ind. Acad. Sci.*, Sect. B, 8, No. 2, Aug. 1938). Sixteen species of the genus *Penicillium* are described, and with the collaboration of M. Umar, 31 species of *Aspergillus* are further considered. Cultural and microscopical characters are given in detail for many of the important species, whilst references to further work are cited for all. The mould flora of the Punjab contains some indigenous elements, but many of the species described are widely distributed. Species of *Aspergillus* and *Penicillium* which occur in India, but have not so far been recorded in the Punjab, are included in the papers, thus making them, in effect, part of a mould flora of India.

Plant Diseases of Greece

THE *Verticillium* wilt of cotton is distributed over wide regions where the host can grow, but the advent of this disease to Greece is somewhat puzzling. J. A. Sarejanni discusses the question in a paper entitled "La Verticilliose du Coton en Grece" (*Ann. Inst. Phytopathologique*, Benaki, 2nd year, 2nd fascicule, 79–85; 1936). Native Greek cotton is immune to attack by the fungus *Verticillium alboatrum*, but several American varieties were introduced a few years ago. These were quickly attacked by the wilt fungus, and after a survey of possible sources of infection, it is concluded that spores of the organism were either carried upon the fibres surrounding the seed, or were present in the water of irrigation. The latter method, though implying wind transmission of spores over considerable distances, appears to be the more likely, as the cotton seed was disinfected against *Bacterium malvacearum*, which treatment should also kill the spores of *V. alboatrum*. The same author also announces, in subsequent notes, the discovery of *Septoriella oleicola*, a newly described parasite of the olive, and *Microdiplodia capsici*, a new species parasitic on pimento.

Recent Earthquakes recorded at Hamburg

DR. E. TAMS reports that earthquakes have been recorded recently at Hamburg as follows: (1) Nov. 5d. 8h. 55m. 34s. *P* compressional epicentral distance 9,300 km. (2) 5d. 11h. 2m. 24s. *P* compressional epicentral distance 9,300 km. (3) 6d. 9h. 6m. 0s. epicentral distance 9,000 km. (4) 6d. 27h. 50m. 57s. *P* compressional at epicentral distance of 9,000 km. (5) 9d. 9h. 28m. 11s. *P* dilatational epicentral distance 9,100 km. All the times are in G.C.T. These confirm the readings from Kew and Stuttgart given previously and probably refer to an epicentre or epicentres under the Pacific Ocean to the east of Japan.

Acetylcholine Hydrolysis

CONTINUING their work on the kinetics of choline esterase *in vivo*, Clark and Raventós (*Quart. J. Exp. Physiol.*, **28**, 155 and 177; 1938) have compared the rate of hydrolysis of acetylcholine by strips of frog's auricle with the rate of recovery of the heart from stimulation of the vagus nerve. It is suggested that a single stimulus to the nerve releases around each heart cell some 20,000 molecules of acetylcholine, most of which is destroyed by hydrolysis. The hydrolytic process is a relatively slow process, 5–10 sec. being required to reduce the concentration of the acetylcholine liberated to half. The contracture evoked in the skeletal muscle of the frog by application of acetylcholine, similarly, is a long-lasting phenomenon, and the authors consequently doubt the existence in muscle of an enzymic system capable of destroying, within a few milliseconds, the acetylcholine liberated at the endings of a motor nerve.

Flavour and Aroma of Butter

CONTROL of the physical condition of butter is more or less a mechanical function, and large differences in texture are rarely encountered. Flavour and aroma, on the other hand, are determined by a complex of biological, biochemical and chemical reactions and in consequence may vary widely. E. G. Pont has recently discussed some of these problems (*J. Australian Inst. Agri. Sci.*, **4**, No. 3, 131). Generally speaking, butters may be divided into two groups, one being full flavoured, acid and prepared by a starter containing bacteria, the other being mild, slightly acid or even alkaline, for which no starter is required. The former is largely produced in Denmark and many other Continental countries, whereas the latter is manufactured almost entirely in Australia and New Zealand. Fullness of flavour, however, appears to be directly dependent on the diacetyl content of the butter, brought about by the complex fermentation processes induced by the starter. Unfortunately, the series of auto-oxidative reactions do not cease at the desired point, with the result that starter butter has not nearly such good keeping quality in cold storage as the non-starter type. The chief problem, therefore, is to find some means of improving the flavour without reducing the keeping quality. Since diacetyl itself, in the concentrations found in butter, does not actively promote deterioration, there is no fundamental reason why the flavour of the mild type of butter could not be intensified without affecting its other desirable qualities. There are, however, considerable technical and other difficulties in the way, but in view of the fact that on the English market (which absorbs the bulk of the Australian butter) a product with a full flavour always commands the better price, the point is considered worthy of further attention.

Hydration of Vitamin B_1

THE water of crystallization of vitamin B_1 (which is deliquescent) has been variously given as one half, one, or approximately one, molecule of water per molecule of vitamin. W. A. Bastedo, N. R. Trenner and T. J. Webb (*J. Amer. Chem. Soc.*, **60**, 2303; 1938) have determined this magnitude by different methods. They find that the results of dissociation pressure measurements are liable to lack of reproducibly owing to minor details in the preparation of the vitamin, such as methods of removing solvent, etc. Standardized procedures were adopted, but it was found that slight variations in the aqueous pressures to which the samples were exposed gave rise to appreciably variable water contents of the vitamin, indicating that the problem was not one of an ordinary system of hydrates. The degree of hydration corresponded with about 0·4 per cent of water at 1 mm. pressure of vapour and varied continuously to 5·2 per cent at 19 mm. At the vapour pressure of the saturated solution, 20·9 mm., the degree of hydration corresponds approximately to one molecule of water of crystallization per molecule of vitamin.

Paths of Ions in the Cyclotron

IN the cyclotron, particles are introduced near the centre of a magnetic field and are accelerated by a periodic electric field applied between two semicircular electrodes. The particles describe closed circuits in time with the alternations of the field, so that they are accelerated at each revolution and the size of their orbits continually increases. If the velocities are so high that the relativity value of the momentum differs appreciably from *mv*, the time of description of a circuit in a uniform field will increase with increasing velocity and the particles will get out of phase with the electric alternations unless the magnetic field increases radially. It has been shown by Bethe and Rose that a radially increasing field exercises a defocusing action on the ions, causing them to diverge on either side of the median plane. This effect sets a limit to the velocities usefully obtainable with the cyclotron. L. H. Thomas now shows (*Phys. Rev.*, **54**, 580; 1938) that a variation of the field with polar angle may introduce a compensating focusing effect. The required variation is of the order v/c, and the variations considered in the paper are a function of the radius and have period $\pi/2$ in angle. It is shown that the resulting orbits for the particles are stable, and that the focusing obtained is not upset by the presence of the electric field. The Bethe-Rose defocusing limitation on the performance of the cyclotron can therefore be removed in principle.

Molecular Films*

THE forces between molecules of organic liquids of non ionic type are ordinarily of such short range that they act only when the molecules are in contact The magnitude of the force depends mainly upon the area and the nature of, the two contacting molecular surfaces This principle of independent surface action has been a useful guide in the development of theories of surface tension phenomena and should be equally valuable for theories of vapour pressures and solubilities It leads directly to the concept of molecules having hydrophobic and hydrophilic parts which spread as oriented monolayers on a water surface

Such monolayers can have the properties of two dimensional gases, liquids or solids A type of film called a duplex film, having no three dimensional analogue, has two interfaces (an upper and a lower) which are separated by a thin three dimensional layer (the interstratum)

Expanded films such as monolayers of myristic acid on acidulated water are duplex films in which the interstratum is a hydrocarbon liquid The lower interface contains all the hydrophilic groups These, because of thermal agitation constitute a two dimensional gas that exerts a surface pressure causing the expansion of the film

Many proteins, although very soluble in water form remarkably insoluble monolayers which are duplex films The interstratum consists of polypeptide chains which form loose loops attached at intervals to the upper interface by hydrophobic groups These give to the upper interface the properties of a two dimensional gas When the monolayer is compressed some of the hydrophobic groups are driven from the upper interface into the interstratum The irreversible formation of the monolayers indicates that the globular proteins have an entirely different structure and gives support to the cyclol theory

The viscosities and elasticities of monolayers furnish information regarding the cross linkages between the chains

Stearic acid spread on water containing traces of barium salts gives monolayers which can be deposited by a dipping process upon solid plates By successive dips any number of layers up to 3 000 can be built up Optical measurements involving interference of light reflected from the top and bottom surfaces, give accurately the thickness of the film

Single monolayers of various substances, deposited upon barium stearate multilayers of critical thickness (about ¼ wave length) are readily visible to the naked eye because of the change of colour With monochromatic light the thickness of the monolayer can be measured to within about 2A

The barium stearate multilayers are both hydrophobic and oleophobic (non wettable by oil) Dipping into dilute solutions of thorium nitrate causes an overturning of the outside layer of molecules making the surface polar and hydrophilic Such conditioned surfaces can absorb many organic substances from solution giving observable increases of thickness This technique serves as a valuable tool in biological investigations

Free stearic acid in barium stearate multilayers can be dissolved out by dipping the film into benzene containing 1 per cent alcohol, leaving a skeleton of unchanged thickness but of refractive index which may be as low as 1 2 The application of a drop of oil fills the pores of the skeleton without wetting the surface and restores the original colour Films of many substances may be deposited upon skeleton films and the permeability of the deposited films to liquids or vapours can thus be measured optically

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* Substance of the Pilgrim Trust Lecture delivered by Dr I Langmuir For Mem R S before the Royal Society on December 8

A Primitive Philosophy of Life*

IT has been rather the fashion of recent years to make too light of what is known as the comparative method in anthropology, used with such effect by Sir Edward Tylor and perfected by Sir James Frazer So much of the work Frazer has done in that field is now taken for granted, that we are perhaps too prone to forget that but for the comparative work done by him much of the intensive investigation into particular areas which is now possible would scarcely have begun to take place In the present lecture, a hypothesis is put forward in regard to certain conceptions on which Sir James has had much to tell us—conceptions of life

That conception of life which forms the subject of the lecture was first thrust on Prof Hutton s attention when investigating the head hunting practices of the Naga tribes of Assam The Karen apparently regard the soul as leaving the body and proceeding to the underworld where eventually it becomes a vaporous substance in a bladder or egg, which bursts, and the contents spread over the fields, fertilizing the developing flower of the rice plant and other herbs of the field This seems to embody a conception of life as a material finite substance—a vaporous matter, limited in form and extent, and on the possession of which the propagation and renewal of life depends It is to be noticed that this condensation of the life substance does not take place immediately after death, but the shade of the deceased continues to exist in a land of shades as a sort of separable soul, before the pupating process, which precedes the next manifestation of the psyche as a sort of fertilizer of vegetation Clearly the belief of the Karens is not rudimentary but has been the subject of speculation and elaboration.

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* A Primitive Philosophy of Life By Prof J H Hutton (The Frazer Lecture 1938) Pp 24 (Oxford Clarendon Press London University Press 1938) 2s net

This idea of the Karens does not stand alone, but has many parallels, particularly in the Indonesian area. The notion of dew as embodying life seems to be widespread, and was not unfamiliar in Great Britain, for example, in the seventeenth century. One of the most meticulous and detailed beliefs about life-material, or 'soul-substance', is recorded among the Kai of what was formerly German New Guinea. Life-material is there identified with the shadow, the reflection and the personal name, and appears to reside in every part of the body, saliva, excreta, the glance of the eye and even the voice. This idea is not foreign to civilized ideas, for it appears in Plato's "Timæus", and is said to be found in the Taoist philosophy of China, while in the Vedanta philosophy of Hinduism, the body is the exterior of a series of sheaths encasing the soul, of which the interior less material sheaths accompany it on its migrations.

Soul material is particularly strong in certain parts of the body, particularly the head. In San Cristoval, one soul emerges from the head after death, a round stone or fossil being used as a receptacle, in which it is placed among the family gods, or, it may be, in the fertilizing waters of a river. The other part of the soul similarly goes into a sacred stone of a baetylic nature, just as the soul in so many Naga tribes enters the wooden statue on the grave, or the memorial stone erected in the rice fields. A third possible destination for the San Cristoval souls is the mandible of the deceased. Hence the mandible of a dead chief is preserved to bring luck in hunting, or to remind them of the duty of blood revenge. The importance of the lower jaw is widespread in Indonesia, and extends to Polynesia, while in West Africa the possession of the mandible gives power over the ghost.

These beliefs in the selective location of the soul-substance in the head, and its relation to fertility, are basic in the practice of head-hunting. The Kwotto seem to state specifically that the enemy head is abstracted in order to transfer to the decapitator, or rather to his community, the virility and power of the slain, and so to build up a sort of virility-power reserve, to be drawn on as the community requires.

In many instances the life material is in the blood; and Sir James Frazer mentions many instances wherein the blood of the killed is partaken of by the killer, as well as carefully avoided, because it contains the life of the dead animal. The liver, the heart, the brain, or the eye are regarded as seats of life by various races. In parts of Papua a man will choose to eat particular parts of the body to reinforce some weakness of his own; while elsewhere people stand under the platform of the deceased to absorb his qualities by anointing themselves with the putrescent fat. Cannibalism, as an act of mourning, may also arise from this same soul-substance notion, as in Australia survivors are urged to eat portions of their dead, so as not to disturb the camp with their mourning.

That life material is regarded as present in grain is indicated by the abhorrence with which the code of Manu regards the act of pounding or grinding it, while in Indonesia plants are regarded as having soul-substance similar to that of man. Many tribes plant a coconut at the birth of a child, when the soul substance of the child is bound to the tree as it grows up. Similarly in Africa, there are stories of the transference of a soul to a plantain tree by means of the placenta planted at its foot, and in India of the fertilization—pollination as it were—of women from the flower of jasmine, or by the petals of the rose tree growing from the tomb of some long-buried saint.

Human sacrifice is clearly traceable in many cases to this same belief in life as a finite substance to be transferred from one person to another, or to vegetation and livestock. Human sacrifice, it has been pointed out, seems to be particularly closely associated with agriculture. It is possible that the association between the souls of dead ancestors and the crops is to be traced to some practice of collecting wild grass seeds and leaving them by the dead as a provision for the future, and the observation of their germination and growth. It has been suggested that the practice of agriculture may have started in this way. It is therefore not inconceivable that the desire to provide for a crop of food grains may have sometimes led to the slaughter of an individual to afford a good grave.

Another aspect of the idea of life as something concrete and finite is in its separability from the body. Hence it must be conceived in some sort of form, and we find it commonly as bee, butterfly, firefly or beetle. It seems clear then that from this conception may arise a philosophy of the soul, conceived in zoomorphic or anthropomorphic shape, while its situation in various parts of the body gives rise to the idea of a multiplicity of souls. From this the way is open to the development of every form of animism, polytheism, or monotheism, to say nothing of a conception of metempsychosis and a future life. Again, from this source are likely to develop theories of nagualism and lycanthropy, at any rate of the kind found in Assam and West Africa; also the idea that the collective soul of the herd may be specially associated with a single individual, as in Indonesia one animal is the leader, or a *Ficus* tree in a grove is considered the chief, who takes care that the soul substance of the other trees does not vanish. So the leader of a community could be the special receptacle of the communal life material, and totemism, so often associated with the external soul, would then be traceable to the same idea. It is possible that ideas about incest, so difficult to account for, may be derived from the same idea, for exogamy is necessary to amass fertility and life from outside the community; while for kings, incestuous marriage was enjoined, whether in order to keep the tribal life pure, or as Sir James Frazer suggests, to maintain hereditary right to rule, which has been vested in the female line.

A first stage in abstraction leads to the idea of life as a force or power, *mana*, then, perhaps inevitably, to taboo, while one aspect of the soul substance doctrine tends directly to sympathetic magic, as action on hair, nails, spittle, etc., affects the whole, of which it formed a part.

Question arises how did this idea originate. It seems probable that limitations of language have played a part in determining ideas as to life and soul. Primitive language is very rich in concrete terms, but poor in abstract. No doubt the lack of any terms other than concrete ones, representing a similarly restricted mental imagery, has been largely responsible for the idea of life as a concrete finite element and, therefore, for the idea of soul substance.

National Parks

AT a meeting of the Linnean Society held on December 8, the objects of national parks were discussed The immediate cause of the discussion was a letter from Prof J B Cleland, chairman of the Commissioners of the National Park at Belair, South Australia, who asked for "an authoritative definition of a National Park" and an expression of opinion as to how far facilities for sport and recreation should be allowed to replace the original flora and fauna, especially when the Park is near a large city

Prof T G B Osborn, a former commissioner, gave an account, illustrated by lantern slides, of the Park at Belair It is an area of 2,000 acres in the hills to the south west of Adelaide, about eight miles by road from the city Its history as a park dates from 1891, but the area has been preserved in a semi wild state since shortly after the foundation of the Colony in 1837 Formerly known as the 'Government Farm', it served as a depot for horses of the Police and Survey Departments The western end is relatively level, with open eucalypt forest (red gums, manna gums and peppermint) and grassy undergrowth This is the part which has been most influenced by grazing of horses and clearings for sports grounds From this area, which lies at about 850 ft altitude, two narrow, steep sided valleys run into the eastern part, which in one corner reaches 16,000 ft The valley bottoms have been largely cleared of timber, though magnificent specimens of the original gums are left Exotic trees have been planted among them, and the growth of grass encouraged Here again, sport facilities and picnic facilities have been provided Most of the steep valley sides and surrounding hills are relatively unaltered and have a covering of stringy bark or pink gum trees with shrubby undergrowth Some 350 species of indigenous flowering plants and ferns, including about 50 species of terrestrial orchids, have been recorded

An area of seasonal swamp is of special interest as a habitat of the rare lycopod, *Phylloglossum*, and a terrestrial *Isoetes* A measure of the interference with the flora is seen in the 150 species of alien plants naturalized in the Park The indigenous mammalian fauna is probably extinct, but many interesting reptilian species remain Eighty one species of birds have been recorded Like other parts of the Mount Lofty Ranges, the Park is liable to damage from fires during the dry season The indigenous vegetation recovers rapidly after burning, but frequent forest fires open the way to invasion by alien species Grazing by horses helps to keep the grass short, and so reduces the danger of fires during the dry season The Commissioners have not a large grant for maintenance, so they welcome the fees from depasturing horses A considerable addition to revenue is obtained from the hire of sports grounds, tennis courts, and pavilions for picnics

Sir Peter Chalmers Mitchell, speaking on behalf of the Society for the Preservation of the Fauna of the Empire, defined a national park as an area under public control, with unalterable boundaries, in which wild animal and plant life is preserved, and hunting or collecting only allowed under licence He agreed that there is need to modify the definition to meet the case of smaller areas near towns, for it is unreasonable to expect that an area so situated should be left exclusively for naturalists

Dr Julian Huxley pointed out that this definition was meant primarily for Africa As a member of the Standing Committee for National Parks of the Council for the Preservation of Rural England, he emphasized that a national park in Great Britain should be an extensive district of beautiful landscape left in traditional usage Whilst in Africa the preservation of flora and fauna might be the chief object, in England possibilities for recreation, walking and camping in unspoilt countryside must take precedence In his opinion, the Park at Belair in South Australia is too small to fulfil the functions of a national park, but it should be possible to restrict games to certain areas, and to establish sanctuaries in the wilder parts The ideal of a national park for England embracing an extensive district (50–200 square miles) of wilder countryside, was developed by Mr John Dower of the Committee for National Parks The aim would be to preserve the beauty of landscape, allow access to the people and afford general protection of wild life

Dr G Herbert Smith, speaking for the Society for the Promotion of Nature Reserves, said that, small though the Park at Belair is, its use for recreation and æsthetic enjoyment is not necessarily incompatible with protection of flora and fauna

Prof F E Weiss urged the importance of localizing sporting facilities and motor traffic and of maintaining strict reserves within the park for plants of special scientific interest Mr C A Gardner pointed out that one such reserve exists near W Albany, Western Australia, for the preservation of *Cephalotus*, the endemic pitcher plant He emphasized the difficulty of conserving the Australian flora, owing to the fact that it is readily modified by recurrent fires and human access Mr H I Burkill reported an unsuccessful attempt to conserve an area of natural jungle in the Botanic Gardens, Singapore

The inevitability of change was stressed by Dr W T Calman, who pointed out that Nature is dynamic, not static, and that, unless the traditional occupations of the countryside are maintained, the flora and fauna of any reserve in Britain will alter in a few years

Summing up, Dr J Ramsbottom said that the term 'Nation's Park', first used in America in 1842, was intended to mean an area of country left in its 'pristine state'

Replying to the criticism of the inadequate area of the National Park, Belair, Prof Osborn said that South Australia has also a flora and fauna reserve of about 200 square miles at the western end of Kangaroo Island The vegetation and animals of this differ from those of the Mount Lofty Ranges; hence the importance of the small reserve at Belair

Count Kaspar Sternberg, 1761-1838

BORN at Prague on January 6, 1761, Kaspar Sternberg was destined for the Church, and to that end studied theology at Freising and Rome When scarcely twenty-two years of age, he obtained an appointment at Regensburg and gave promise of rapid advancement. Turning his attention, however, to natural science, he began a thorough study of botany in connexion with certain forestry duties allotted to him. He collected and cultivated wild plants and acquired an extensive scientific library In 1810 he published his first monograph, "Revisio Saxifragarum"

In the same year, following the death of his older brother, Sternberg returned to Bohemia, taking his herbarium and library with him From this time onwards he lived alternately in Prague and at his country seat, Březina Castle near Radnice in West Bohemia, maintaining a keen interest in science and supporting its extension and application to local industries He began the agitation for a national museum and became its first president when it was founded in 1818, a post he retained until his death He appointed Palacký as secretary of the National Museum Society, K. B Presl as curator of the natural history collections and later (1836) A J Corda to take charge of the zoological section, whilst Presl was left with the botanical part Sternberg gave his own herbarium and mineral collections to the Museum and also impoverished himself in the purchase of the collections of others to make it as representative as possible. Thus he bought the 15,000 specimens collected by the Bohemian explorer Thaddeus Haenke, and engaged Presl and F M Opiz to classify and describe them, financing their "Reliquiæ Haenkeanæ", which appeared in two sumptuous volumes in 1825 and 1835

At his castle near Radnice, Sternberg amassed a wonderful library, which has passed into the possession of the Bohemian National Museum, and he laid out botanical gardens, including hot-houses for tropical plants The coal deposits of Bohemia were attracting attention at this time and Count Sternberg investigated the formation of coal and described many fossil remains of plants in his "Flora der Vorwelt" (1820-38) which he wrote with the assistance of the Presls and Corda, and which remains a phytopalæontological classic. It was not his first work in this field, for he had already communicated papers to French and German journals on the analogies between fossil and living plants.

Sternberg's interest in the application of science to industry is shown in his "Outline of the History of Mining and Mining Laws in the Kingdom of Bohemia". This monumental work appeared in two parts in 1836 and 1838, and the frontispiece to the first depicts Wenceslas II handing a document of mining rights to miners in 1300, whilst at the end is a map of Bohemia in 1500 showing the centres of gold-, silver- and other mining activities. In the preface he urged the necessity for scientific and technical education as a means of checking wasteful methods in working the mines

Most of Sternberg's works were in German, though he supported what Czech publications there were and he encouraged the printing of text-books and treatises in that language His last public function was to preside at the medical congress at Prague in 1837, on which occasion he advocated the greater application of science in the study of medicine His memory is perpetuated by the name sternbergite assigned to the mineral, an argentiferous pyrites, discovered by Haidinger in 1826

Count Sternberg died at Radnice on December 20, 1838, after a full and useful life.

Air Conditioning in Deep Mines

AT a joint meeting of the Institution of Mechanical Engineers and the Institution of Chemical Engineers held on May 17, a paper entitled "Engineering Problems associated with the Improvement of Temperature and Humidity Conditions of the Atmosphere in Mines at Great Depths" was presented by Dr. J H. Dobson and Dr. W. J. Walker. In it were raised points of world-wide importance in connexion with mining operations which are carried on where wet bulb temperatures of mine atmospheric air approach 90° F. and approximate to normal blood temperatures. The task of the engineer is to produce satisfactory conditions for underground workers in these extremely difficult conditions, and the authors explained the complexity of the problem and gave a brief account of the research which has been devoted to it.

In describing the conditions to be dealt with, the considerable progress made in modifying them and the trend of future developments, the Witwatersrand goldfields were cited as an object lesson by the authors, who presented the subject in broad outlines with the view of stimulating interest in this work and encouraging suggestions towards a solution of the intricacies involved in it. The present working levels at these mines are from 6,000 to 8,000 feet, and Rand mining engineers hold that depths of 12,000 feet are within economic possibilities Owing to the nature of the dust, silicosis has to be guarded against and the wet system of mining is employed. This means that there must be copious supplies of water at the drills, at all working points and wherever dust may occur. This condition, taken in conjunction with the high virgin rock temperatures in restricted spaces with a limited circulation of air, points to the fundamental nature of the problem. To present an idea of the magnitude of the heat inflow, the authors estimate, in relation to a mine at a depth of 6,000 feet from which the monthly output is 150,000 tons of rock, that, from all sources, 70,000,000 B.Th.U. per hour may be expected Of this total a large percentage has to be extracted in order to adapt the underground atmospheric conditions to the health and physical efficiency of the workers

Three methods in operation were described At the Robinson Deep Mine, a surface refrigeration plant is used which deals with 407,000 cubic feet of air per minute, cooling it from 65°/60° F wet bulb temperature to 38°/33° F the cooled air being sent down the downcast shaft to a depth of 7,500 feet Underground refrigeration is adopted at the East Rand Proprietary Mine and the plant treats more than 8,000 tons of air per day, cooling it from 81° to 72° As a contrast to these systems, dehumidified compressed air is used at various mines of the Anglo American Corporation by employing it at every possible machine underground This eliminates one source of heat in the use of electric motors, and from the practical point of view offers a much simpler system at the hot spots than any of the others Devaporization of the air is effected by over compression It is first compressed to 90 lb /in ^{2} abs and then taken to an over compressor where it is raised to 130 lb /in ^{2} abs It next passes through a cooler, the first water separator, the heat exchanger where it is further cooled and a second water separator from which it goes to the expansion turbine Then after passing through a third water separator and the heat exchanger it goes to the compressed air pipes in the downcast shaft

As the wet method of mining is responsible for a substantial portion of the problem presented, the authors also discussed the relative advantages which would accrue from the adoption of drier methods and dealt with the concomitant problem of the prevention of dust

Preservation of Antiquities of South Africa

WITH the view of safeguarding the evidence of antiquity in South Africa, the Minister of the Interior of the Union of South Africa has published orders prohibiting the removal or export of monuments, relics, or antiques without the written consent of the Commission for the Preservation of the Natural and Historical Monuments, Relics and Antiques (Notices No 1571 and No 1572, *Gazette of the Government of the Union of South Africa*, Sept 20, 1938, No 2569, pp 955 958) The orders are made under the provisions of Section 10 of the Natural and Historical Monuments, Reliques and Antiques Act, 1934, as amended by Section 4 of the Natural Monuments Amendment Act, 1937 The antiquities covered are specifically stated to be drawings, paintings, and petroglyphs of the Bushmen, or other aboriginals, or peoples inhabiting South Africa prior to the arrival of the Europeans, implements or ornaments known or commonly believed to have been used by them, and any anthropological or archæological contents of the graves, caves, rock shelters, middens or shell mounds, and any vertebrate fossil Further, the orders cover any objects that have been proclaimed, or are capable of proclamation, as antique

While the Commission thus entrusted with the responsibility of deciding to whom permits shall be accorded under the orders, is most anxious to encourage the exploration of the rich archæological and palæontological fields of the Union of South Africa, and welcomes research by all who are properly equipped, it is determined to do everything in its power to ensure proper investigation and to put an end to such reckless exploitation—often unwitting—as has been all too common in the part With this object the orders now published embody by laws which lay down regulations upon which the consent of the Commission to the excavation or removal of relics is made dependent

These regulations prescribe the terms of the application, which must define the character of the antiquities and their exact location with a locality sketch of the area, and require that after removal the Commission shall be furnished with a description of the objects removed, a statement of their destination, and when the investigation is archæological, a complete set of plans and stratigraphical records Further, the excavator may not dispose of any object without the written consent of the Commission by whom is also reserved the right to retain in South Africa a representative collection of the excavator s finds While the right of scientific ownership is recognized, this may lapse if suitable publication does not follow within such time as the Commission may approve

In order to ensure the proper character and technique of the excavation not only must the application to investigate set out the applicant s credentials, but *also access to the excavation is reserved to the Commission* or its representatives, uncivilized labour must be properly supervised, all material must be sieved through a prescribed size of mesh and photographs of material *in situ*, and of sections of stratified deposits must be submitted with notes to the Commission as soon as possible Finally, not only must a witness section be left intact, but also not more than one half of any known area of a site shall be demolished, removed or excavated without the specific authority of the Commission

The regulations, though drastic, are such as no archæologist could fail to approve It is eminently reasonable that the South African authorities should seek to protect their antiquities from the fate by which other countries too often have suffered, owing to the removal from its place of origin of evidence of value, sometimes unique, of past cultural achievement Even more important is it, especially in a country so sparsely populated and so difficult for supervision, as South Africa, to secure that antiquities are not wantonly despoiled, either through ignorance or through the indiscriminate greed of the curio hunter, but that when they must be made the subject of investigation in the interests of science, their evidence should be made available for the advancement of learning by examination under supervision in accordance with an approved scientific technique and by fully qualified and responsible investigators The provision that part of any excavated site, unless otherwise determined, must be left undisturbed, is especially commendable

Science News a Century Ago

The English Agricultural Society

THE first general meeting of the English Agricultural Society since its formation took place on December 18, 1838, Earl Spencer being in the chair The committee, it was stated, had agreed to publish a quarterly journal of its proceedings and this would contain prize essays. It was desirous of enlisting all the talent it could for the discussion of subjects of deep interest to the practical farmer An award for that year was being given to the Rev. W. Pearse, of Winkfield, Berkshire, for an essay on the cheapest and simplest process for analysing soils. The essays sent in on the origin and progress of the black caterpillar, the present state of agricultural mechanics and the improvement of implements had not come up to the required standard One prize to be given at the Oxford meeting in July 1839 would be for an essay in the cultivation of the soil for cattle and breeding of stock. A veterinary college had long been established in London, and the committee had represented that great advantages would accrue if the College, instead of confining its attention to horses, would inquire into the diseases of cattle, sheep and pigs A favourable reply had been received from the College by the committee

Naval Architects in the Royal Dockyards

UNDER the heading "The Admiralty and the Members of the School of Naval Architecture", *The Times* on December 21, 1838, published a contribution from a correspondent referring to the dissatisfaction among the naval architects who had been trained in the School at the lack of recognition they received The School, which was the first of its kind in Great Britain, was in existence from 1811 until 1832, having been founded as a result of the findings of Lord Barham's Commission of 1806 Those who entered the School had been induced to do so by promises held out by the Government that after proper examinations they would be eligible for the positions of foremen, assistant master shipwrights and master shipwrights in the dockyards An Order in Council of January 30, 1816, had stated that the object of the School was to introduce a better and more skilful description of shipwright officers into H.M Service. Those who qualified were under a bond of £600 to remain in the public service for at least ten years after the completion of their apprenticeship Official countenance, however, was uniformly withheld from members of the School, and out of the last twelve appointments superior to that of foreman, said the writer, only one had been conferred on a past student

The history of the School and the careers of those who passed through it were dealt with by the late Sir A. W. Johns in articles in *Engineering* of March 12 and 26 and April 9, 1926

Technical Education at King's College, London

IN its "Weekly Gossip" column, the *Athenæum* of December 22, 1838, said: "Having so frequently advocated the cause of an improved system of education . . . it is with no little interest that we have watched those demonstrations which have been of late made in London, Durham, Dublin and elsewhere, in favour of methods of elementary instruction having for their basis the great principles of manufacturing and commercial science, and systems proposing to themselves the practical development of these, and their application to the processes of the commercial and manufacturing arts . . . and we are pleased to hear that the Council of King's College, in addition to the well-organised system of instruction to which we lately alluded, have recently added a teacher in Mineralogy; and yet further to determine the practical direction of their course, have at a recent meeting, assigned fees for the formation of one, if not two, additional professorships, of an exclusively practical nature, having for their object the development of the *Economy* of the mechanical arts, and the *Composition* of machinery An arrangement has also been made, as we are informed, by which students who have attained a certain stage of their progress will be secured admission to various manufactories and public works carried on in the neighbourhood of the metropolis."

Discovery of Roman Skeletons

THE *Gentleman's Magazine* of December 1838 contains the following information: "Some interesting discoveries have been recently made at Shooter's Hill, near Pangbourne, Berks, on the line of the Great Western Railway. Several human skeletons, in a high state of preservation, have been disinterned, together with small sepulchral urns, of rude workmanship, but elegant and classical devices, and upwards of 40 Roman coins, of gold, silver and brass of reigns of Domitian, Constantine, Julian the Apostate, Constantius, Gracianus, Licinius or Lupicinius the Pro-Praetor (who was invested with regal authority), and several others Spear-heads, battle-axes and spears of British and Roman manufacture were also found; and some of the graves contained considerable masses of charcoal, without bones The bones are well preserved, having laid in dry gravel, about 4 feet from the surface, immediately over laying the chalk; and one of the skulls appears heavier and more consolidated than is natural"

University Events

DUBLIN.—On December 8, the honorary degree of D.Sc. of Trinity College was conferred on Dr R Lloyd Præger, formerly librarian of the National Library of Ireland, and Prof. E. S. Goodrich, professor of zoology and comparative anatomy in the University of Oxford.

DURHAM—Dr. F A. Paneth, reader in atomic chemistry in the University of London, has been appointed professor of chemistry in the Durham Division, vacant by the appointment of Prof Irvine Masson to be Vice-Chancellor of the University of Sheffield.

LONDON.—Mr. E. R. J. Hussey has been appointed as a third Heath Clerk lecturer for 1938-39.

SHEFFIELD.—The following resignations have been recently received: Dr. Arthur Pool, from his post of lecturer in mental diseases; Mr. A. W. Fawcett, from his post of lecturer in surgical pathology; Mr H. E. Collins, from his post of lecturer in mining.

Societies and Academies

Edinburgh

Royal Society November 7

A D Peacock and **Ann R Sanderson** The cytology of the thelytokously parthenogenetic saw fly *Thrinax macula* Kl The fern living saw fly, *Thrinax macula* Kl in the laboratory at least, reproduces solely by females All male, or predominantly all male broods occasionally appear under parthenogenesis but the males so far appear to be reproductively useless The female somatic and germ tissue constitution is 14 that of the male spermatogonium and spermatocyte counts 7 Autoregulation of chromosome number in the parthenogenetic female producing egg shows only one maturation division non reductional and the formation of only one polar nucleus

Mary H Latham Some Eocene Ostracoda from North West India The collections of Eocene Ostracoda described in this paper were made by Lieut Colonel L M Davies and by Mr Pinfold of the Attock Oil Company The specimens are of particular interest and importance owing to the fact that very few fossil Entomostraca had previously been found in India Both Bairdiidæ and Cytheridæ are especially abundant in beds of Upper Ranikot age in the Punjab and Attock districts It therefore becomes evident that those beds were of a predominantly estuarine facies During the later Palæocene and the Lower and Middle Eocene times Ostracoda became exceedingly rare and small probably owing to the extension of marine conditions

W Peddie Establishment of the trichromatic theory of colour vision The various points on which misunderstanding arose regarding the essential implications of the trichromatic theory were reviewed Inessential postulates were frequently looked upon as fundamental although they were only introduced for purposes of ready description Again postulates introduced only as being the most simple to be retained only so long as no occasion for expansion arose were taken as necessary The latest of these was the postulate regarding the magnitudes of the component colour vectors which has been amended by Schroedinger Three independent stimuli are now universely recognized as sufficient So three sensations follow logically and trichromasy is established

B N Desai P M Barve and **Y S Paranjpe** Importance of dialysis in the study of colloids (5) Colloidal gold (6) Colloidal vanadium pentoxide The cataphoretic velocity of the particles in gold and vanadium pentoxide hydrosols and their tendency to aggregate in the presence of electrolytes are markedly dependent upon the extent to which the sols are dialysed Hence certain apparent anomalies may be attributed to disregard of the influence of dialysis The behaviour of the sols on dialysis and dilution shows that the properties of such systems are not related in the simple fashion frequently postulated In particular, it would appear that the stability does not depend directly upon the magnitude of the particle charge

Ian Sandeman Molecular spectra of the hydrogen isotopes (1) Application of the rotating vibrator model to the states of D_2 Measurements of some of the band systems of deuterium in the visible part of the spectrum are now available from the work of G H Dieke and his collaborators Difficulties raised by the practical application of the theoretical work of the late J L Dunham to the spectrum of the neutral molecule of deuterium are discussed and the constants of two of the molecular states are calculated and compared with those for the corresponding states of the neutral hydrogen molecule It is shown that the potential functions of the two isotopes differ considerably and that the equilibrium internuclear distance is greater for hydrogen than for deuterium at least in one of the states considered The results of the analysis are sufficiently consistent to indicate that in states of the type considered the rotating-vibrator model provides an accurate means of spectral analysis and opens up new avenues for investigation

G N Watson The computation of the error function

T M MacRobert Solution in multiple series of a type of generalized hypergeometric equation Those generalized hypergeometric equations which are of the same type as the ordinary hypergeometric equation have solutions in terms of generalized hypergeometric functions in the domains of the origin and of *infinity* This is also the case for the ordinary hypergeometric equation in the domain of the unit point, but it is not true there for the generalized equations In this paper solutions for these equations in the domain of the unit point are obtained in the form of multiple series

Paris

Academy of Sciences (*C R* 207, 949 1020 Nov 21, 1938)

G Bertrand and **G Brooks** Methoxyl content of lignified tissues

C Giraud Derivatives of functions which correspond to a problem of the Dirichlet type

L Daniel Two curious cases of vegetative revival

L Hibbert Curves of equal argument univalent cellules inversion of *fonctions entières*

L Tchakaloff Some properties of the gamma function

L Goldstein Statistical interpretation of the recombination of atomic nuclei

Mlle N Morguleff Research on cyanogen in stars of types *K*0 and *A*0

G Garcia and **A Rosenblatt** Stokes's formula in the theory of gravity

M Schlumberger and **V Baranov** Gravity anomalies in the region of Alençon

Mlle P Février Kinematic geometry adapted to the theory of quanta

J Loiseau Remarks on the subject of the theory of relativity and the representation of phenomena in space of four dimensions

A Datzeff Stable orbits in a reduced problem of three bodies

P Chavasse Measurement of the acoustic time of reverberation

E Hochard Artificial modification of certain constants of a galvanometer

A Ollivier Evaluation of the specific magnetic rotatory powers of dissolved ferric nitrate and of ceric sulphate

V Dolejšek and **M Ježek** The separating power and the penetration of X rays in mosaic crystals

V Karpen Adherence of the framework to the concrete in reinforced concrete

Mlle H thi Nga Reduction of orange 2 and of methanile yellow at the dropping mercury electrode

W. HELLER and **E. VASSY**: Remarks on the action of alcohol on colloidal systems with hydrophile particles

MME. R DUVAL and **C. DUVAL** · A sodium cobaltopyrophosphate

E. GRILLOT · Neutral and basic lead monochlorethanoates.

E. CATTELAIN . Some derivatives of β-[4-methoxyphenyl] methylpyruvic acid

E. RAGUIN: Age of the granitic rocks in the Pyrenees

C FRANCOIS-BOEUF: Data on the transparency of the maritime Aulne at Trégarvan Such measurements can be used to study the currents of this river.

J-L PERROT and **M PERROT** Chromosomes of the genus *Helix* The chromosome number of this genus is 27, not 12 or 24 as has been reported by earlier investigators

M-L ROCCO Metabolism of compounds of purine origin in insects Excretion of uric acid is not the general rule , the acid, as in vertebrates, is generally degraded by enzyme action to allantoin or allantoic acid

MLLE C-T BAUDOUY: Formation of ovokeratin in *Raja batis*

L. BOUNOURE: Segregation of the germinal layers, and the general problem of embryonic segregation

R LECOQ and **R DUFFAU** . Influence of conditions producing total avitaminosis B or mineral disequilibrium on the composition of the muscle of the pigeon.

RAYMOND-HAMET: Hypotensor and vasodilator effects of cryptolepine, an alkaloid extracted from *Cryptolepis sanguinolenta* Schlechter

R. CHAUVIN: Reddening of the migratory cricket. The cricket and other acridians have beneath the skin a yellow compound which becomes red on reduction.

Vienna

Academy of Sciences, October 20

E SPÄTH · Peganin (vasicin) (13) A review of recent work on this alkaloid

F. GALINOVSKY and **H BRETSCHNEIDER** · Thermal decomposition of cholestenonpinacone.

HERTA SCHEICHENBERGER . Production of artificial radioactivity in europium, rubidium and cæsium by irradiation with neutrons. In the case of europium, β-activities with half periods of 9·2 hours and 1·2 years were found. Rubidium gave β-activities with half periods of 18 minutes and 18 days, while cæsium gave an activity with a half period of about a year The percentages of these activities which are due to thermal neutrons were found.

A. SKRABAL: Rate of formation of chlorate in bleaching solution.

H. BENNDORF and **E. RUMPF**: Badly conducting surface layers on apparently clean metals, and their effect on the operation of sensitive electrometers. Instability of the zero of a string electrometer is ascribed to a badly conducting layer on the surface of the fibre, which can retain charges and has a variable contact potential to the other electrodes.

H. SEELMEIER: Occurrence of diabase on the Christophberg at Klagenfurt

R. KNEBEL: Geological profile of the Kehr anticline (southern slope of the Pleschkogel at Graz).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

LECTURER IN MECHANICAL ENGINEERING in the Burnley Municipal Technical College—The Director of Education, Education Offices, Burnley (December 22)

CHEMIST in the Ordnance Factory, Irvine, Ayrshire—The Under-Secretary of State (C 5), The War Office, London, S W 1 (Quote Appts 112 December 23)

DIRECTOR OF WATER EXAMINATION to the Metropolitan Water Board—The Acting Clerk, Offices of the Board, 173, Rosebery Avenue, E C 1 (December 31)

INSPECTOR OF AGRICULTURAL AND HORTICULTURAL EDUCATION AND RESEARCH, Ministry of Agriculture and Fisheries—The Secretary, 10 Whitehall Place, S W 1 (December 31)

ASSISTANT TO THE ADVISORY CHEMIST, Department of Agriculture, University of Cambridge—The Secretary (January 7)

SECRETARY of the Institution of Electrical Engineers—The Chairman of the Selection Committee (February 1)

LECTURER IN GEOGRAPHY in the Portsmouth Municipal College—The Registrar

PROFESSOR OF ZOOLOGY in the University of Reading—The Registrar

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Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Annals of the Cape Observatory Vol 14, Part 3 Stellar Parallaxes (2nd Series) determined in the Years 1928-1931 with the Victoria *Telescope of the Royal Observatory, Cape of Good Hope, under the* direction of Dr H Spencer Jones Completed for publication under the direction of Dr J Jackson Pp xi+100 (London H.M Stationery Office) 11*s* net [2211

Tuberculosis in Cyprus an Interim Report on its Incidence and Means of Control made under the auspices of the National Association for the Prevention of Tuberculosis By Dr Noel Dean Bardswell Pp vi+228 (London Adlard and Son, Ltd) 2*s* 6*d* [2211

Tuberculosis, Cancer and Zinc an Hypothesis By Douglas Barron Cruickshank Pp xv+75 (Papworth Sims Woodhead Memorial Laboratory) [2211

Board of Education Science Museum Science in the Army a Brief Account of the Scientific Training and Technical Work of the Soldier To-day, as illustrated by a special War Office Exhibition held at the Science Museum, November 1938–February 1939 By Anthony Armstrong Pp 20+3 plates (London H M Stationery Office) 6*d* net [2211

Proceedings of the Royal Society of Edinburgh, Session 1937–1938 Vol 58, Part 3, No 16 Two Cases of Malformation of the Gill-covers in Salmon By Dr V Tchernavin Pp 233–241+1 plate 1*s* Vol 58, Part 3, No 17 The Dynamics of Sheet Intrusion By Dr E M Anderson Pp 242–251 1*s* (Edinburgh Robert Grant and Son, Ltd , London Williams and Norgate, Ltd) [2311

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1816 (2522) Full Scale Tests of the Airspeed Envoy Type A S 6 G By J E Serby, R H Francis and P Fortescue Pp 10 1*s* 6*d* net No 1825 (3361 and a) Diffusion of Load in certain Sheet-Stringer Combinations By Dr W J Duncan, with an Appendix by H L Cox Pp. 15 2*s* 6*d* net No 1827 (3366) The Use of the Principle of Minimum Potential Energy in Problems of Static Equilibrium By D Williams Pp 18 2*s* 6*d* net. No 1829 (3066) Measurements of Accelerations at Different Parts of a Boat Seaplane during Take-off and Landing By G C Abel Pp 12 2*s* 6*d* net No 1830 (2775) Stressed-skin Structures—Compression Tests of Panels with Tubular Stiffeners By I J Gerard and Dr B G Dickens Pp 28 4*s* net. (London H.M Stationery Office) [2311

Other Countries

India Meteorological Department Scientific Notes, Vol 7, No 78 Temperatures and Humidities up to 3 kms over Karachi By P R Krishna Rao and K L Bhatia Pp 119–130+3 plates (Delhi Manager of Publications) 9 annas , 10*d* [2111

Division of Fish and Game of California · Bureau of Marine Fisheries Fish Bulletin No 52 Historical Account of the Los Angeles Mackerel Fishery By Richard S. Croker. Pp 62 (Terminal Island California State Fisheries Laboratory) Free [2111

Conseil Permanent International pour l'Exploration de la Mer Faune ichthyologique de l'Atlantique nord Publiée sous la direction de Prof Joubin. No 18 24 plates. (Copenhague Andr Fred Høst et fils) 4 00 kr [2211

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No. 183 The Control of Peach Mildew By Dr. Amin Fikry Pp. ii+14+7 plates P T.3 Bulletin No. 208 Two Genera and Species of Aphids new to Science. By Dr. Labib B Soliman Pp ii+6+8 plates. P T 5. (Cairo Government Press) [2211

Scientiae Naturalis Bibliographia Ed. W Junk Annus 2 1938. Pars 1. Pp 80. (Den Haag : Dr. W Junk) 3 fl. (6*s*. 9*d*.) a year. [2211

Tanganyika Territory Department of Lands and Mines, Geological Division. Short Paper No 20 · The Geology of Parts of the Tabora, Kigoma and Ufipa Districts, North-West Lake Rukwa. By G M Stockley Pp. 35. (Dar es Salaam . Government Printer) 3*s* [2311

NATURE

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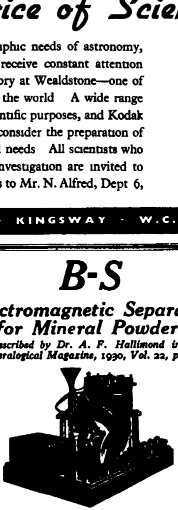

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Vol 142 SATURDAY, DECEMBER 24, 1938 No 3608

An African Bureau

THE African Survey for which Lord Hailey has been responsible derives no small share of its value from the comprehensive way in which it brings together in readily accessible form information that previously was extremely scattered and difficult to collect On this ground alone, apart from its critical suggestions, the Survey is of immense value to all those concerned with African problems whether in the administrative or economic sphere, in scientific work or in philanthropic or missionary enterprise

The very magnitude of the survey made however with its masses of data, emphasizes the point so strongly stressed in the Survey, that, in contrast with India, where information on such subjects is usually readily accessible, it is very difficult to obtain information on matters which are essential to an understanding of conditions in Africa This difficulty is experienced fairly widely, though to an extent differing in various fields, and being perhaps more conspicuous in regard to political, economic or social developments than in the scientific field Here, of course, the bulletins issued by the Imperial Agricultural Bureaux and the periodicals and reports issued by the medical and other research institutions in Great Britain circulate full information on the progress of scientific investigations in a wide field

Even these publications, however, do not usually distinguish the matters which specially concern Africa and are scarcely to be found collected in any one institution This difficulty is much greater in the other fields The Institut Colonial International issues from Brussels publications which are a valuable source for the documentation of the legislative and similar proceedings of colonial Governments and its periodical sessions have yielded a useful series of discussions on different problems in administration There are also a number of journals devoted exclusively to social, linguistic and similar studies of Africa such as *Africa* the journal of the Royal African Society, or *Congo* and certain journals are published locally in the African colonies In addition to this periodical literature, there is a growing mass of general literature on Africa as well as of studies of special problems Those sources of information are all, however, very scattered, and sometimes, as in certain French and Portuguese territories, are difficult of access The compilation of a comprehensive bibliography, let alone the examination of source material on many African problems is apt to be extremely laborious and expensive

None of the available sources of information on Africa is open to the public All are circumscribed by other purposes and in none of them are African problems considered as the major interest Moreover, the difficulty of obtaining material is frequently accompanied by difficulty in judging its real bearing or value Where, as in Europe or the Dominions, public measures are fully discussed in the Press or in a representative legislature the observer is able to consider facts or statistics in relation to the policy which gives them their significance This advantage is seldom enjoyed by observers of African colonial administrations, where policy is frequently decided in proceedings which are not made available to the public

As regards the applied sciences, as already indicated, a wealth of material is available to the student in the scientific periodicals which the various abstract periodicals of the Imperial

Bureaux assist in rendering available. Here the difficulty lies rather in providing means by which the non-technical inquirer or the administrator can inform himself of the value of the work which is being discussed and its bearing on the practical problems with which he may have to deal The success of a modern Colonial administration depends largely on the use which it makes of its technical departments, and accordingly any agency which keeps the administrator in touch with the contributions made by science to the solution of his problems is of value

These are the reasons which led to the second main recommendation of the Survey—the provision of some effective means for making knowledge of Africa more accessible, not only to the public but also to those interested in the special study of African questions. To this end is advised the institution of an African Bureau, preferably situated in London, and designed on lines which would make it not only a source of information on practically every aspect of activity in Africa, but also a convenient body to maintain close contact with institutions and voluntary organizations in Great Britain and other countries interested in African development The Bureau should be constituted so as to be capable of providing guidance to those who seek to pursue a special study in any subject of interest in Africa, or of placing them in touch with those who are competent to do so.

The scheme contemplates the appointment of a director who should himself have some experience of the requirements of social or scientific investigation He should have as assistants, three specialists, acquainted with African conditions, and with knowledge, respectively, of scientific, economic and social (including administrative) subjects They would publish periodically a survey of contributions to the knowledge of Africa and of events which affect workers in any branch of study. Their main contribution would not be the result of any original study; they would be dealing with information, much of which would be recorded in some form or another elsewhere.

In regard to the assembling of material, a nucleus already exists in the offices of the African Research Survey, consisting of the more important Government reports and a library of important books on Africa. This material, as well as a large number of leaflets and memoranda specially prepared for the Survey, is already classified and filed under appropriate headings, and some of it would be difficult to obtain elsewhere.

Experience must decide how far the Bureau should proceed in assembling a library of literature on African subjects. Particularly in regard to the earlier publications, it may prove unnecessary to duplicate in the library of the Bureau some of the material on Africa already to be found in the libraries of the Colonial Office, South Africa House, the Royal African Society and the Royal Empire Society. It would indeed be of advantage to avoid amassing material unlikely to be used by those concerned with the present-day development of Africa Equally, of course, this material will frequently require supplementing on the foreign side, and it will also be essential, in regard to scientific and technical subjects, that the staff of the Bureau should acquire a working knowledge of the information available in the libraries of the different scientific institutions and of the additions which scientific research is making to it

On this side of the work of the Bureau, an organization such as the Association of Special Libraries and Information Bureaux may well be able to render signal service in the initial stages Some of the most important aspects of the work of the Bureau will, however, be the establishment of contacts, particularly with such institutions in Great Britain as the International Institute of African Languages and Culture or the Royal African Society It may even be possible to establish a common library and to group these three particular institutions in the same building Overseas contacts, however, are equally important, whether with the "Bureau Internationale de Renseignments" of the Institut Colonial International of Brussels or with official and non-official circles responsible for developments in the Union of South Africa, for example

The Survey estimates that the proposal for an African Bureau involves an initial expenditure of about £10,000 a year, including the renting of suitable accommodation, though this expenditure would probably increase as the work developed While it is hoped that the Bureau would receive full support from the British Government, the desirability of control by a non-official body which would be in a position to seek assistance also from Colonial Governments and from other sources is emphasized. The scheme visualizes control by a managing committee, including representatives nominated by the Colonial Office, the Union of South Africa and Southern Rhodesia, the International Institute of African Languages and the Royal African Society. If the proposal is adopted, this committee might well be extended by co-option or otherwise, to include representatives from different branches of science, the International Missionary Council and the like.

The organization of a clearing house of information on these lines should directly assist the application on a much greater scale of existing scientific knowledge in the service of African needs and the solution of African problems at what the Survey describes as the most critical and formative period of African history. Equally it should stimulate further research, particularly the more comprehensive study of the factors determining the nature of its social development, and a more scientific approach to the problems of health and material well-being to which the physical characteristics of the natives of Africa have given rise.

On both these grounds the project claims the interest and support of all scientific workers, and particularly at a time when constructive development on such lines may well hold the key to the solution of the more threatening aspect of the problem of Colonies themselves.

The Science of Slang

A Dictionary of Slang and Unconventional English

Slang, including the Language of the Underworld, Colloquialisms and Catch-phrases, Solecisms and Catachreses, Nicknames, Vulgarisms and such Americanisms as have been naturalized. By Eric Partridge. Second edition, revised and enlarged. Pp. xviii + 1051. (London: George Routledge and Sons, Ltd., 1938.) 42s. net.

A DICTIONARY of slang may at first sight seem to have no special message for readers of NATURE, but it is impossible to turn over the pages of Mr. Partridge's monumental work without realizing how many important and perplexing problems, philological, psychological and social, are raised in the pages of this dictionary. The book provides data that will be eagerly seized on by the students of many sciences.

What is slang? We have somewhere to set a term to definition, and it may be assumed that everyone knows what is meant by standard English. Making this rather large assumption, we know also that there are deviations from the standard which are not to be classed as dialect—deviations which consist in substitutes, generally undignified, sometimes humorous, and sometimes coarse, "for those modes of expression which are employed by persons who value themselves on propriety of speech". Such substitutes are, for the most part, *slang*, and the reasons for their introduction make as difficult a scientific problem as do the philological problems involved in the derivation of the words themselves.

Over and above this, there are jargons developed by groups which desire their speech to remain cryptic—such jargons have been invented by schoolboys, by vagrants, by professional thieves, and not infrequently have in their make-up a considerable element of humour. The desire to use words or phrases which, without being cryptic or necessarily more exact in technical meaning, shall be different (and usually humorously different) from those usually employed gives rise to the slang of certain trades and professions. A massive contribution to Mr. Partridge's dictionary accrues from terms which in some instances, originally standard English, have for reasons not always apparent become coarsened and colloquial and are certainly not used to-day by that class which prides itself on propriety and refinement in speech. Many such expressions possess a Rabelaisian humour and outspokenness which is something of a saving grace; many are frankly coarse *ab initio* and have never appeared in standard English. In dealing with this last-named class of unpleasant terms, Mr. Partridge is at pains to assure us that his method has been to handle them "as briefly, as astringently, as aseptically as was consistent with clarity and adequacy". He is, in short, in this matter, a consistent disciple of his great predecessor, Captain Grose. None of these categories has been neglected by Mr. Partridge. Johnson could say, speaking of the technical terms of various arts and crafts:

> "I could not visit caverns to learn the miner's language, nor take a voyage to perfect my skill in the dialect of navigation, nor visit the warehouses of merchants and shops of artificers to gain the names of wares, tools and operations, of which no mention is found in books; what favourable accident or easy inquiry brought within my reach, has not been neglected; but it had been a hopeless labour to glean up words by courting living information, and contesting with the sullenness of one, and the roughness of another."

Mr Partridge, more fortunate in the accessibility of his sources than was Johnson, has covered a very wide field. His dictionary is enriched, not only with many and varied examples of military, naval and sporting slang, but also with the jargon of the printing and other trades

Of the varieties of slang and of cant which go to make up the dictionary, some possess much greater interest and freshness than others, great interest, for example, is attached to the *back slang* so prevalent in the coster class during the nineteenth century—a jargon in which the constituent words were produced by pronouncing the more important words in a phrase *backwards*. A skilled exponent of the art could reverse a word rapidly in a most remarkable fashion, and would not have a moment's hesitation in giving, say, "summa-toppopy" as the back slang for "hippopotamus", sometimes making the interpretation more difficult by giving the word a humorous twist "like a tol-de-rol, sir, at the end of a chorus". Back slang has given at least one word to colloquial English. "Kool the silop", the cant phrase for "look (out for) the police", obviously provides a well-known and still extant term for 'policeman'

Rhyming slang, which has had a considerable vogue among Thespians and others, offers some curious problems to the psychologist. It is not an easy matter to place the mentality which—apart from the desire to produce a cryptic mode of speech—finds pleasure in such unmeaning rhyming substitutions as "German flutes" for "boots", "Rory o'More" for "door" and the like.

Mr. Partridge carries his learning lightly, so lightly, indeed, as to refer to Browning's famous unintentional misuse of a vulgarism as "the literary world's worst brick" It is remarkable that he should omit any notice of a similar mischance at the first night of the performance of Tennyson's "Promise of May". Mr Pett Ridge recalls the incident in a volume of reminiscences of London in the 'eighties and 'nineties

It is difficult to avoid superlatives in describing Mr. Partridge's massive contribution to lexicography—he has, single-handed, accomplished a feat of scholarship which it seems almost impertinent to criticize We find, in this dictionary, at a rough estimate, some forty thousand entries of slang, colloquialisms, solecisms, nicknames, cant and vulgarisms, accompanied, where possible, with etymological notes, dictionary definitions, indications of the period in which a term was commonly in use, indications showing whether it is obsolete or obsolescent, and symbols such as +1847, meaning "in significant first use then, but still extant" and −1847, meaning "known to exist then, and presumably used some years earlier". In these matters uniformity of practice is of considerable importance, and it does seem rather unfortunate that, in the use of the negative sign, Mr. Partridge should not have subscribed to the usage of the Oxford Dictionary in which "the latest limit of an obsolete word or sense is shown by means of the year preceded by a dash, as −1759"

It would convey a completely erroneous impression were one to devote a disproportionate amount of space to the few omissions and inaccuracies which have caught the eye of the reviewer, but there are one or two points which Mr Partridge may see fit to consider when a third edition of the dictionary is contemplated

The entry "gas and gaiters" carries the definition "nonsense; . . . exaggerated rubbish; from *ca* 1928" Is it possible that Mr. Partridge has forgotten the existence of the old gentleman in small-clothes and of his advances to Mrs Nickleby? "My love, my life, my bride, my peerless beauty! She is come at last—at last—and all is gas and gaiters!" Equally surprising, too, is it to find a "modest quencher" defined as a "small drink" and dated *ca* 1860. The immortal phrase is Mr Richard Swiveller's, and the modest quencher is anything but modest Even if Dickens is dated nowadays, that generation has lost much which has never repeated and relished:

"I go. Untaught and feeble is my pen,
But on one statement I may safely venture
That few of our most highly gifted men
Have more appreciation of the trencher
I go. One pound of British beef, and then
What Mr. Swiveller called a 'modest quencher',
That, home-returning, I may 'soothly say'
'Fate cannot touch me; I have dined to-day'"

Turning to less literary slang, we find the dictionary defining "fixed bayonets" as a brand of Bermuda rum and dating the term as late nineteenth-early twentieth century. This may very well be, but the late Nathaniel Gubbins, who had an intimate knowledge of mid-nineteenth century Indian military slang, had no doubts about it The term then referred to an awe-provoking dish of chicken stewed in rum.

In dating the phrase "I don't think" as 1837 and in giving a reference to Pickwick, Mr. Partridge follows the lead of the O.E.D. I find, however, that the phrase "You're a nice man, I don't think" occurs in Moncrieff's operatic extravaganza "Tom and Jerry", a dramatization of Pierce Egan's "Life in London", which was staged in November 1821. It would seem, then, that we can antedate the account given for the first appearance of this phrase by some fifteen or sixteen years.

References to music hall and other songs are very often helpful in dating a catch phrase and might be recorded more often than they are By Jingo', 'twiggy vous', 'not for Joseph' and Jim Crow' are relevant instances

The article *s v* non me' elucidates the phrase by a reference to Queen Caroline s trial whereat the Italian witnesses said *non mi ricordo* (I don't remember) to every important question' The reports of the trial put this phrase constantly on the lips of one witness only Theodore Majocci who was flustered by Brougham s cross examination The point is a minute one, but dictionaries and dictionary makers specialize in such matters

The editor's learned note on all my eye and Betty Martin" might well be enriched by de Morgan s adaptation of the phrase (' all ocular and Elizabethan) the delightful military slang of guessing stick ' for slide rule is overlooked and Mr Justice Hawkins appears under a novel title and name as Judge Sir Frederic Hawkins

These are however trivialities , and no one can use extensively Mr Partridge's work without feeling that it is in the ranks of the great books It naturally owes much to its predecessors but much has been added and many errors corrected Its genial scholarship classes it with Grose It supplants Farmer and Henley and the philologist, psychologist and sociologist will find in it an inexhaustible quarry of raw material

ALAN FERGUSON

A Catalogue of the Steroids

The Chemistry of the Sterids
By Harry Sobotka Pp xiii+634 (London Baillière, Tindall and Cox 1938) 38*s*

THE effort directed towards steroid chemistry in all its guises since, and as a consequence of, the introduction of the Rosenheim King formula in 1932, has led to a rapid multiplication of the steroids, so much so that there are now described in the literature nearly five thousand interrelated derivatives of *cyclo* pentenophenanthrene The main purpose of 'The Chemistry of the Sterids is to present a systematic classification of the more important of these derivatives recorded before January 1 1937 together with their physical constants and references to the original literature The classification is extremely successful, for by the introduction of an ingenious system of arrangement based upon the number of ethenoid linkages, hydroxyl, carbonyl and carboxyl groups the matter has been rendered easily accessible In presenting this catalogue the author has considerably lightened the task of approach to the steroid literature

The catalogue occupies nearly five hundred pages, the first part of the book (161 pages) being devoted to a descriptive account of steroid chemistry The early chapters deal with history methods and results of structural investigation A very welcome chapter is concerned with choleic acids and other molecular compounds of steroids Another on steric considerations has the unavoidable disadvantage, common to reviews of rapidly moving and incomplete fields of endeavour, that several important memoirs have appeared since the manuscript was completed A chapter on physical properties gives a summary of crystallographic data and a table of ultra violet absorption spectra It is rather unfortunate that in this table only the maxima and not the corresponding intensities are quoted The book concludes with a collection of some four hundred formulæ which serves as a companion to the catalogue and to the text and to which reference is freely made in both Various errors which have been detected in proof reading have not been adjusted in the diagrams but are carefully recorded in the legends

The general impression gained by a perusal of this text is that a task characterized by its multiplicity of detail has been faithfully accomplished that here is a text which will be welcomed by those directly concerned with steroid chemistry and will supplement the recognized catalogue of organic chemistry

The book has given birth to the word sterid', which in the opinion of the reviewer is ill advised to say the least According to the author, it is meant to comprise sterols and steroids, *i e*, sterol like substances " The word 'steroid' introduced by Callow and Young has been defined as a generic name for the group of compounds comprising the sterols, bile acids, heart poisons saponins, and sex hormones", and though this definition requires modification, the usefulness of the term was immediately recognized and adopted by most investigators The term 'steroids' includes the sterols, so we greet 'sterid' coldly as befits '*jargonese*' all this apart, 'sterid' is devoid of the euphony of steroid'

F S SPRING.

The Newer Human Morphology

Les Types humains

Par Eugene Schreider Première Partie Les Types somatiques raciaux morphologiques constitutionnels Pp 104 + 8 plates 20 francs Deuxième Partie Les Types psychologiques tempéraments caractères types d orientation générale de l esprit types psychanalytiques types réflexologiques types psychosociologiques Pp 79 18 francs Troisième Partie Les Types somatopsychiques variétés neurovégétatives constitutions somatopsychiques biotypes et variétés endocrinologiques types criminels Pp 105 + 5 plates 20 francs (Actualités scientifiques et industrielles 495 496 and 497 Biologie du travail et biotypologie 3 4 and 5) (Paris Hermann et Cie 1937)

THE study of the diversities of mankind is passing through a transition time in which each worker probably sees only a part of the change that is going on and can but bear honest witness to what he sees Measurements of populations leading to calculations of means and standard deviations and complicated by the creation of various coefficients have proved disappointing and at times have led to obviously incorrect results regarding relationships besides obscuring the biological fact that persons diverse in many ways appear in a population generation after generation through direct inheritance Descriptions on the other hand by means of reference to abstract types sometimes the creation of statisticians rather than the results of biological observation have also proved themselves to be misleading Yet the diversities noted by Retzius Blumenbach and others who have followed them obviously have meaning—long heads of various kinds short heads also of various types with facial diversities and so on in each case remain important—and even if such characters as skin colour have a different kind of biological history they must obviously enter into descriptive schemes

For the moment it seems wise on one hand to try to see what groups of characters often occur together in individuals and to study the distribution of such groups of characters but it is likely that diverse groups of characters are but the outward and visible indications of deep internal diversities whether what are called constitutional or what are thought to be endocrinological Many attempts have therefore been made to describe constitutional varieties of mankind and critical reviews of many of these attempts are the main contents of this work after a brief and not very interestingly compiled review of race classifications has been given

Special attention is given to the classification of the French school of constitutionalists led by Sigaud and especially MacAuliffe These observers seem satisfied with simple Lamarckian interpretations of the phenomenon of adaptation which is to them as to many others who do not quite share their point of view the most important fact in biology Their classification of types however does not really depend upon these interpretations It divides the French male population into respiratory digestive muscular and cerebral types covering respectively about 30 per cent (chiefly in the mountain areas) 14 (especially in Lorraine Normandy and French Flanders) 47 and a variable number from 7 to 25 per cent but it is recognized that vast numbers cannot be put completely in one or other group In each group there are eugenetic persons in whom the predominance of one or another of the systems is only moderate there are others called irregular persons in whom that predominance is exaggerated

Face and body are supposed to be linked and the face is said to have an upper or cerebral an intermediate or respiratory and a mandibular or digestive zone The athletic type apparently has a moderate development of all three One cannot but suggest such difficulties as that many distinguished intellectuals are far from approaching the definition given by MacAuliffe of the cerebral type A revised version of Kretschmer s classification divides constitutions into *leptosome* with height and length (vertical structures) developed more than breadth (horizontal structures) *athletic* with more balanced development and *pyenic* types emphasizing breadth rather then height Kretschmer s *asthenic* types are exaggerated leptosome forms and the term displastic is used for persons with markedly exaggerated characters Kretschmer gathers temperamental differences around the terms cyclothyme and schizothyme The first the extroverts of Jung are commonest among pyenic types according to Gourewitch and Ozeretzki The second the introverts of Jung are commonest among leptosome types but are found also among the athletic types few of whom are found among the cyclothymes

It is evident that MacAuliffe s digestive type and Kretschmer s pyenic cyclothyme have a good deal in common as have the muscular and athletic types of the respective authors but for the present the schemes of classification remain quite separate The attempts of the Italian authors

Viola and Pende to define constitutional types by measurement are discussed in detail and there is a considerable bibliography

These little books are thus a useful guide to several new attempts to understand the diversities of mankind the more useful perhaps because the author keeps his own preferences in the background The new morphology is trying to penetrate into the depths of causation and to find linkages including linkages between physical and psychical It suffers as work on human diversities has always suffered from the well nigh impossibility of establishing genetic sequences that can be adequately demonstrated It also needs to be more careful than have been the racialists not to try to classify by subdividing in such a way as necessarily to find a niche for each individual of the sample under consideration Further it needs to remember that these types are perhaps really growth tendencies and that their distinguishing features may not be purely and fully heritable Typology in mankind is a subject on which satisfying conclusions are notoriously difficult to reach more difficult than ever since race prejudice involving cruel treatment of Jews and others has spread so widely

H J F

French Colonial Petroleum Resources

Les ressources minérales de la France d outremer 5 Le pétrole (Publications du Bureau d études géologiques et minières coloniales) Pp iii +263 (Paris Société d Éditions géographiques maritimes et coloniales 1937) 45 francs

DURING the last few years the Bureau d Études géologiques et Minières coloniales has published four bulletins on French colonial mineral resources These concern coal iron zinc and lead and phosphates respectively Now a fifth and final bulletin of the series on petroleum is available The introductory chapter to this bulletin contains a description of petroleum deposits in general with special reference to geological conditions necessary for their accumulation migration and distribution This is followed by a concise exposition of present day methods of exploration to enable the reader to appreciate what has already been accomplished in this direction in French Colonies also what still remains to be done

Tectonically Morocco has proved very difficult from the point of view of exploration Nevertheless in spite of interruptions due to frequent warfare and other misadventures much progress has already been made and an extensive programme of research is being followed Existence of important petroleum deposits has not yet been proved in Tunis and Algeria but numerous surface seepages point to deep lying pools and there is certainly justification for continuing systematic exploration of this vast tract of unproved territory The geology of French equatorial Africa is as simple as that of North Africa is difficult but unfortunately the equatorial forest is an ever present obstacle against which prospectors must battle Exploratory work must therefore necessarily be slow Nevertheless great strides have been made during the last four years and it is considered worth while combating physical difficulties if there is any chance of substantial petroleum deposits being discovered

Madagascar is geologically different from any French African possessions and cannot therefore be grouped with them Petroleum exploration in the island is however so comparatively new a venture that there are few actual results to report All that can be said at present is that a programme of exploration has been drawn up which is being followed with great pertinacity

In Syria no systematic search was made for petroleum until well after the Great War and even then it was only because of its proximity to Iraq that its potential importance was appreciated In fact no real programme of investigation was adopted until 1933 Although Iraq does not belong to France it plays an important part in supplying France with liquid fuels and for this reason together with its proximity to Syria its position is reviewed in conjunction with Colonial resources proper

As a conclusion to this bulletin a chapter is devoted to France s present economic position in the world petroleum market interesting details being given of consumption and imports

A bulletin of this description is bound by its very nature rapidly to become out of date Accordingly so that its usefulness may be extended the Chronique des Mines Coloniales has undertaken to supply statistics and details of geological investigations from time to time as research and mining proceed Further a series of short articles is to be published by the same authority as occasion arises describing the position in the mining industry of each of the countries under French rule In this way it is hoped to direct attention not only to results already achieved in French Colonies but also to possibilities of future development of natural mineral resources

Hints to Travellers

Eleventh edition. Vol. 2. Organization and Equipment, Scientific Observation, Health, Sickness and Injury Edited by the Secretary with the help of many Travellers. Pp. xv+472 (London Royal Geographical Society, 1938) 14*s*

THE new edition of this second volume of "Hints to Travellers" is to all intents a new book. Former editions treated of little besides medical and surgical care and hints on the scope and methods of scientific inquiry These matters are not neglected and the sections dealing with them have been recast In addition, however, there are thirteen chapters on organization, clothing, equipment, food transport, etc, in fact on every aspect of the fitting out and management of an exploring party This is perhaps the most valuable part of the book, for it embodies the experience of many different travellers of recent years.

Polar travel looms large, but then, as the editor says, it marks a present trend in exploration, and so must command attention Moreover, it is in polar travel that the technique has changed most in recent years There are many extracts from the writings of recent travellers which may appear to occupy much space in a book the bulk of which must be kept within small dimensions for the sake of the traveller. On the other hand, these extracts have been carefully chosen, and each stresses some matter of importance even if it is a detail easily overlooked. Food and food values receive much attention, and photography has a long section. even the narrative volume of the expedition, written on its return, is not ignored

The volume is valuable in every chapter, an indispensable handbook for any traveller off the beaten track and an expression of the care and critical judgment of its editor

Railways To-day

By J. W Williamson. (The Pageant of Progress Series.) Pp 160+23 plates. (London, New York and Toronto. Oxford University Press, 1938.) 3*s*. 6*d*. net.

MR. J W WILLIAMSON will be known to many men of science as the former secretary of the British Scientific Instrument Research Association He has a facile pen and also hobbies, one of which is the study of railways and their working. The opening chapter in the book under notice touches on conditions of transport in Great Britain during the sixteenth century, the development of roads in later years and eventually of the 'rail way', from which the modern railway arose early in the nineteenth century Succeeding chapters discuss individual aspects of railway transport, such as the track, the locomotive, building and repairing rolling stock, signalling, operating traffic, traffic control, and so on, with a concluding chapter on electric traction The book is well illustrated with plates and explanatory diagrams. To the mechanically minded boy, and also to those of his elders who still regard the railway as something more than a necessary means of transport, it will be of absorbing interest.

The Nature of Man:

Studies in Optimistic Philosophy By Prof. Élie Metchnikoff. The English translation edited by Sir P Chalmers Mitchell Revised and brought up to date by C. M Beadnell Pp xviii+210. (London · Watts and Co., 1938) 5*s*. net.

WE welcome the new edition of this lively and attractive work, of which the first translation appeared thirty-five years ago (see NATURE, **70**, 394, 1904). The book has been ably revised by Rear-Admiral C M Beadnell, who in addition to several footnotes has added appendixes dealing with artificial insemination, blood transfusion, ages at marriage, illegitimate births in different countries, suicide, infant mortality and other matters. The work begins with a historical sketch showing that while natural philosophers in all ages have sought the foundation of morality in human nature itself and have held human nature to be good, many religious doctrines, especially Buddhism and Christianity, have depreciated the body as compared with the soul.

In the following chapters the harmonies and disharmonies first among beings inferior to man and then in the human race are discussed, special attention being paid to the disharmonies in the organization of the digestive and reproductive systems, as exemplified by the presence of rudimentary organs and disharmonies before and after marriage The part played by science in combating disease is then considered, and the final chapters are devoted to the scientific study of old age and death, which the author maintains will probably bring about great modifications in the course of the last period of life

Human Powers and Their Relations

By K W Monsarrat Pp xvi+289 (Liverpool University Press of Liverpool, London · Hodder and Stoughton, Ltd, 1938) 10*s* 6*d*. net

THIS book offers an excellent example of constructive thinking in theoretical and practical philosophy The problem of knowledge forms its central theme, and is taken as the basis of a more rational organization of human relations. Knowing is conceived as a process which produces and presents reports or ideas The proper use of ideas leads to the conception of the world in terms of power, and not in terms of matter. The classical dualism between power and matter should not be referred to the world as such, but to a duality in the relations of the process of knowing.

Applied to social problems, these views involve the consideration of the world as composed of diverse power-items which compensate each other without fusion in assemblies or associations: the human being is thus conceived as an example of influence-assembly, which retains his freedom and individuality. Society is the combination of human beings according to the same metaphysical process. The interest of these views, as we understand them, is to be found in the conception of an idealist philosophy which preserves the relative independence of the individual. In contrast with the misguided application of idealism by totalitarian States, the vision implied in this book will be found both useful and refreshing. T. G.

Archaic Vertebrates and Evolutionary Principles

By Prof J Graham Kerr, F R S , M P

RECENT attendance at the discussions of the Institut International d Embryologie and of the British Association (Section D) has impressed on me the desirability of offering—more especially to the younger generation of researchers in zoological science—a short statement of personal experience emphasizing certain general considerations which are in my opinion useful as affording guidance along profitable lines of investigation and at the same time warning against dangerous pitfalls I have been in my time responsible for a considerable number of new facts and theories relating on one hand to the evolutionary history of vertebrates and on the other to the general theory of evolution I will not burden this note with bibliographical details but refer anyone interested to my text books on Vertebrate Embryology (Macmillan 1919) and Evolution ’ (Macmillan 1926)

I may say that in my research work I have owed much to the foundations on which I was able to build—a sound training in mathematics and physics experience of fossil collecting among the carboniferous rocks of central Scotland and a *quite unusual training in field natural history* when living among the primitive Natokoi Indians of the Gran Chaco Indications of my early interest in field natural history will be found in my various communications printed in the *Ibis* during the nineties of last century I allude to this preliminary training for it may perhaps be taken as explaining at least in part my somewhat unfashionable attitude towards the branches of science I have mentioned—an attitude sometimes disrespectful towards the mathematical treatment of complicated biological phenomena which have not been subjected to the preliminary analysis into simple components essential to make them amenable to mathematical treatment a somewhat critical attitude towards pronouncements of palæontologists based upon the inadequate foundations provided by a study of skeletal structures in ignorance of ‘soft parts’, and finally an attitude of what may have seemed over emphasis of the need in all evolutionary speculation of paying due regard to each one of the three factors (1) structure (which alone provides actual *records* of evolutionary history), (2) function and (3) natural environment

The Cambridge school of zoology, in which I received my later training, was then at an important stage of its evolution the old school of natural history having sprouted out into a luxuriant new growth of laboratory activity under the stimulus of Balfour and Foster Regrettably but unavoidably the two great branches of laboratory activity diverged as they grew that of physiology on one hand with Foster Gaskell Langley Sherrington and the rest and that of morphology on the other with Balfour and his successor Sedgwick and a galaxy of colleagues of the highest distinction The splendid zoological laboratory of to day—an imposing memorial to the tenure of office of Prof Stanley Gardiner—represents what in its early days was called as it actually was the morphological laboratory

The remarkable Tripos course in zoology in those days in addition to providing a vast amount of knowledge regarding the comparative anatomy and embryology of the main groups of the animal kingdom exercised naturally a strong directive influence on those who passed through it In my own case this directive influence was affected by the recognition of two important weaknesses in the school of morphology (1) the tendency to concentrate attention *on preserved specimens* to the neglect of physiological and environmental conditioning factors and (2) the fact that the body of observations out of which the edifice of morphological theory had been built had been gathered not from such animals as from their admittedly archaic character might be expected to yield reliable information regarding earlier evolutionary stages, but from such as happened to be easily accessible to the investigator From this latter consideration came the determination to concentrate my life work in research upon archaic animals in spite of the technical obstacles in the way As my immediate interest lay in the problem of the evolution of land vertebrates or tetrapods it was to this problem that I proceeded to devote my attention

Of the various types of tetrapod actually surviving at the present day and therefore available for morphological study apart from mere osteology the most archaic seemed undoubtedly to be the urodele amphibian Of the evolutionary stages antecedent to the tetrapods or land vertebrates on the other hand, the most archaic surviving representatives seemed undoubtedly to be the sharks, the crossopterygian ganoids, and the lung fish The lampreys and hagfish I left on one side as liable to mislead owing to their adaptation to abnormal semi-parasitic habits. As regards my own research work, I determined to concentrate upon the crossopterygians and lungfish, not because I regarded them as more primitive than the selachians, but simply because our ignorance of them—particularly of their ontogeny—was more profound. The programme which I set myself, was the investigation of the three genera *Polypterus*, *Lepidosiren* and *Protopterus*—the embryology of which in particular was then entirely unknown—in order to see to what extent they supported or contradicted the accepted canons of vertebrate morphology. I need not refer here to the carrying out of that programme or to the tragic loss to science which it involved in the premature death of that splendid naturalist John Samuel Budgett, who had taken over the *Polypterus* part of the programme.

The study of these archaic vertebrates proved a fascinating task as it provided solutions to many puzzling problems of vertebrate morphology. To take, for example, one organ system alone—the blood system

Why does the headward end of the embryonic heart in the tetrapod assume that spiral twist which results in the common pulmonary artery of the adult amniote having a diagonal position, running forwards from right to left, across the root of the systemic aorta ?

What is the explanation of the reduction of the fifth aortic arch in the Amniota ?

Why did the main stream of blood from the hinder parts of the body in the Amniota come to be carried forward by a new vessel, the posterior vena cava, in place of the original posterior cardinal veins ?

Such are examples of morphological puzzles which found their solution in the developmental phenomena of *Lepidosiren*.

Incidentally, these investigations convinced me that real progress in the advancement of evolutionary theory is to be made through the careful investigation of particular organ systems rather than by speculation regarding the ancestral origin of particular taxonomic groups. They have also provided useful warnings as to pitfalls in the way of the morphological investigator, the non-recognition of which has frequently helped to inflict undeserved discredit on morphological science as a whole.

One of these is, strangely, forgetfulness of the elementary fact that all scientific theories are simply working hypotheses, fitting the knowledge of the moment, to be discarded or modified in immediate response to the requirements of new knowledge. The neglect of this principle has made itself conspicuous again and again. An excellent example is concerned with the mode of development of nerve fibres in the Vertebrata. The view I had been taught was that the nerve fibre, already fibrillated, grew out from the central nervous system and joined up secondarily with its end-organ, muscle-fibre or what not. Investigation of embryos of the large-celled *Lepidosiren* demonstrated that this was not the case, and that the appearances which at first sight appeared to support the accepted idea were deceptive. As it is clearly against all probability that the method of nerve development in vertebrates is not fundamentally the same throughout, it might have been expected that the alternative conclusions would have been obvious to all—either that the accepted theory was wrong, or that the observations that contradicted it were erroneous. It might have been anticipated that neurologists would have hastened to check the observations for themselves As a matter of fact, during the twenty years or so before the preparations succumbed to the wear and tear of student demonstrations, only one single neurologist made his appearance to do so—Elliot Smith He duly satisfied himself as to the accuracy of the observations on the motor nerve trunks of *Lepidosiren* and was good enough to check the general principle involved by extending them to a sensory trunk, the olfactory nerve.

While this experience with the nerve trunks of *Lepidosiren* exemplified well the sterilizing influence of dogma in restraining the recognition of awkward new facts, the same investigation of nerve development soon directed attention to another type of pitfall, namely, the tendency to place too implicit reliance upon one particular technique. This was provided by Harrison's basic experiment in which he showed embryonic nerve rudiments growing freely through a culture medium. The careful study of sections of embryos of *Lepidosiren* showed no reason to doubt the accuracy of Harrison's results so far as mere observation went, but on the other hand did show that in the actual body of the embryo the nerve trunk, instead of terminating in a free end, was already in continuity, as a simple protoplasmic bridge, with its end-organ, in this case a muscle cell, at an extremely early stage in development when the myotome had not yet begun to recede from the spinal cord ; and that accordingly reliance upon the experimental method without applying the check of different technique was apt to lead to erroneous conclusions.

This need of checking by the use of different technical methods, frequently impressed itself during the study of sections of embryos, when it was found necessary to check the evidence of paraffin sections by celloidin or conversely.

Still another and a peculiarly prevalent source of error lies in the tendency to base broad evolutionary generalizations upon the inadequate base provided by the knowledge of only a single organ-system. This is illustrated in particularly flagrant manner by conclusions based on knowledge of the skeletal system. The study of histogenesis in *Lepidosiren* was instructive in emphasizing the curiously vague way in which skeletal stiffening gradually spreads through the embryonic connective tissue—in striking contrast with the well-defined units which go to build up, say, the muscular or renal system. It is well also to recall in this connexion the readiness with which skeletal tissue, such as bone, develops secondarily in the living body in response to merely mechanical factors, as is well known to surgeons in the case of the human being. It is indicated that the greatest caution must be exercised in drawing phylogenetic conclusions from skeletal facts

In the critical frame of mind induced by such considerations, it is astonishing to note the frequency with which palæontologists have allowed themselves to base the most far-reaching evolutionary conclusions upon a basis of purely osteological fact. The suggestion that the resemblances in general form of the skull and in the dentition between a Tasmanian wolf and a member of the Canidæ indicate genetic affinity would be recognized as absurd; these striking resemblances are recognized as indicative simply of convergent adaptation to similar modes of life. Yet similar resemblances in skull structure between certain mammals and certain extinct reptiles have been taken as indicating the evolutionary origin of the group Mammalia from such reptilian ancestors. The fact of the matter is, of course, that far more complete knowledge than is at present available—not merely of the skull but of the whole skeleton—would be necessary to identify the ancestor of the Mammalia, and even should this ancestor be in the distant future identified, it will still be impossible in the absence of information as to its organs other than the skeleton—such as, for example, its heart and main blood-vessels and its reproductive arrangements—whether it can safely be regarded as falling within the boundary of the group Reptilia.

Another shortcoming which frequently invalidates the conclusions of the less thoughtful palæontologists is the failure to appreciate physiological considerations. Striking examples are seen in speculations on the phylogeny of cephalopods based entirely on shell structure and ignoring the immensely important flotation effects of the gas in the chambers of the shell.

Equally striking are the efforts still made to bolster up the Balfour theory that the pectoral and pelvic limbs of the vertebrates are persisting and enlarged portions of a once continuous structure along the side of the body. Long ago it was shown that the embryological foundation of this theory was unsound. Later on, it was shown to be not merely unsound but also erroneous. But still it survives, its supporters unmoved by the physiological considerations which make it entirely improbable. One fact alone, that in every vertebrate the muscular system is in its early stage composed of segmentally arranged myotomes, indicates clearly that the primitive mode of movement of the vertebrate was propulsion through a watery medium by waves of lateral flexure passing back from the head region, and a full appreciation of the perfection of this method of propulsion is sufficient to indicate that the evolution of a new type of motor organ in all probability had to do not with swimming but with making use of solid features in the environment to lever the body forwards The detailed investigation of the external gills of *Polypterus*, *Lepidosiren*, *Protopterus* and urodele amphibians has disclosed the existence within the phylum Vertebrata of a type of organ which possesses the full potentiality of giving rise in the course of evolution to a purely motor organ or limb Nevertheless, we find many palæontologists still ignoring such considerations and quite unnecessarily making use of the Balfour theory to provide interpretation for fossil fragments such as those of the ancient shark *Cladoselache*

Another old-fashioned idea which is allowed to persist in spite of its being untenable in the light of modern knowledge is that which derives the lung of land vertebrates from the air-bladder characteristic of teleostean fish. This no doubt seemed a natural enough idea to those whose freedom of vision was effectively blinkered by the general principle that land animals have evolved out of aquatic, and who did not pause to reflect that the teleostean fishes form the terminal twigs of a branch of the Vertebrata showing the highest degree of evolution for a free swimming existence and inseparably linked with this mode of existence.

What we now know, however, of the comparative anatomy and embryology of air-bladder and lung in the archaic vertebrates leaves no escape from the startling conclusion that the air-bladder of the teleostean fish, instead of representing a condition ancestral to that of the typical lung, is to be interpreted in exactly the opposite fashion. The evidence is, in fact, convincing that the air-bladder of the teleost is the modified right lung of an air-breathing ancestor.

I should not conclude this article without again directing attention to the fact that one of these archaic vertebrates, namely, *Lepidosiren*, happens to possess a character in the relatively enormous size of its cellular and particularly nuclear structures which renders it of unusual value for the study of histogenesis and especially gametogenesis. It was a delightful, though distracting, experience to observe for the first time the beautiful mitotic figures of *Lepidosiren* in those days when Cambridge teaching was still sceptical regarding the existence of centrosomes! The value of *Lepidosiren* material for the investigation of cell-detail is well brought out by the beautiful studies on the histogenesis of the blood by Bryce, on microgametogenesis by Agar, and on neurone relations by Ballantyne. The last-mentioned provides a typical case of new facts which, if they are really facts—and that they *are* facts, accurately described, I can personally testify—are shattering to one of the most sacred beliefs, for neurofibrils can be clearly seen to pass across the synaptic junction and plunge down into the cell-body of the next neurone

Various ideas of a more general kind bearing on the principles of evolutionary theory have been inspired by these researches that variability is to be regarded not as a phenomenon by itself but merely as one aspect of the general instability inherent in all living substance, that the selection of variations in a definite direction necessarily involves the selection of the *tendency* to vary in that particular direction, and therefore necessarily results in 'orthogenesis', that the phenomenon of parasyndesis discloses the existence of an attractive force which draws *like* chromatin together, and that this, while explaining the clumping together of like chromatin at successive points in the chromosome, renders unnecessary the assumption that the material basis of heredity consists of discrete and separate units or 'genes'

Finally, I would urge, my prolonged experience in research has served to emphasize a consideration that is too often ignored, namely, that it is not sufficient to be content with making use of newly determined facts simply as arguments for or against already existing theories On the contrary, it is essential that from time to time there should be a stock-taking, in which the body of relevant facts as now known is examined from a detached point of view, and the endeavour made by judicial consideration to arrive at a sound conclusion as to what general formula adequately fits the knowledge of to-day

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Food Storage and Research

THE report of the Food Investigation Board describes the general activities of the Board and, in summary form, the scientific researches carried out by the members of the food investigation staff, under the general direction of Mr E Barnard, the director of food investigation * References are given to published work, but the special purpose of the report is to record the latest progress in those investigations which have not yet reached the stage at which full publication of the results is feasible

Sir Joseph Barcroft was appointed chairman, on the resignation of Sir Frank Smith Mr Blackman, Prof Hilditch and Sir Thomas Middleton were re-appointed members of the Board Two special reports have been published, the first by R B. Haines, summarizing the more important data relating to the invasion of animal tissues by micro-organisms and their control (Special Report No 45), and the second by C. H. Lea on rancidity in edible fats (Special Report No 46).

Members of the food investigation staff paid visits to South Africa, Germany and the United States and Canada during the year Broadly speaking, the impression which the Board has gained from the report on the American tour is that while Great Britain is in no way behindhand in research on the handling and storage of foodstuffs, the application of science in this field is not so forward here as in the United States There, the active belief of the leading industrialists in the value of research, and their keenness to apply scientific method and knowledge in the food industry were striking, and so was their readiness to spend large sums in developing new processes and in introducing new products to the public.

Reference is made in the report to the recommendation of the committee appointed to review the scope and form of the "Index to the Literature of Food Investigation", that this publication should be continued The Board endorsed this recommendation and decided that the "Index" should cover the whole of the field which lies between the production of foodstuffs on one hand, and nutrition on the other hand, that it should be brought up to date as quickly as possible and should be published quarterly instead of half-yearly. In pursuance of this decision, the "Index" to the literature published in 1937 has now been issued, as vol. 9, Nos. 1–4. It is hoped to complete shortly vol. 7, No. 2 and vol 8, which will deal with the literature published during 1935 and 1936.

From time to time, the Board is asked whether food that has been stored by modern methods, such as cold storage gas storage or canning, is as nutritious as fresh food The question was put to the Medical Research Council who replied that in the present state of knowledge it is impossible to state categorically whether or not stored foods are as nutritious as fresh foods Nor is it feasible to undertake research with the view of answering that question directly since many years of intensive work on large groups of human beings would be necessary Even then there would be little prospect of arriving at a definite decision for with further knowledge of the effects of dietary factors on nutritional processes it would be found necessary to reconsider the results of the early years studies in the light of fresh evidence Nevertheless useful information can be obtained by comparing the chemical composition of stored foods with that of fresh foods and the general conclusion can be accepted that relatively little loss of known constituents occurs in foods stored by modern methods Moreover experiments on animals have shown that satisfactory nutrition can be maintained on diets composed solely of stored foods In fact food of good initial quality stored by the best modern methods is likely to be superior to similar food that though still technically fresh is in reality stale Vitamin C and to a less extent vitamin B_1 however are liable to be destroyed by heating

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* Report of the Food Investigation Board for the year 1937, (Department of Scientific and Industrial Research) Pp 260+v (London H.M Stationery Office, 1938) 4s net.

The report of the Director of Food Investigation is divided as usual into sections dealing with the different foodstuffs and the engineering problems of food storage Two considerable pieces of work were undertaken for the Herring Industry Board the first dealt with the quality of kippers in relation to the quality of the fresh herrings from which they are made and the second with the freezing and cold storage of herrings The development of rancidity in the fat of herrings during cold storage is due to the action of certain enzymes which are activated by common salt Herrings frozen in brine need careful washing and glazing before storage the possibility of satisfactory freezing in air is being explored

Storage in ice will keep fish fresh for 10 12 days a period which covers some two thirds of the trips made by British trawlers Freezing in brine at −20° C with storage at the same temperature or at −30° C will keep white fish fresh for at least six months lemon soles have been kept in a palatable condition for as long as two years The fishing industry is now seriously considering the commercial possibilities of brine freezing and cold storage It must however be emphasized that the fish should be absolutely fresh when frozen it is of interest, therefore to note that a simple chemical test for freshness, based on the estimation of volatile organic bases appears promising According to the report the dimethylamine content of the fish follows the bacterial curve very closely during spoilage although the absolute amount present is much less than that of the triamine and ammonia (See also NATURE Dec 17 p 1078)

The increase in the hydrogen ion concentration which is essential to the proper keeping of the flesh of animals can only be ensured if an ample reserve of glycogen is present in the muscles at the moment of death The practice of resting animals for at least twenty four hours before slaughter is essential it is also advisable to give a ration of easily absorbed food such as cane sugar or glucose rather than to withhold food completely during this period Struggling on the slaughtering floor should also be reduced to a minimum estimations of lactic acid in the blood of slaughtered animals which have struggled show that an appreciable loss of acid may take place from glycogenolysis in the muscles the acid in the blood will not contribute to the rise in muscle hydrogen ion concentration

About two fifths of the report is devoted to the storage of fruit and vegetables The study of the respiration of the apple has brought to light a new fact of practical importance It appears that in the stage before the attainment of full maturity at which the fruit is often gathered namely just before the onset of the climacteric rise in respiration apples exhibit on exposure to concentrations of carbon dioxide up to 15 per cent a temporary increase in activity which may amount to as much as 100 per cent Hence the possibility of carbon dioxide accumulating to dangerous levels is greater in the period immediately after the fruit has been put into store especially if warm and respiring rapidly than had hitherto been thought possible

Experiments have been carried out on the cooling and storage of fresh strawberries for short periods A temperature of 38° F was satisfactory for 2 3 days storage but 32° F gave more control over fungal rotting and would probably be necessary for longer storage The rate of cooling affected the rate of subsequent deterioration With slow air speeds and a high relative humidity, no perceptible damage occurred in fruit cooled with air at either 23° or 28° F provided the fruit was not allowed to freeze A preliminary experiment on gas storage showed that the growth of fungal rots could be retarded without damage to the fruit by an atmosphere consisting of 10 per cent carbon dioxide 10 per cent oxygen and 80 per cent nitrogen

Other matters which are dealt with in the report are the storage of broccoli the preservation of pears and asparagus by freezing the effect of various methods of manuring the storage properties of apples, the storage of hothouse grapes and the ripening of imported pears and plums

The Nile Flood

By Dr. H. E. Hurst, C.M.G.

THE Nile flood of 1938 has been exceptionally high, and if we consider the Nile at Aswan, it was the highest since that of 1898 or perhaps 1892. Thanks to the protective measures carried out by the Ministry of Public Works, the water was passed through the whole length of Egypt to the sea (1,500 kilometres) without serious damage. Damage was limited to the loss of crops on islands and low lands lying inside the river banks and to infiltration, and this occurs in all years when the flood is fairly high Among the protective measures was the use of the Aswan Reservoir to prevent the river-level passing the danger point, whereby the peak was lowered by about twenty centimetres, and the level of the river reduced during about twenty days.

The flood is produced by rainfall (not snow) on the Abyssinian Plateau, which causes the Blue Nile, Atbara and their tributaries to rise regularly each year beginning usually in May or June and reaching their maximum in August or September. The White Nile contributes, but its variation is much less than that of the Abyssinian tributaries, and it does not reach its maximum until some weeks after the peak on the Main Nile is past. This year the maximum discharge on the Blue Nile was about 730 millions of cubic metres per day on September 2 and on the River Atbara 310 millions of cubic metres per day on August 23, while the maximum on the Main Nile at Wadi Halfa was about 1,020 millions of cubic metres per day and occurred on August 31.

There is no doubt that the present flood is the highest for forty years, but an exact comparison with the high floods of last century is not easy. Previous to the present century there were few measurements of discharge and these were always made with floats, so that we cannot compare directly quantities of water which are the real measures of floods. Current meters were introduced by Sir Henry Lyons at the beginning of the present century. There are, however, records of the level on gauges which have been read regularly for the last seventy years. The difficulty with these is that changes of river bed affect their readings, so that it happens that with two floods of nearly equal maximum height one may appear higher on the first gauge and the other on the second. There is reason to suppose that even the Aswan Gauge at the foot of the first Cataract has changed relatively to other gauges since the Dam was built at the beginning of this century. However, these variations are not as a rule large, and the gauges at some sites give a fair comparison of the heights and volumes of floods.

For more than thirty years there have been gauges on the tributaries of the Nile in the Sudan, the farthest south on the Blue Nile being at Roseires near the Abyssinian frontier, and thus warning of the rise of the river is obtained about ten days before its peak reaches Aswan. A similar warning is received from a gauge station on the Atbara, but the time interval is shorter.

The frequency distribution of floods is interesting. In addition to records of the level at Aswan which cover the last seventy years, there are records from the Roda Nilometer in Cairo which go back, although with large gaps, to A.D. 622, soon after the Arab conquest of Egypt. These records have not the precision of modern observations but are probably as reliable as present-day statistics about less well-defined phenomena such as health and social conditions, and they cover a very long period of the rise and fall of the Nile They have been analysed for periodicities by the late Prof. H. H. Turner, Mr. J. I. Craig and Dr. C. E P. Brooks, and periods varying from 2 to 240 years have been found The period of greatest amplitude so far is one found by Prof Turner of 240 years, with an amplitude of 15 cm for the maxima and 46 cm. for the minima.

RECORDS OF ASWAN GAUGE

Description	1869–1898		1899–1938	
	Height (metres)	Year	Height (metres)	Year
Maximum gauge reading of highest flood	94 15	1878	93 50 (Corrected for effect of reservoir)	1938
Maximum gauge reading of lowest flood	91·40	1877	90 11	1913
Mean flood maximum for period	93 26		92·46	
Number of years with maximum greater than 93·30 m	16		2	
Number of years with maximum less than 91 40 m.	0		2	

The analysis by Dr. Brooks does not extend to periods longer than 76 8 years, but he finds a number of periods of average amplitudes of the order of 10 cm. His best-defined periodicity is that of 76 8 years, with a mean amplitude of 17 cm. The average standard deviation of the flood-levels is 56 cm., which makes apparent the relative smallness of any periodic effects, which although of theoretical interest, are of no use to the forecaster. A glance at the records when plotted on a fairly large scale shows that there is no period which is directly evident to the eye, and that the principal features are the existence of fairly long terms of years when, on the whole, the floods have been high and others when floods have been low. This fact is well illustrated by the Aswan gauge records for the period 1869–1938. By dividing this period into two parts, 1869–1898 and 1899–1938, an example is afforded of a high term of 30 years followed by a low term of 40 years, with the results shown in the preceding table.

The most striking feature of this table is that in the thirty-year high term one year in two was higher than all but one of the succeeding forty-year low term. The important question, which however we cannot answer, is, are we now entering on a term of high floods ?

If flood heights are taken without regard to order, they give a frequency curve of normal form, but owing to the existence of high and low terms of years this frequency curve cannot be applied directly to give, for example, the chance of occurrence of a very high flood like that of 1878 in the next twenty years. Some work has recently been done on problems of this type which it is hoped to publish later

Obituary Notices

Prof. William McDougall, F.R.S.

WILLIAM McDOUGALL, whose death was recently announced, was partly Scottish, partly Saxon; he came partly of industrial and partly of agricultural stock; he was in part scientist and in part philosopher. One side of him was intensely interested in social movements and social activities; another was reserved, contemplative, and, to use his own word "arrogant". He was probably the most widely studied, the most universally known and appreciated of all contemporary psychologists. Yet to the end he regarded himself as an upholder of lost causes, a rebel against current conventions, a voice crying in the wilderness with but few to listen and to pay attention. In 1930, he wrote a brief, charming and frank autobiography ("History of Psychology in Autobiography", edited by Carl Murchison, Clark University Press. Vol. 1, pp. 191–223), and there, if anywhere, the paradoxes of his life and work are clarified and interpreted.

McDougall's life was a varied one. After a private school and a year at Weimar he entered the University of Manchester, and though he was at first deeply attracted by geology, he graduated in 'general science'. In 1889, he won a scholarship at St. John's College, Cambridge. At that time physiology was developing rapidly in Cambridge, and soon McDougall decided to specialise in this direction and to qualify in medicine, not in order to practise, but to fit himself more fully for original research. He took his degree with the highest honours and went to St. Thomas's Hospital, where he worked in the Physiological Laboratory, then under the direction of C. S. Sherrington. His research, partly on muscle contraction and partly on psychophysical problems, brought him a fellowship at St. John's College, but soon after this, in 1899, he joined the Cambridge Expedition to the Torres Straits, where he collaborated with W. H. R. Rivers and C. S. Myers in a comparative experimental study of native sensory reactions. He paid an extended visit to Borneo and saw something of China, Java and India before he returned to Cambridge.

For a day or two McDougall was an elected tutor of St. John's. But suddenly he flung aside one of his principles—"that a man whose chosen business in life was to develop to the utmost his intellectual powers should not marry before forty, if at all"—and married. For some time he combined a honeymoon and science at Göttingen, where he worked with G. E. Müller. Although he was somewhat out of sympathy with Müller himself, it was here that he began his experimental work on colour vision which many still think to be the best work he ever did. Characteristically he opposed Helmholtz, Hering and all his contemporaries who approved of their views. He said that he returned to Thomas Young, but it was a return with many differences. It was probably this work more than anything else which later won him his fellowship of the Royal Society.

Back in England, he taught experimental psychology for a few years at University College, London, and continued his own research on vision, on attention, and on general psychophysical problems He also planned a book on social psychology.

In 1904, McDougall became Wilde reader in mental philosophy at Oxford, and he continued to hold this post until shortly after the Great War. He was, he says, happy enough with the Oxford people—he became in due course a fellow of Corpus Christi—but very restive and discontented with the Oxford atmosphere of those days. When the Great War came, he was for a short time a private in the French Army and for a longer time a major in the British. At the Netley Hospital he had charge of a great many nerve and 'shell shock' cases and became deeply interested in the psychological study of functional disorders of the central nervous system.

During the Oxford period he wrote his "Introduction to Social Psychology", "Body and Mind", "The Pagan Tribes of Borneo" (with Dr. Charles Hose), the small Home University text-book and finally "The Group Mind". The first of these books, he says, dropped like "a stone into a bottomless pit". If so, it has successfully bounced out again, exhausted some twenty-three large editions and vastly influenced very nearly everything that psychologists have written about the subject since.

After the War, McDougall was invited to succeed Münsterberg in the chair of psychology at Harvard. He went to the United States with high hopes, found there very many friends, but was plunged into intense public controversy which persisted to the end of his life. American behaviourism represented for him everything which he most heartily disliked. He attacked it vigorously. He continued his attacks long after the battle had, to all intents, been won. He published book after book, and the motive of them all was the same, to fight all types of 'mechanistic' explanation in every field of science and to do this in the interests of "the art and theory of the internal life of man".

Harvard did not hold him for long. In 1927, he accepted a new chair of psychology at Duke University, North Carolina, and there he remained, latterly with yearly visits to England, until his death. On the whole this suited him the best of all his many dwelling-places The less hurried, more patriarchal atmosphere fitted well with his temperament and helped his work. His philosophical and ethical interests, always strong, became ever more pronounced. As a psychologist his primary concern was to establish a wide teleological point of view, and in so far as his experimental interests persisted, they were confined to a general approval of work on telepathy, clairvoyance and the like, and to his well-known Lamarckian experiment.

McDougall began the Lamarckian work at Harvard and continued it at Duke. He considered the question at issue "the most important question yet formulated by the mind of man and clearly susceptible of solution by experimental procedure"; and he was firmly convinced that his own long-continued work with white rats had achieved a "clear-cut and indisputable proof of the reality of Lamarckian transmission".

A few months before his death McDougall published his last book, "The Riddle of Life". He had set out, an unwearied soldier, upon his old campaign against mechanistic explanation in Nature and in life. He had conducted it with brilliance and with vigour. He was in the grip of a painful and a fatal disease. Only a "marvellous operation" enabled him to complete the work. As he read the proofs of this book it seemed to him that possibly some of his criticisms of physical and biological men of science might appear to be harsh and unsympathetic. So, himself near to death, he paid a last tribute to scientific endeavour. "I am now more than ever sensible of the splendour and achievements of modern science, and grateful to those whose skill and labour and genius have made possible such great benefits as I have received from the hands of my colleagues". He desired only that science should discard all pontifical claims and remain humble and honest in its search for truth. For himself the beginnings of the ultimate truth had been found. He saw in all forms of behaviour "some large unity or community of Nature underlying the separate individual organisms". He believed that, within every society, from insects to man, he could discern a harmony of activities "secured by the direction of some intelligent purpose more comprehensive and powerful than that of any individual member". F. C. BARTLETT.

AN anthropological correspondent writes:

Prof. McDougall, with the late Dr. W. H. R. Rivers, was a pioneer in the application of the methods of scientific psychology to the study of peoples of backward culture in the field, when they were both members of the Cambridge Anthropological Expedition to the Torres Straits under the leadership of Dr A. C. Haddon One outcome of this early interest in primitive mentality was "The Pagan Tribes of Borneo", which Prof McDougall published in 1912 in collaboration with the late Dr (afterwards Sir) Charles Hose. This intimate and detailed study of peoples, who when first known to one of the authors were in the enjoyment of a simple culture barely touched by European influence, is still one of the most highly regarded of ethnological treatises belonging to the early part of this century. A further result of Prof. McDougall's early studies in social anthropology is to be seen in his bent towards the sociological implications of psychological studies, which is apparent throughout his published works, and is especially to be noted in the analyses of world problems, which he has produced in the years since the Great War.

Prof. Georges Urbain

THE death on November 5 of Prof. Georges Urbain, director of the Institut de Chimie, past-president of the French Chemical Society, removes a well-known figure from French scientific life.

Born in Paris on April 12, 1872, son of a professor of chemistry, he studied at the Paris School of Physics and Chemistry and carried out research work under Friedel, Schutzenberger and Jean Perrin, obtaining his doctor's degree for investigations on the rare earths.

After five years of industrial research with the Compagnie générale d'Électricité, Urbain returned to academic life, lecturing at the School of Physics and Chemistry and later at the Faculty of Sciences of the Sorbonne, where he became professor in 1908.

The name of Urbain will always be associated with our knowledge of the rare earths. He showed that a number of so-called pure elements belonging to that series were in fact mixtures of europium, gadolinium, terbium and dysprosium. On the other hand, from ytterbium he separated a new element, lutecium (atomic number 71) and forecast the existence of a further element of atomic number 72 (celtium) which was later identified by Hevesy (haforium.)

In pursuing the difficult investigations connected with the separation of the rare earth elements, Urbain showed great versatility in employing many physical and chemical methods, often necessitating prolonged and tedious work It is estimated that, together with Lacombe, he had carried out some 200,000 fractional crystallizations over a period of fifteen years.

Like preceding investigators, Urbain began by studying the absorption and emission spectra of the rare earths, then went on to the magnetic properties and the phosphorescence in cathode tubes, discovering the law of optimum phosphorescence of binary systems. He also carried out many accurate atomic weight determinations.

In addition to his work on the rare earths, Urbain will be remembered for his contribution to the study of complex inorganic salts, which he considered to form a link between inorganic and organic compounds.

During his career, Urbain filled many important posts. He lectured at the École Centrale and presided over the Experimental Section of the École des Hautes Études. In the Great War he directed the Chemical and Technical Section of the Artillery.

These numerous activities none the less left Urbain time for artistic recreations. Those who attended the banquet in his honour given at the Maison de la Chimie last June were privileged to hear several of his original musical productions

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WE regret to announce the following deaths .

Prof Edwin H. Hall, emeritus professor of physics in Harvard University, on November 20, aged eighty-three years

Prof. J Šplíchal, professor of inorganic and analytical chemistry in the School of Mines, Příbram, Czechoslovakia, who had only recently completed a lengthy study of the thermal decomposition of the carbonates of calcium, magnesium, iron and manganese, on December 8, aged fifty-three years

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News and Views

Society for the Protection of Science and Learning

PERHAPS there is no finer testimony to the work undertaken by the Society for the Protection of Science and Learning, the report for 1938 of which was referred to in NATURE of December 17 (p. 1051) than the extent to which it has received the active support during the whole of its five years existence of the university staffs in Great Britain. Not only have individuals and committees in the majority of academic centres lent ready assistance to their exiled colleagues from abroad in the way of advice and vigilance for new openings for them, but also they have contributed financially more than £10,000 towards the funds of the organization which seeks to aid academic refugees. The Society itself has arranged a week of meetings early next term to take place in the great majority of British academic centres, with the view of spreading information concerning the plight and prospects of academic refugees Among those who have agreed to take part in these meetings are included · the Home Secretary, the Archbishop of York, Viscount Samuel, the Marquess of Reading, Sir William Bragg, Sir Henry Dale, Sir Richard Gregory, Sir John Hope Simpson, Sir Norman Angell, Sir Allen Mawer, Sir Bernard Pares, the Hon. Harold Nicolson, Mr. Philip Guedalla, Mr. Walter Adams, Prof. Gilbert Murray, Prof. Winifred Cullis, Prof. John Macmurray, Prof. P. M. S. Blackett, Prof. Lancelot Hogben, Prof. F. A. E. Crew, Miss Rebecca West and the Hon. V. Sackville-West. The Royal Society is giving a special reception to the academic exiles and those who have been working in their interests, in collaboration with the British Academy, on February 7 ; and on February 10 the evening discourse at the Royal Institution is to be given by Prof. Max Born, one of the most distinguished of the refugee men of science.

The Chemical Society

AT a meeting of the Chemical Society held at the Royal Institution on December 15, it was stated that Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford, has accepted nomination to the office of president for the period 1939–41, which includes the centenary celebrations of the Society to be held in April 1941. The Longstaff Medal for 1939 has been awarded to Prof. I. M. Heilbron, for his outstanding contributions to the science of chemistry in the field of natural products, especially vitamin A and related natural pigments, the anti-rachitic vitamin D and its precursors, and the constituents of the fish liver oils and of natural resins of the triterpene group. Prof. Heilbron was lecturer in organic chemistry in the Royal Technical College, Glasgow, from 1909 until 1914, and in 1919 became professor of organic chemistry there. In 1920, he proceeded to the University of Liverpool as professor of organic chemistry; in 1933 he held the chair of organic chemistry in the University of Manchester. In 1938, he was appointed professor of organic chemistry at Imperial College, London.

AT the meeting of the Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society, held on December 14, it was decided that the Harrison Memorial Prize for 1938 should be awarded to Mr. Alexander King. Mr. King received his chemical training at the Imperial College, South Kensington. From 1930 until 1931, he worked in the Physical Chemistry Institute of the University of Munich under Prof. K. Fajans, and from 1931 to the present date has held the post of assistant lecturer at Imperial College. His original investigations on adsorption and on emulsions and other colloid topics form notable contributions to our knowledge of physical chemistry. After a brief statement regarding the establishment of the Faraday lectureship, the president (Prof. F. C. Donnan) introduced Dr. Irving Langmuir, who then delivered the seventeenth Faraday Lecture entitled "Monolayers on Solids". At the conclusion of the lecture he presented the Faraday Medal to Dr. Langmuir.

Life-size Model of a Blue Whale

A MODEL of a 93-ft. Blue whale has just been completed in the Whale Hall of the British Museum (Natural History). It is constructed of plaster of Paris and cement on a wood and wire-netting framework and weighs between six and seven tons The proportions and colour are based on photographs and written descriptions and on very numerous measurements of actual specimens. Features of interest in the model are: the great size of the head, which is nearly a fifth of the total body length; the eye just behind the angle of the mouth, and the very small ear opening a little distance behind the eye; the tapering beautifully stream-lined flippers, and the enormous tail flukes some eighteen feet from tip to tip. The numerous grooves covering the throat and chest are a typical feature of the family Balænopteridæ to which this species belongs. The Blue whale, which grows to 100 ft., is the largest of all living animals and, so far as is known, the largest that has ever existed. At birth it is more than 24 ft. in length, and by its third year of life when it becomes sexually mature it is 74–77 ft. long. Its distribution is world wide, but at the present time the only remaining important area of concentration is in the Antarctic. There it is being hunted by the whalers for the oil obtained from blubber and flesh. During the 1936–37 antarctic whaling season, out of a total of 32,821 whales slaughtered, 14,183 were Blue whales

A Kentish Iron Age Hill-Fort

THE hill-fort at Oldbury, near Ightham, Kent, the excavation of which was described by Mr. J. B. Ward before the Society of Antiquaries of London on December 15, is the largest hill-fort of iron age date in Britain. Its ramparts are some two miles in circumference and enclose a space of 120 acres. Originally, it would appear from the evidence of sections cut in the ramparts, the erection was a place of refuge rather than a permanent settlement. This was at the very beginning of the first century A.D.; but later the gate facing the North Downs was elaborately refortified with stone-revetted fighting platform and outworks. The associated pottery shows that this refortification was carried out in A.D. 43 at the time of the Claudian invasion. Although Oldbury lay off the line of march of the Claudian armies proceeding from East Kent, where they landed, to Colchester, the evidence of the burning of the gates and quantities of sling stones suggest that it was sacked then or soon after. The camp was not again occupied. No Belgic pottery was found in the original fortification, but only in the later works. From this Mr. Ward infers that the original fortifications were erected by another people who had established themselves in the Wealden areas of Kent, Surrey and Sussex, working the local supplies of iron, and that its original purpose must have been to serve as a protection against the inroads of the Belgic tribes, whose headquarters lay north of the Thames The occurrence of Belgic pottery in the later fortifications suggests that by that time the Belgic people had taken possession of the fort.

Mesolithic Dwellings at Farnham, Surrey

EXHIBITS illustrating the culture of the inhabitants of mesolithic pit-dwellings at Farnham, Surrey, are now on view in the Prehistoric Galleries of the British Museum (Bloomsbury). These dwellings, on a site which is the only one of its kind as yet found in Britain, have been excavated by Dr and Mrs Grahame Clark. The results of the excavation, which has occupied two seasons, were described by Dr. Clark at a recent meeting of the Prehistoric Society The site of the settlement, which is the property of the Farnham Urban District Council, consists of a number of irregularly shaped pits, three feet deep in places, which have been scraped out of the gravel of the old Blackwater River. These pits represent the chief habitations of a mesolithic people, who probably spent their summers hunting on the Lower Greensand, when they lived in temporary shelters. Four huts have been excavated. In one pit there was a hearth and near another there were signs of a post, which probably had supported some light framework arranged tent-wise. Generally, however, the roofing seems to have been of the nature of a lean-to. Large numbers of microlithic implements were discovered, with flint axes, scrapers and waste flint cores and flakes. Altogether, between forty and fifty thousand worked flints have been discovered, and fifteen thousand flints cracked by fire have been found. These houses are, as stated, the first of their kind to be found in Britain; and they probably represent the first type of habitation in use in Britain other than the cave. They are considered to date from about 3000 B.C., and support the contention that artificially constructed dwellings are more ancient than has been thought. On the Continent, evidence is accumulating that mesolithic man was nomadic, inhabiting light shelters in the summer, and more or less permanent dwellings, usually of the pit-dwelling type, in the winter. The exhibits now shown in the British Museum are drawn from two of the dwellings excavated, and include a large and representative selection of the implements found

Accessions to the British Museum (Bloomsbury)

INTERESTING additions to the collections of British antiquities of the British Museum (Bloomsbury) were announced at the December meeting of the Trustees. Among these the most important is an iron sword of the second century B.C., with its bronze scabbard mount, which has been lent for temporary exhibition by the Duke of Northumberland. It was found in the River Witham below Lincoln in 1826, probably at the same time as the famous bronze shield of the iron age, which, with its characteristic Celtic ornament combining the use of metal and enamel, has long been one of the Museum's most striking exhibits among British antiquities. The decoration of the scabbard mount is an example of the earliest Celtic art of Britain, and shows the La Tène curvilinear style of ornamentation in the form in which it reached Britain Other accessions, also of great interest, come from a round barrow at Riffley Wood, near King's Lynn, which has been excavated by Mr. I. J. Thatcher and Mr. P. L. K. Schwabe. Among these are a segmented bead and a ring pendant of bluish-green faience, which were associated with nine or ten cremated urn burials of the Middle Bronze Age found on top of the mound. They belong to a class of ornament which has been found in bronze age burials in Britain and on the Continent; and they agree in all respects with examples found at Tell el-Amarna in Egypt, dating from about 1400 B.C. The grave pit of the mound below the level at which the urn burials were found, contained no remains; but the whole of the surface-level below the barrow was covered with pottery fragments, representing hundreds of vessels. These sherds were of beaker pottery of the Early Bronze Age, of the approximate dating of 1800 B.C It seems clear that this was not a habitation site, and the sherds are thought to be either the debris of the floor of the dead man's hut, which was brought here entire, or, perhaps more probably, the result of a ritual, which involved the scattering of a large number of potsherds.

The Iron Industry in South Yorkshire

BEFORE the introduction of mild steel about sixty years ago, engineers had to rely on wrought iron made by the puddling process introduced by Henry Cort in 1783. Among the various brands of wrought iron none was superior to those made in Yorkshire. But long before Cort's time iron was made in Yorkshire, and in a paper entitled "The South Yorkshire Iron Industry 1698–1759", read to the Newcomen Society on December 14, Dr. A. Raistrick gave an account of the operations carried out in the Sheffield–Leeds–Huddersfield area about two hundred years ago. The source of his information was manuscripts discovered a few years ago, and now preserved by the Bradford City Museums and Library Committee, relating to the activities of the various branches of the Spencer family, all Quakers. The documents give accounts of 10 furnaces, 14 forges and 5 slitting mills, and though much of the information relates to the business side of the industry, they embody a considerable amount of technical information about the mining of the iron ore, the construction and working of the furnaces and forges and the production of charcoal. The main group of furnaces was on the outcrop of the Tankersley Ironstone and near streams which were used for driving water-wheels for working the bellows. As in Sussex, a determining factor of the industry was the supply of charcoal, and it was rarely possible for a furnace to be worked for more than half the year. The manuscripts, as Dr. Raistrick said, put a new complexion on the story of the iron industry in the area.

British Coal Utilisation Research Association

ON December 14, the British Coal Utilisation Research Association held its first ordinary general meeting under the presidency of Sir Evan Williams. It was founded in April last, having incorporated the Research Department of the Combustion Appliance Makers Association (Solid Fuel) and with a membership covering all sections of the industries of coal and its appliance manufacturers. Its income from these sources and Government grant is guaranteed at £29,000 for five years. Premises near West Brompton Station have been secured and are being adapted to the purposes of an experimental station. It was stated that fruitful work has already been done in both the domestic and the industrial sections In the former this has been concerned with the open fire, and the use of natural smokeless fuels and smoke reduction. In this connexion it is claimed that success has been achieved in the design of solid fuel cookers to replace in railway restaurant cars those fired with oil gas On the industrial side, the supply and use of solid fuel for small industry, pulverized fuel, and industrial temperature measurement have engaged attention. A special committee has been set up to study the question of producer gas transport and supplement the work already in progress at the Fuel Research Station It has long been a matter of reproach against the coal industry that it has shown complete indifference to the rational and efficient utilization of its commercial product The launching of this Association will remove this reproach, and, as the president said, it will be "the missing member of a team which will work in harmony to bring about a more perfect knowledge of the properties of coal measures and advances in their fuller and better utilization".

Blind Landing System for Royal Air Force Equipment

THE Air Ministry has announced its intention to equip all R.A.F. bombers and reconnaissance aircraft with the Lorenz blind approach system. If experiments during this winter prove this to be successful, the fighter class of aircraft will then also be so equipped. This follows the announcement that forty R.A F. aerodromes would have the radio transmitting apparatus for this system installed, as mentioned in NATURE of November 26 The apparatus to be carried in each machine weighs 50 lb. and costs about £200. Its manipulation demands a certain technique, and pilots need considerable practice before being able to use it in addition to the other movements and observations that are incidental to the operation of landing a modern high-speed aeroplane. A special 'Link' trainer is used for practice in the use of the Lorenz system, upon which approaches and landings can be simulated without leaving the ground. These are to be provided at R.A.F. flying schools, in addition to which each service station will carry one. The training of the personnel will be undertaken by special instructors, who will have already attended courses at the Central Flying School at Upavon, Wilts.

Wedgwood's Portrait Medallions of Men of Science

IN his Friday evening discourse before the Royal Institution on December 16, Dr. John Thomas spoke on "Josiah Wedgwood and his Portraits of Eighteenth Century Men of Science". The great success of three fellows of the Royal Society—Josiah Wedgwood and his two friends Matthew Boulton and James Watt—as industrialists was discussed The successful production of artistic pottery at Etruria and of steam engines at Soho Factory, was only possible because of the persistent application of scientific principles. These 'philosophic' fellow-manufacturers endeavoured to satisfy this craving for scientific knowledge by attaching themselves to (*a*) the Lunar Society in the Midlands and (*b*) the Royal Society of London. Josiah Wedgwood, because of the artistic character of his jasper portrait medallions in the days before photography, established himself practically as the 'official' portrait producer of learned societies. Proof of this is the assembly of more than one hundred portrait medallions in Dr. Thomas's collection. Wedgwood handed the torch of science to his descendants, among whom was the illustrious Charles Darwin, his grandson, of whom Dr. Thomas exhibited a fine plaque by Wedgwood. Thus we, who live in the twentieth century, owe a great debt of gratitude to the 'prince of potters', not only for his scientific outlook, but also for the light which he has shed on his scientific contemporaries, through his inimitable portrait medallions.

Earthquake in Spain

AN earthquake was experienced in Spain on December 13, shaking the whole province of Valencia. The shock, which lasted three seconds, caused some apprehension and damaged buildings, but no casualties are reported. The district concerned is to some extent seismically active, as it borders the well-established Mediterranean region of earthquake activity, though it is not so densely populated with epicentres as is the region of Andalusia and Granada to the south of it. No really great earthquake has been experienced nearer to this region than Lisbon, 475 miles distant. It was from the Lisbon epicentre that the three shocks and several aftershocks occurred on and after November 1, 1755, at 9 h. 40 m. local time. The first lasted seven minutes, destroyed Lisbon and caused remarkable sea-waves in such distant regions as Scotland and Sweden. The second at 10 h. engulfed the Cays Depreda with the people on it and the vessels near it so that none of them were seen again, and altogether upwards of fifty thousand people lost their lives on that occasion.

New Merseyside Nature Society

FOLLOWING an inaugural field-meeting at Freshfield dunes and shore on December 11, a new nature study society for south-west Lancashire and Wirral was launched, as the Merseyside Branch of the British Empire Naturalists' Association, when the following officials were elected for 1939: *Hon. President*, J. W. Nixon (who is the Ribble Valley representative of the B.E.N.A. and honorary secretary of the Blackburn Naturalists' Field Club); *Chairman*, J. C. Miller, of the University of Liverpool; *Hon. Organising Secretary*, Eric Hardy. It was announced that the new Merseyside Naturalists' Association would cover the area between the Ribble and the Dee on a much more modern and active method of general field nature study than was at present available in the area, although it was in no way antagonistic to some ten older natural history societies in the district. Mr. Hardy stated that the Society had been formed by about fifty naturalists and nature-lovers who had given their signatures to the desire for introducing the B.E.N.A. work to Merseyside. It was agreed that in 1939 they report on their area for the national bird survey being carried out by the scientific committee of the British Trust for Ornithology, and for the selected list of trees and insects chosen for national observation by the B E.N.A. headquarters. Arrangements had been made for combination with the branches of the B.E.N.A. for Manchester and West Lancashire (Lytham)

The Parliamentary Science Committee

THE fifth annual meeting of the Parliamentary Science Committee was held at the House of Commons on December 13, under the presidency of Prof J. Graham Kerr. The honorary secretary's report disclosed that the Committee's constituent bodies now number twenty-six, five of which have become affiliated during the past twelve months. Three peers and fourteen Members of Parliament are now associated with the executive, with the result that the Parliamentary activities of the Committee have greatly extended. Interventions in debate on the initiative of the Committee were frequent last session; more than thirty questions were asked in the House of Commons on scientific and technical matters; and during the current session it is hoped that members will be fortunate in the ballot for private members' motions. The Committee has been associated with Parliamentary action on the Thames barrage and the removal of the oil tanker limits on the Thames Negotiations are on foot to establish complete liaison with the new Division for the Social and International Relations of Science of the British Association Two lectures were arranged during the last session at the House of Commons for Members of Parliament. The following were elected officers for 1939 *President*, the Right Hon the Earl of Dudley, *Vice-President*, Sir Arnold Wilson, M.P.; *Chairman*, Mr. S. F. Markham, M.P.; *Vice-Chairman*, Prof B. W. Holman; *Deputy-Chairman*, Mr. Alan E. L Chorlton, M P.; and *Hon. Secretary and Treasurer*, Mr. H. W. J. Stone.

The Cultural Influence of the Cinema

THE League of Nations Advisory Committee on Social Questions has issued a report, based on information collected from the Governments of forty-six countries and from other sources, on "The Recreational Cinema and the Young" (London: Allen and Unwin. Pp. 32. Price 9*d*.). It discusses the frequency of the attendance of young people at cinema theatres, the effects of attendance, juvenile taste in films, protection from unsuitable films, teaching of film appreciation, special performances and special films for juveniles. Of outstanding interest under the two last-mentioned headings are accounts of certain activities of the Governments of the U.S.S.R. Their "Children's Cinemas" are, it is said, equipped on broadly conceived lines as recreational centres. In addition to the theatre itself, they include a large hall for games and musical programmes, a library and reading room, a room for quiet table games, a refreshment counter, and a sort of cinema museum in which are displayed exhibits illustrating the history and technique of cinema production with sets of photographs of the best films and leading cinema personalities. Children are encouraged to amuse themselves, before the performance begins, in the various rooms, especially the large hall, where the programme usually is such as to prepare them for understanding the film about to be shown

APART from the technical staff of these Children's Cinemas, a special staff of teachers is employed in these houses. A special section of the Central Department for Industrial Cinematography employs a regular staff for the making of films for children, the subjects including travel and exploration, animal life, children of the U.S.S.R. and other countries, lives of remarkable persons and works of popular children's authors, among whom are mentioned Mark Twain, Jules Verne, Swift, Kipling and Pushkin. For the guidance of makers of such films certain basic principles have been prescribed, such as: "Any attempt to address children otherwise than in the real language of art, to 'talk down' to the child's intellectual level—i e., any conscious or deliberate simplification—makes the juvenile film stereotyped and false. It should be simple with the simplicity of a real work of art, but not simplified".

Technical Progress and Unemployment

AN Advisory Committee on Management (International Labour Organization) at its meeting on May 2 and 3 studied the practical methods which industrial undertakings could adopt to alleviate the immediate social consequences of the elimination of surplus works or technical equipment and of the rapid and extensive mechanization of production (Geneva: International Labour Organization). The Committee drew up a list of measures which might be taken by organizations obliged to reduce their staff in consequence of progressive mechanization or other industrial changes. These measures are classified into five groups according to whether they are preliminary and designed to postpone or minimize or avoid dismissals as, for example, by reduction of hours or transfer of workers to other services; those intended to systematize inevitable dismissals, taking account of all psychological and moral issues involved; those intended to help workers who are dismissed; measures of adjustment among the remaining staff, and general measures involving co-operation with staff representatives, other undertakings and official or private organizations.

IN regard to the measures for dealing with actual dismissals, the Committee stresses the importance of selecting workers for dismissal on the basis of objective criteria, the information of staff in advance and the careful spreading of dismissals over a period. The Committee also considered a report prepared by the International Labour Office on the use of office machinery and its influence on conditions of work for staff. Various technical means of mitigating the physiological and psychological consequences of the mechanization of office work were suggested by the Committee, which in regard to the general effects, expressed the opinion that a reduction of hours of work in offices would assist in reducing those drawbacks. The Committee also holds that to counteract the occupational consequences of the use of machines, the social guarantees recognized as due to the industrial worker should be granted equally to office employees, especially by a general extension of social legislation and of the system of collective agreements.

The Rockefeller Foundation

THE Rockefeller Foundation in 1937 distributed a total of more than 9,500,000 dollars Fifty-five per cent of the grants were for work in the United States, and among the largest appropriations and authorizations of the year were 420,000 dollars to the China Medical Board for the maintenance of the Peiping Union Medical College; 360,000 dollars to Harvard University for research in industrial hazards; 300,000 dollars to the Yale University School of Medicine for the Department of Psychiatry, 300,000 dollars to the California Institute of Technology for the development of organic chemistry; 275,000 dollars to the National Research Council for research in problems of sex and in biophysics; 250,000 dollars for the general research fund of the Yale University School of Medicine; 240,000 dollars to the Royal Institute of International Affairs for research in international problems; 156,000 dollars for teaching and research in psychiatry at the Harvard Medical School and Massachusetts General Hospital; 150,000 dollars to the National Institute of Economic and Social Research for basic economic research, and 100,000 dollars to the International Institute of Intellectual Co-operation for research in connexion with the International Studies Conference. The annual report of the Foundation includes the president's review with the detailed reports of the secretary, the treasurer and the directors of the International Health Division, the Medical Sciences, the Natural Sciences, the Social Sciences and the Humanities and the vice-president in charge of the programme in China.

IN the natural sciences, the Foundation has given its major support to experimental biology, including research on hormones, nutrition, and enzyme chemistry, while assistance given to organic chemistry has been largely prompted by a desire to develop work on its biological aspects with the view of forwarding the progress of medicine itself in the United States. The president's remarks on the social sciences are of special interest at the moment. Emphasizing the importance of scientific work in this field, he suggests that in it lie the possibilities of ultimate social intelligence. Social progress more and more requires minds trained to function scientifically on social problems, as well as improved facilities for observing, recording and interpreting social phenomena and public recognition of the importance of accessions of knowledge in this field. The appropriations of the Foundation in this field in 1937 were largely for the promotion of research in social security, international relations, and public administration. It is satisfactory to note that although the normal development of the work in China has been rudely interrupted, no project has been discontinued, although six out of the eight major projects have been forced to leave the areas in which their work was being done. Reference has already been made in these columns to the president's comments on the barriers to the work of the Foundation which have been encountered through restrictions on intellectual freedom in certain countries (see Nature May 21, p 939).

The Gas Engine Afloat

In a paper on 'Marine Engineering Problems of To-day' read to the International Conference of Naval Architects and Marine Engineers in June of this year, Mr Sterry B Freeman suggests that the time is now ripe for a reconsideration of the gas engine for ship propulsion. On October 11, Mr J F Gibbons read a paper at the Institution of Marine Engineers on "Gas Engines for Small Craft". The author considers only small vessels like tugs, colliers, coasters and trawlers, using gas producers of ordinary type and the power contemplated lying between 300 and 1,500 h p. Mr A E L Chorlton in 1913 outlined a proposal for a gas steam plant of 5,500 brake horse power suitable for driving a Channel passenger vessel, and took as an example the well known passenger steamer *La Marguerite*. The gas engines in this design were to be arranged athwartship and geared to the paddle shaft. They were assisted in manœuvring by uniflow steam cylinders, the steam being supplied by a waste heat boiler operating on the gas engine exhausts. In the early stages of development there was no competition by the oil engine, as it had not yet been developed. The ordinary type of marine steam reciprocating engine often operated more economically. In those days, the cost of coal was much less than it is now so there was less urge to reduce its consumption. The question now is very different. Apart from the national advantage of having fuel in the country that does not need to be imported, a great deal of experience has been gained in the design of small producers for use on road vehicles. In an article in *Engineering* of November 4, it is stated that if the use of gas engines and producers afloat, instead of being tentatively explored by individuals, had been persevered in by established engineering firms, with only a fraction of the financial backing that has been given to Diesel engines, there is little doubt that by now the technical problems would have been commercially solved.

Does the Mocking-Bird Mock?

The mocking-bird (*Mimus polyglottos*) repeats notes used by other birds, and one case at least has been recorded where it was able to do so by the time of its first winter plumage, that is, before it had had much experience in listening to other birds. A suggestion has been made, therefore, that long racial habit in mimicry may have impressed these notes upon the genetic complex of the species, so that the young individual inherited, rather than learned, the adopted song—an acquired character in fact. On the other hand, there is a possibility that the repetition of notes may be due to parallel ability and adventitious similarity rather than actual and individual mimicry. Another suggestion is made by Loye Miller (*The Condor*, 40, 216, 1938). He interprets the song as a sequence of *motifs*, each *motif* being commonly repeated from three to nine times (making a unit) before a new *motif* is adopted. An ordinary song employs from thirty five to fifty of such units. Now these *motifs* are largely original: rarely do 10 per cent of them resemble the notes of other species of birds, and the resemblances may be fortuitous or mimetic. But the fact that the notes of the California woodpecker or of the shrike are repeated only in places occupied by these birds, suggests some deliberate mimicry. Miller suggests that the mocking bird is not to be regarded as a plagiarist, but as an artist picking up a suitable stave wherever it may be found to weave into its own roundelay.

Improvement of Child Nutrition

An appeal has been circulated by the Children's Minimum Council, 72 Horseferry Road, S W 1, for the improvement of the nutrition of children, and to ensure that no child, by reason of the poverty of its parents, be deprived of at least the minimum of food and other requirements necessary for full health. The Council desires that free milk may be available for all school children, and also midday meals in all schools under local education authorities. Where the expenditure available for food is insufficient, it urges the provision of cheap milk for expectant and nursing mothers and children under school age, and free meals for older children. It is maintained that if the known deficiencies in the national dietary were made good, a revolutionary improvement in the public health would certainly follow. The Council needs an income of at least £1,000 a year for the continuance and expansion of its work, and subscriptions are invited for this purpose.

Journal of the Czech Astronomical Society

With a delay of only one month during the crushing events of last October, the next issue of *Říše Hvězd*, the monthly journal of the Czechoslovakian Astronomical Society, has been published under an editorial entitled Začínáme Znovu—"We start again". In this editorial, Dr Hubert Slouka calls upon all Czech astronomers to unite in working together for the creation of a well-equipped Government observatory, even if only a modest beginning can be made

The need for such an observatory is further intensified by the recent ceding to Hungary of the Astrophysical Observatory of Stara Dala. Astronomers and other men and women of science will unite in wishing a happy outcome to this gallant determination to start anew.

Publications of the Carnegie Institution of Washington

A **catalogue** of its publications has been issued by the Carnegie Institution of Washington giving a classified list of publications in various branches of science, international law and literature. Most of the books marked in the classified section as out of print are to be found in the libraries throughout the world which have been selected as depositories of the publications of the Institution. A list of these depositories will be sent on application, and a few copies of each publication are reserved for sale at prices which are less than the cost of printing. Price lists or classified lists may be obtained on request and special lists of reprints relating to the work of the Geophysical Laboratory, the Nutrition Laboratory, the Department of Terrestrial Magnetism and the Mount Wilson Observatory can also be obtained. The catalogue also includes an index of authors.

Bibliography of Seismology

We have just received vol. 12, No. 18 of this valuable work, and hope that collaborators in many other countries where seismological work is being done will soon come forward. The U.S.S.R., the Balkan States, and South America, to mention only three, and this time even Germany have no representative. It is pleasing to note that Italian papers are represented, and there is a very full list of American publications. It might be suggested that periodical publications of observatories throughout the world be noticed as, in addition to routine readings of seismograms, the more fortunate observatories find time to investigate shocks local to the station. There is a full list of seismological notes from Nature.

Mineralogical Society of America: Roebling Medal

Dr. Waldemar Theodore Schaller, chief mineralogist of the United States Geological Survey, an authority on rare and unusual minerals, has been awarded the Roebling Medal by the Mineralogical Society of America "for meritorious achievement in mineralogy and allied sciences". This Medal, awarded for the first time in 1937, was established in honour of the late Colonel Washington A. Roebling of Trenton, N.J., whose private collection in the field of mineralogy, now forming part of the display at the United States National Museum, contained some 16,000 specimens, many of them very rare, and was one of the most complete in the country. Colonel Roebling's interest in the growth of the Mineralogical Society led him to create an endowment fund to provide a wider scope in mineralogical publication. The medal commemorates his lifelong concern with mineralogy.

Announcements

The following elections to the Paris Academy of Sciences have been announced: Prof. W. J. de Haas, professor of physics in the University of Leyden, to be *correspondant* for the Section of Physics in succession to the late Dr. C.-E. Guillaume; I Holmgren to be *correspondant* for the Section of Medicine and Surgery in succession to the late Prof. I Pavlov; M Paul Wintrebert, professor of comparative anatomy and histology in the Sorbonne, to be a member of the Section of Anatomy and Zoology in succession to the late F. Mesnil.

Dr. Heinrich Ritter von Srbik, professor of history in the University of Vienna, has been nominated president of the Academy of Sciences of Vienna

The German Society for the Study of Colloidal Chemistry has awarded its grand annual Laura Leonard prize to Prof M. Samec of Ljoubljana for his work on the colloidal chemistry of starch.

Dr. Desidor Miskolezy, professor of psychiatry at Szeged, Dr Roman Adelheim, professor of pathological anatomy in the University of Latvia, Riga, and Prof. Charles Spearman, emeritus professor of psychology in the University of London, have been elected members of the German Academy of Natural Science at Halle

Dr H Morley Fletcher is representing the Royal College of Physicians of London at the opening of the Royal Australasian College of Physicians at Sydney He presented on its behalf to the new College an illuminated address and a replica of its silver wand or caduceus given by Caius in 1556.

At a meeting on October 28 of the international committee for instruction and action for the protection of a civilian community in war, which was set up at Luxembourg on July 4, sub-committees were formed to deal with propaganda, diplomacy, military matters, medical treatment, legal questions, civilian defence and protection of women. The next meeting of the international committee will be held at Luxembourg next January.

The Annual General Meeting of the Association of Women Science Teachers will be held in Bedford College for Women, Regent's Park, London, N W.1, on January 4–5. On January 4, Prof. Alan Ferguson will deliver a lecture entitled "Some Notes on Eighteenth Century Physics". On January 5, a discussion on "New Methods of Biology Teaching emphasizing Practical Problems with Living Organisms" will be opened by Mrs. Hatfield. Further information can be obtained from M. W. Sutton, 18c Christchurch Road, London, S.W.2.

Erratum.—In the article on "National Parks" in Nature of December 17, p. 1087, second paragraph, line 18, for "16,000 ft." read "1,600 ft."

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 1123.

Correspondents are invited to attach similar summaries to their communications

Coherent Modified Scattering of Light

IT has been assumed hitherto that when light is diffused by the particles in a medium with frequencies different from that of the incident light, the radiations from the particles are necessarily incoherent with each other. The following considerations indicate that this need not always be the case, and indeed that coherence is possible and may play a very important part in the scattering of light with altered frequency.

Consider two neighbouring volume elements in a medium and assume that as a result of translatory or rotatory movements of the molecules contained in them, the optical properties of these volume elements vary with time. This variation may be analysed into its Fourier components and we may, for the moment, fix our attention on a component having the frequency ν^*. Under the influence of the incident monochromatic light of frequency ν, each of the volume elements will emit secondary radiations of frequency $\nu \pm \nu^*$. Since the incident light wave at the two volume elements has a definite relation of phase, the scattered radiations would also be partially or completely coherent, provided that the fluctuations of frequency ν^* in the optical properties of the two volume elements are either partly or completely correlated in phase. If such a correlation of phase exists, it must be considered in evaluating the intensity of the modified scattering which is the resultant of the effect of the different volume elements in the medium. It will be readily seen that in general, the resultant intensity would be different in different directions of observation.

If the frequency ν^* be small, the detection of the modulated frequencies, $\nu \pm \nu^*$, would require the use of an interferometer. A correlation of phase of the oscillations in the neighbouring volume elements would necessarily exist, if there are *stationary* waves in the medium covering a wide range of frequencies. In those directions where the phases of the scattered radiations are most nearly in agreement, we should expect the scattered light to show most strongly the modulated frequencies $\nu \pm \nu^*$. An explanation is thus forthcoming of the effects depending on the direction of observation, which have been observed in interferometric studies of light-scattering in fluids and solids.

The point of view here suggested has the merit of bringing the observed changes of frequency under the single general principle governing all such changes, namely, that the frequency of the scattered light is the sum or the difference of the frequency of the material particles and of the radiation frequency. It is thus more general than the well-known theory due to Brillouin,[1] which regards the observed displacements of frequency as Doppler effects arising from *progressive* sound waves in the medium. According to the concepts here outlined, the scattered light should in general exhibit a continuous spectrum with maxima of intensity depending upon the direction of observation rather than discrete frequencies as suggested by Brillouin's theory. The appearance of the component of unmodified frequency also receives an instantaneous explanation as due to the existence of local fluctuations of infinitely low frequencies in the medium. The new point of view also indicates that harmonics of the oscillation frequencies should be observable in favourable cases as frequency shifts in the scattered radiation.

A further application of the idea of coherence to the problem of light-scattering seems to arise in the case of those oscillations in crystals which are classified under the heading 'lattice frequencies'. It would seem difficult to explain the great intensity with which frequency shifts of this class appear in the light-scattering by crystals unless a coherence in phase of the oscillations of the neighbouring lattice units in the solid is assumed to exist. This idea, however, requires further examination, and we are putting it forward in this note with due reserve.

C. V. RAMAN.
C. S. VENKATESWARAN.

Hebbal, Bangalore.
Nov. 20

[1] Brillouin, L., *Ann. Phys.*, 17, 88 (1922).

The Sub-Arctic Region as a Molluscan Habitat

THE Mollusca, as an ancient, widely distributed and relatively diversified group of animals, provide favourable material for biogeographical study. The freshwater and terrestrial Mollusca of the Sub-Arctic Region (which may be defined as the territory lying between the fiftieth parallel of north latitude and the Arctic Circle except in north-western Europe and western North America, where the boundaries lie farther north) are of special significance since in that region the effect of progressively more unfavourable conditions of life upon animal distribution can be observed upon a vast scale. The following note, which is based upon original observations[1,2,3,4], may therefore be of interest.

The presence of a relatively small number of species, many of which have a wide geographical range, and are to be found in large numbers of individuals, is the most characteristic feature of the molluscan fauna of the Sub-Arctic Region. Conditions of life for molluscs in this northern region are evidently so severe that the majority of the species which inhabit the southern part of Europe, Asia and North America are unable to survive in the sub-arctic sectors of those continents.

In some instances the molluscs which are found in the Sub-Arctic belong to 'archaic' groups which in former times occupied a more or less predominant position in the molluscan fauna of the world, but have now been superseded over the greater part of the earth's surface by more recently evolved and apparently better adapted forms. The super-family of land snails known as Orthurethra, which includes the families Vallonııdæ and Pupillidæ may serve as an example. This super-family is a group of primitive Basommatophora (Mollusca, Pulmonata) of which the existing members are the scattered descendants of an ancient snail fauna of the world. The few survivors of this group which are still found on the great continental land masses now occupy the poorer habitats and the less-favourable regions, such as the Sub-Arctic, into which many species belonging to the more recently evolved groups of snails have not followed them as yet.

It may be seen to be somewhat remarkable that although the hardy molluscs which are able to survive under sub-arctic conditions have had the ground to themselves, there has been little tendency for them to give rise to new species and varieties which are characteristic of different parts of the territory. Apart from a conceivable direct physical effect of low temperature upon the rate of evolutionary change, the explanation of the very limited degree of speciation in the Sub-Arctic may well lie in the geographical conditions, and particularly in the sameness of the environment over vast tracts in this region. Only a very few types of landscape are found in the Sub-Arctic[3], and in each of them conditions of climate, soil and vegetation are strikingly similar at widely separated points This must surely result in there being only a limited number of food chains available to the animal inhabitants of a given area. Under such conditions it seems to be reasonable to conclude that the opportunities for new species to establish themselves successfully are correspondingly limited as compared with other areas having a more diversified landscape.

There are certain exceptions to the general rule of sameness, and poverty so far as the number of species is concerned. The most notable of these exceptions are to be found in the freshwater families Lymnæidæ and Planorbidæ (Mollusca, Pulmonata), and in the fauna of Lake Baikal. The usual habitat of Lymnæidæ and Planorbidæ is in ponds and lakes. As a result of widespread glaciation within relatively recent times, ponds and lakes are common in many parts of the Sub-Arctic and even a casual examination reveals a wide range of different physical, chemical and biological conditions in them. So far as these particular molluscs are concerned, therefore, the opportunities for diverse modes of life (which probably form the basis of any successful attempt by new species to establish themselves) are quite considerable. The other outstanding exception is the molluscan fauna of Lake Baikal. This is a large body of fresh water situated in Eastern Siberia approximately midway between Calcutta and the mouth of the River Lena. The animal population of this lake is of a highly remarkable character. Approximately ninety per cent of the species of animals, the majority of the genera, and many of the larger groups are strictly confined to this one body of water. Moreover, the fauna is a rich one. The exact number of species of Mollusca which are present is not known[2,5], but it is believed to be large. The explanation of the presence of this highly peculiar and abundant fauna in Lake Baikal probably lies in the uninterrupted biological history of this body of water since Jurassic (?) times, and the great diversity of conditions met with in the Lake. In this latter connexion, the profound depth of the Lake (maximum 1,741 m.) is probably of some significance.

The impression gained from a study of the Sub-Arctic Mollusca, therefore, is that the general character of the fauna has been brought about to a considerable extent by geographical conditions and particularly by the types of habitat available. If there was once more a clear field in the region and comparable biological material found its way into the country, there appears to be a considerable likelihood that although the channels of development might be different, the resulting fauna would be of very much the same character as the one which exists in the region to-day.

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Nov. 18

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[1] Mozley, Alan, "Reports of the Jasper Park Lakes Investigations, 1925–26 The Mollusca of Jasper Park", *Trans Roy Soc Edin*, **56**, 647–669 (1930)

[2] Mozley, Alan, "The Fresh-Water and Terrestrial Mollusca of Northern Asia", *Trans Roy Soc Edin*, **58**, 605–695 (1935)

[3] Mozley, Alan, "A Biological Study of the Sub-Arctic Mollusca", *Proc Amer Phil Soc*, **78**, 147–189 (1937)

[4] Mozley, Alan, "The Fresh-Water Mollusca of Sub-Arctic Canada", *Can J Res*, **16**, 93–138 (1938)

[5] Kozov, M M (= Kojov, M M), "Mollusques du Lac Baikal Trav Stat. Limnologique du Lac Baikal", (8), *Acad. Sci U S S R* (1936)

Directed Hereditable Variations Conditioned by Euploid Chromosome Alterations in Higher Plants

IN studying a series of eupolyploid plants produced during the last few years[1] and especially those produced recently by colchicine and acenaphthene treatments[2,3,4,5] in Solanaceæ, Compositæ, Gramineæ, etc., I found that eupolyploid chromosome alterations condition a series of hereditary variations Most of them are directed; others are not. Directed hereditable variations in plants which show an increase with the euploid increase of the chromosomes are: (1) amount of nucleolar substances (number of nucleoli, size, or both); (2) volume of the nuclei; (3) amount of cytoplasm per cell; (4) volume of the cell; (5) breadth of the leaves; (6) thickness of the leaves and the weight of unit surface portions of the leaves; (7) size and weight of the ovules; (8) size and weight of the seeds or of the grains; (9) size and weight of the anthers; (10) breadth of the styles and stigmas; (11) breadth of the petals; (12) thickness of the petals; (13) length and breadth of all kinds of trichomes (on the leaves, stems, flowers and seeds); (14) number of the chloroplasts per cell; (15) amount of chlorophyll at unit leaf surface; (16) expression of the green colour of the leaves; (17) expression of the corolla colours, and (18) metabolic (photosynthesis) and katabolic (carbon dioxide) processes per unit leaf surface.

The length of the vegetation period (from planting of the seeds until the beginning of the flowering) increases in almost all plants with doubled chromosome numbers. Most of the latter plants are larger than their 'diploid' forms. This is especially true for plants with relatively small chromosome numbers. But there are also cases when chromosome duplication does not necessarily lead to an increase of the plant size. In a few cases polyploids are smaller than their original diploids (octoploid *Nicotiana Sanderæ*). The length of the flowers (corolla and calyx) and the breadth of the corolla behave in a similar way. All organs of the polyploid plants appear coarser.

The sizes of the fruits and capsules change in different ways. They are chiefly regulated by the number of the seeds. The number of the seeds, that is, the suppression of fertility in autopolyploids, depends greatly on the length of chromosomes and on the degree of polyploidy (chromosome number). Plants with longer chromosomes set much smaller percentages of seeds per capsule in respect to their original forms than plants with shorter chromosomes. When the plants have chromosomes approximately equal in length, those of them that have many more chromosomes (higher polyploidy) set less seeds per capsule. This is true for higher degree of polyploidy. It does not always hold for the members of the polyploid series with smaller chromosome numbers These regularities are of great evolutionary significance.

The contents of various chemical substances are altered in different directions as results of chromosome duplications.

Polyploids have not larger plastids. The latter show great autonomy in respect to the nucleus (chromosomes, genes).

Hereditary variations conditioned by euploid chromosome alterations are of great agricultural value, because we can predict, for most of them, the direction of changes after chromosome doubling. Contrary to this, all hereditary variations conditioned by gene mutations, and structural or aneuploid chromosome alterations, that we can induce at the present time, are not directed.

The realizations of the characters in polyploid plants compared with those of their 'diploids', as described above, are contrary to the mechanistic conception of the nature and behaviour of the organisms.

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[1] Kostoff, D , *J Genetics* (in the Press).

[2] Kostoff, D , *C R Acad Sci Moscow*, 19, 197-199 (1938).

[3] Kostoff, D , NATURE, 141, 1144-1145 , 142, 753 (1938)

[4] Kostoff, D , *Current Science*, 6, 549-552 , 7, 8-11, and in the Press (1938)

[5] Kostoff, D , *Privoda* (in the Press)

Genetics of Hybrid Sterility

IT is a remarkable fact that the disturbances connected with genic sterility in hybrids between species (or races) are paralleled within species by similar disturbances caused by single genes. For example, there is an analogy between the asynaptic mutations in several plants and genic asynapsis in hybrids and likewise between the polymitotic mutation in *Zea* and the spermatogenesis in *Drosophila pseudo-obscura* hybrids. Similarly, I have recently found a property analogous to the long-chromosome mutation in *Matthiola* in a grasshopper hybrid, the chromosomes of which also show a sort of 'stickiness' reminding one of the 'sticky' mutation in *Zea*[1]. Dobzhansky has several times directed attention to this parallelism[2], though he does not seem to think it has any deeper genetical significance. In my opinion, there is, however, a possibility of putting the two phenomena on a common basis.

Dobzhansky's admirable work on hybrids between *Drosophila pseudo-obscura A* and *B* has shown that at least eight sterility genes, spread out over the whole set of chromosomes, are present, all of them having like and cumulative effects. We may presumably take for granted that such series of sterility genes are at work in other cases of genic sterility in hybrids as well. Assume that these genes are of the same kind as the sterility genes known to act within species. But instead of having one recessive with a strong effect, we are concerned with a series of recessives with but slight effects. Assume further that they only become effective if a certain, not too small, minimum number is present in a homozygous state. Then, even a moderate mutation pressure will be able to infiltrate a cross-breeding population with mutated genes until the proportion of them at every locus concerned approaches or exceeds 50 per cent. The distribution of mutated loci in any gamete produced in the population, with random mating and absence of linkage, is given by the binomial expansion. Thus the number of mutated loci present in a gamete in a population of moderate size will vary within relatively narrow limits, being usually about half the number of sterility genes in the whole population. Since the mutated genes of two gametes constituting an individual will as a rule be at different loci, individuals homozygous for as many genes as to cause sterility will practically never arise (except on inbreeding) The accumulating evidence as to the occurrence of deleterious recessives in wild populations indeed makes it conceivable that such genes with very slight, but cumulative, effects are widely spread.

The species (or races) engaged in a cross will probably have developed their sterility genes during and after their isolation from each other. Different environments and pure chance will have led, for the most part, to different sets of sterility genes becoming established. At the same time a genetic system making the genes concerned recessive must have arisen (Fisher[3]); these systems, too, must be different, each acting on its own set of genes only.

Consequently, on crossing related species two sets of sterility genes would enter the hybrids. The specific recessive-making systems would break down (*cf.* Harland's work on *Gossypium* hybrids, reviewed by Dobzhansky[2]). The two series of sterility genes, now dominant or semi-dominant, would combine to give the same sterility effect as they would in a homozygous state in a non-hybrid individual.

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Nov. 12.

[1] Klingstedt, NATURE, 141, 606 (1938).

[2] Dobzhansky, "Genetics and the Origin of Species" (1937).

[3] Fisher, "The Genetical Theory of Natural Selection" (1930).

Occurrence of Burbot in the Estuary of the River Severn

A SYSTEMATIC study has been made during the past year of the fish and invertebrates caught in the kypes or 'fixed engines' secured between tide marks in the upper regions of the Bristol Channel, between Avonmouth and Gloucester. During the spring of 1938, three specimens of the burbot, *Lota vulgaris*, were obtained. Two, measuring 9 cm. and 10·5 cm. long respectively, were caught during February in kypes at Oldbury, and the third, 11·5 cm., during March at Hallen, some eight miles nearer to the sea. These appear to be the first modern records of this fish in the West of England, although it is not uncommon in the rivers which flow into the

North Sea between Durham and East Anglia and is of general distribution in northern and eastern Europe.

It is possible, however, that this fish has been previously observed in the estuary of the Severn. Mr. L. H. Matthews has directed my attention to a list of fishes contained in John Smyth's "Berkeley Manuscripts" written at the end of the sixteenth century. This is a description of the Hundred of Berkeley in the County of Gloucester with an account of its inhabitants, and among the fish listed is the "Eele pout", one of the various English names of this interesting freshwater representative of the Gadidæ.

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Effect of Organic Acids on Germination, Growth and Ascorbic Acid Content of Wheat Seedlings

Several observations made on dehydrogenase activity of various seeds have been described by Thunberg[1,2]. These investigations have directed attention to the fact that different seeds show different capacities for the utilization of dehydrogenase substrates.

In the experiments here sketched, an attempt has been made to follow the effect of various aliphatic organic acid substrates of dehydrogenase systems on the germination and growth of wheat seedlings, and also their effect on the ascorbic acid content of the germinated seeds.

The sterilized seeds, pure line Wilhelmina wheat from the National Institute of Agricultural Botany, Cambridge, were germinated on moist filter paper placed in sterilized Petri dishes. Each dish contained thirty seeds. The acids were dissolved in sterile twice distilled water and were stored on ice The technique of these experiments was similar to that already published by Havas[3]. Acids were used in two concentrations, namely, 5/1,000 and 1/10,000, this choice being based upon experience obtained in earlier experiments of a similar nature[4]. The duration of the experiments was twelve days, by which time the food reserves of the seeds were exhausted. The results obtained involved examination of some 1,600 seedlings.

The observations have shown that different acids of the same concentration exert entirely different effects on the growth and germination of the wheat seedlings. At a concentration of 5/1,000, an inhibiting action was observed in each case. Despite the fact that such hydrogen ion concentrations (pH 3·0–4·0) are not optimum for the germination of wheat seedlings, this inhibiting action cannot be due entirely to the acid reaction of the solutions, since if this were the case one would expect that each acid would act similarly. This, however, is not the case. Such acids as citric, lactic and succinic, which are the substrates of the most important dehydrogenase systems, do not inhibit germination or growth completely even at a concentration of 5/1,000. The inhibition is only of the order of 60–70 per cent at a concentration of 5/1,000, whilst fumaric, malonic, oxalic and pyruvic acids exert a completely inhibitory effect on germination at this concentration. This action is all the more interesting because, according to Fodor's investigations[5], wheat-germ extract produced the longest decoloration time with citric, lactic and succinic acids as substrates. Furthermore, glycerophosphoric acid solution at the same concentration (pH 6·8) caused only a 35 per cent inhibition of growth. At 1/10,000 concentration, no difference was detected between the experimental seedlings and the controls

Estimation of the ascorbic acid content of the seedlings at the end of the twelfth day showed that whilst seedlings treated with 1/10,000 solution did not give greater values than the controls, those treated with 5/1,000 solutions gave 40–50 per cent increase in ascorbic acid content Johnson and Zilva[6] described several plants and fruits containing ascorbic oxidase with an optimum pH 5·0–7·0 It might be supposed that germinating and growing wheat seedlings contain an ascorbic oxidase which is inhibited in consequence of acid treatment This, however, cannot be so, since experiments have shown not only that ascorbic acid added to the wheat-germ extract of pH 6·8–7·7 is not oxidized more rapidly than the control, but even a protection against oxidation is observable. An ascorbic acid synthesis from the three substrates seems also unlikely, on account of an insignificant increase of ascorbic acid found in the case of 1/10,000 concentration. It seems likely that a disturbance of some regulatory mechanism of the ascorbic acid formation is responsible for the increased ascorbic acid content in the abovementioned cases. Monoiodoacetic acid has been tried to see whether this supposed regulatory mechanism is connected with the carbohydrate metabolism of the wheat-germ. Monoiodoacetic acid is highly toxic for the growth of the seedlings; even in a concentration of 1/10,000 it produces 55 per cent inhibition. However, it has no influence on the ascorbic acid content of the shoots.

Summing up the various observations made in the course of the present work, it was found that certain aliphatic acids are capable of influencing the growth, *germination and ascorbic acid production of the wheat* seedling. The divergent action of various acids and their connexion with the ascorbic acid increase of the germinating wheat seedlings obviously points to a complicated relationship between them and an ascorbic acid controlling system.

Details of the experimental results will be published elsewhere.

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[1] Thunberg, *Skand Arch Physiol*, 54, 6 (1928)
[2] Thunberg, *Skand. Arch. Physiol* 74, 1, 16 (1936)
[3] Havas, Nature, 136, 435 (1935)
[4] Havas and Gal, Nature, 138, 586 (1936)
[5] Fodor and Frankenthal, *Biochem Z*, 235, 417 (1931)
[6] Johnson and Zilva, *Biochem J*, 31, 438 (1937)

Glycolysis in Barley

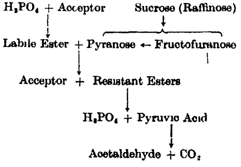
The sugars commonly present in barley tissues are the usual plant trio, sucrose, glucose and fructose. Their relation with the plant's respiration has been the subject of much investigation; the following scheme is based on evidence collected in my laboratory over several years.

Sucrose is always unstable in the tissues, and a high concentration can only be maintained by rapid synthesis; when this ceases, disappearance is rapid both in young seedlings[1] and mature leaves[2]. The breakdown of the sucrose is by hydrolysis yielding α β-glucopyranose and fructofuranose The fructofuranose reverts rapidly to α β fructopyranose but in the presence of cell catalysts is decomposed more rapidly than the pyranose Acetone preparations of young tissues will decompose fructofuranose arising in the hydrolysis of sucrose or inulin but will not attack either glucopyranose or fructopyranose The system is probably a zymase since it is active both in the absence and presence of oxygen and is not extracted by water There is an inverse relation between the rate of hydrolysis and the amount of sugar broken down, some component of the zymase being readily saturated

It seems sometimes to be supposed that the breakdown of fructofuranose would be incompatible with the occurrence of a phosphorylation cycle but this is not necessary in theory nor probable in fact The breakdown of pyranose which is suppressed by the acetone treatment certainly occurs in the living tissues The disappearance of sucrose from starving leaves is associated with a temporary accumulation of glucopyranose which is not enough to account for half the sucrose loss Fructose does not accumulate and the glucopyranose is soon broken down In germinating seedlings sucrose together with raffinose also a fructofuranoside is extensively consumed and during starvation hexose accumulation is again equivalent to less than half the loss of sucrose

Mr S E Arney and I have obtained evidence that these breakdowns are associated with phosphorylation The conflicting results of earlier work were probably due to the facts that young tissues always contain a large amount of free inorganic phosphate and that esterification is limited by the capacity of some acceptor Seedling tissues have been found to contain small quantities of a phosphate carrier which loses phosphate by hydrolysis at a rate similar to that of adenylpyrophosphate More stable esters are also invariably present and probably include hexosephosphates Under extreme starvation the rate of carbon dioxide production becomes proportional to phosphate supply With excess of free phosphate the respiration rate is still proportional in certain states to the concentration of phosphoric esters During starvation the esters more resistant to hydrolysis disappear faster than the labile carrier

The evidence at our disposal leads me to suppose that the following outline reactions are likely to occur during glycolysis



Phosphorylation and the decomposition of sucrose go on simultaneously The preferential decomposition of the fructofuranose may be due to its easier phosphorylation or to some entirely non phosphorylatory mechanism which is of little effect with pyranoses We cannot at present decide between these alternatives Whichever happens seems to be accompanied by the phosphorylation of pyranose some of which may be derived from reversion of the furanose itself

Pyruvic acid does not accumulate in any barley tissues we have examined but is very readily broken down by acetone and other dead preparations, as well as by the tissues themselves when alive Acetaldehyde is formed and carbon dioxide given off[2] These reactions will occur in the presence of atmospheric oxygen but we must reserve judgement as to their occurrence or suppression in the presence of respiratory oxidations

Details of these investigations will be published in a series of papers in the *New Phytologist*

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Nov 25

[1] James A I D Phil Thesis Oxford 1938
[2] Yemm E W *Proc Roy Soc* B 117 504 (1935)
[3] James W O and Norval I P *New Phytol* 37 (1938)

Coagulation by Shearing and by Freezing

IN an attempt to find out how the most available silkworm (larva of *Bombyx mori*) makes the insoluble fibroin strands of its silk from the stiff water soluble fibroinogen paste which forms the cores of the contents of its silk depots two of the observations made have so much general interest that I send a brief account of them in the hope that others will either contribute to their explanation or direct attention to corresponding phenomena in other cases

(1) When the isolated fibroinogen paste is sheared by squashing it firmly between two flat plates of glass (or mica or Perspex) an irregularly striated semi opaque doubly refractive membrane is formed which is insoluble even in $N/10$ sodium hydrate solution and is far too thick to consist of hypothetical membranes coagulated by adsorption and rubbed off the surfaces of the plates

(2) After a not too dilute aqueous solution of the paste has been frozen solid by immersion in ice salt mixture at −13° to −17° C for a quarter of an hour and then allowed to thaw most of the fibroinogen is found to have undergone irreversible coagulation Certain salts (for example, 0 9 per cent sodium chloride) prevent this change

This coagulation by freezing might conceivably be either a special case of coagulation by shearing or a coagulation by electrolytes, since the protein and any other solutes would become steadily more concentrated as ice crystals increased, and growing ice crystals would shear the protein paste eventually produced If it is a coagulation by shearing, both observations would find a common explanation, and the one I would tentatively suggest is that, during the shearing contiguous fibroinogen molecules would be strained and distorted, and possibly activated and that while being thrust past their neighbours or rolled over them potentially mutually reactive hydrophil groups would be given opportunities to unite with each other, groups which in the unsheared paste would not be strained and would be kept apart by hydratation shells The fact that fibroinogen in aqueous solution is thermostable is in no way inconsistent with this suggestion

As bearing on coagulation by freezing, I should add that fibroinogen in aqueous solution, although thermostable, is nevertheless eminently surface coagulable, that is, like egg albumin, fibrinogen and certain other proteins[1] when adsorbed from aqueous or aqueous saline solution at interfaces with any gas or with various neutral oils, it promptly forms a coagulated surface membrane which can be dragged off as a thread, if traction is exerted on it while it is being formed and is still sufficiently plastic

This surface coagulability makes it necessary to state that the coagulation by freezing is far too massive to be explicable as coagulation solely at the surface of frozen out gas bubbles Further when *solutions of egg albumin are frozen coagulation is* limited to the surfaces of the frozen out gas bubbles

I had expected to find that coagulation by surface influence was responsible for the conversion into fibroin, but observation (1) and others an account of which will it is hoped appear shortly have led to the conclusion that absorptional coagulation proper has nothing to do with it and that the conversion is brought about either entirely or almost entirely by the shearing to which the paste is subjected in the silk channels

Added in proof, Dec 3 I now find that Foà[2] investigating spontaneously coagulable aqueous extracts of finely divided silk depots solutions which would contain much besides fibroinogen observed that freezing accelerated their *coagulation* and also that fairly thick layers of coagulated protein (doubtless surface coagulated W R) collected on solids dragged repeatedly from their free surfaces From this latter fact he inferred that the coagulation of depot content into the fibroin of silk was brought about by traction

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Nov 24

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[1] *Proc Roy Soc* A 72 1 6 (19 3 NATURE 112 6 1 19

[2] Foà *Koll* 7 10 (1912)

Œstrogenic Activity of Anol, a Highly Active Phenol Isolated from the By-Products

IN a previous communication[1] it was suggested that the œstrogenic activity of crude specimens of anol and of the mother liquor from these preparations may be due to the presence of a polymer possessing an extremely high degree of potency The active substance has been isolated by the following procedure

Anethole was demethylated by heating in an autoclave with potassium hydroxide and alcohol The phenolic products were completely re methylated and from the mixture of methyl ethers anethole together with some *p* methoxy *n* propyl benzene was removed by steam distillation The residual thick oil was distilled at 0 15–0 2 mm when almost half passed over between 160° and 170° C and produced œstrus in rats with doses of 2 mgm This oil fraction was oxidized by treatment with finely powdered potassium permanganate in ice cold acetone and the products separated into anisic acid (i) α (*p* methoxy phenyl) *n* propyl methyl ketone (ii) and a saturated oil (iii) The production of (i) and (ii) demonstrates the presence among the products of demethylation of the di anol already described by us[2]

The saturated oil gradually deposited a small amount of a crystalline substance which, after purification, melted at 144° C and gave on analysis C, 80 7, H, 8 8, CH_3O, 20 1 per cent ($C_{20}H_{26}O_2$ requires C 80 5 H 8 8 CH_3O 20 8 per cent) When this substance was demethylated the resulting phenol melted at 184–185° C and gave on analysis C 79 9 H 8 2 per cent ($C_{18}H_{22}O_2$ requires C 80 0, H 8 2 per cent)

The phenol produced full œstrus response in all rats when administered in doses of 0 2 γ Doses of 0 15 γ gave 60 per cent and doses of 0 1 γ gave 20 per cent response

The substance proved to be identical with the 4 4 dihydroxy γ δ diphenyl *n* hexane produced by hydrogenation in presence of palladium of 4 4 dihydroxy γ δ diphenyl β δ hexadiene[3] or of 4 4′ dihydroxy α β diethyl stilbene[4] although in poor yield from the latter

A full account of the synthetic work on these substances is now being prepared and will shortly be submitted for publication in collaboration with Mr L Golberg and Prof R Robinson

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Trimethylamine in Menstruous Women

HAVAS's recent communication in these columns[1] on the suggestive hormonal properties of trimethyl amine recalls the fact that it was so long ago as 1902 that Michin[2] first directed attention to the presence of trimethylamine in the vaginal secretion of women Michin carried out his investigations on Russian women Briefly his findings were as follows

The percentage of trimethylamine in normal women varied between 0 07 and 0 72 with a mean of 0 33 In women with various genito urinary disorders the range was 0 00 0 64 per cent

Cases with metastatic tumours were associated with a significant increase in the amount of trimethyl amine, more benign tumours with a less appreciable increase In *primiparæ* the average amount was 0 30 and in secundiparæ 0 29 During parturition the amount is between 0 1 and 0 86 per cent with a mean of 0 31 In four out of nine women at the climacterium no trimethylamine was found and in five others it was more or less reduced In post menopausal women trimethylamine was altogether absent Trimethylamine was found to be very bactericidal and in a solution of 1 15 000 completely inhibited the growth of most bacteria and reduced the activity of others

It is of interest here to note that in 1927 Klaus[3] obtained trimethylamine from the menstrual discharge and in 1930 Lanczos[4] found that a preparation of frog's gastrocnemius muscle loses excitability when either the nerve or the muscle is treated with dilute solutions of trimethylamine She also found that the same effect is obtained when these structures are held by a menstruous woman for 10 15 minutes This suggests that trimethylamine may be excreted through the skin during menstruation and that the deleterious effects which the contact of menstruous women are said to exert upon such things as hams, preserves, bread, wine, and flowers, may be attributable to the action of this substance. Experiments which I have had under way for some time lend strong support to this suggestion

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Temperature Influence on the Pressure Broadening of Spectral Lines

THE classical theories of pressure broadening of spectral lines given by Lorentz[1] and by Weisskopf[2] lead to the following intensity distribution in an absorption line.

$$K_\omega = \text{Const.}\ \frac{\gamma}{(\omega-\omega_0)^2}, \qquad (1)$$

subject to the condition $\omega \gg \gamma/2$. Here $\gamma/2$ is the number of collisions per second of the absorbing atoms with the perturbing ones, K_ω the absorption coefficient for frequency ω, and ω_0 the frequency corresponding to the centre of the line. If the concentrations of absorbing and perturbing atoms are constant, Lorentz's theory predicts $\gamma \sim \sqrt{T}$, where T is the absolute temperature of the gas Taking into account Weisskopf's relation between impact diameter and relative speed of colliding atoms, we find $\gamma \sim T^{3/10}$. Under special conditions, relation (1) follows as a limiting distribution from the wave-mechanical theory given by one of us[3,4]. In this theory, the width of spectral lines does not depend directly upon the number of collisions per second, although it does depend upon the kinetic energy of colliding atoms and upon the shape of potential curves.

So far as we know, Orthmann[5] was the only one who investigated the dependence of line broadening upon temperature at constant concentration of absorbing mercury atoms as well as of perturbing hydrogen molecules. His results agreed with the theory of Lorentz. We have investigated the broadening of the Hg absorption line 2537 A. caused by helium at the concentration of $8{\cdot}8 \times 10^{14}$ mercury atoms and $1{\cdot}24 \times 10^{19}$ helium atoms per c.c. The gases were contained in a silica tube 150 cm. long. The absorption spectra were photographed by means of a Hilger quartz spectrograph (dispersion 1·6 A./mm.). As is well known, the lines broadened by the presence of light gases show a symmetrical intensity distribution similar to that given by the relation (1). It is usually thought now, that in this case the broadening is due mostly to the so-called collision damping effect, which depends upon the temperature; the role of statistical effect, which does not depend upon temperature, should be negligible. The use of a mercury-helium mixture enabled us to vary the gas temperature within very wide limits without changing the atom concentration.

It is well known that the total quantity A of light absorbed from a continuous background (as well as the surface limited by the curve in the accompanying graph) by a line with intensity distribution given by (1) is, *caeteris paribus*, proportional to the square root of the line width:

$$A \sim \gamma^{1/2} \qquad (2)$$

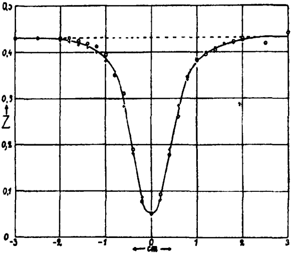
when the absorbing layer is sufficiently thick. Lorentz's theory leads in that case to

$$A \sim T^{1/4}; \qquad (3)$$

whereas that of Weisskopf leads to

$$A \sim T^{3/20}. \qquad (4)$$

We think that our measurements were sufficiently precise to show the effects predicted by the relations (3) and (4). The accompanying graph shows an absorption curve obtained from absorption photographs taken at 398° K. (crosses) and at 1198° K. (circles); the blackenings of continuous background given by the hydrogen discharge tube were reduced to constant intensity. The curves for both these temperatures are seen to be identical within the limits of experimental error (for the lower temperature the surface limited by the curve is about 4 per cent greater than the surface limited by the curve corresponding to the higher temperature; but this difference lies within the limits of experimental error). This result indicates that the broadening of the Hg absorption line 2537 A. caused by helium does not depend appreciably upon the temperature.



HG ABSORPTION LINE 2537 A. BROADENED BY HELIUM. BLACKENING OF PHOTOGRAPHIC PLATE AS FUNCTION OF DISTANCE FROM CENTRE OF LINE. + ABSORPTION SPECTRUM AT 398° K., ○ ABSORPTION SPECTRUM AT 1195° K.· 1 CM. CORRESPONDS TO 0 23 A.

Similar researches upon the influence of other gases upon the mercury line 2537 A. will be undertaken shortly.

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Humidity in the British Isles

IN an article in NATURE of August 20, p. 365, "Humidity in the British Isles", it was stated, referring to Stacey's figures: "It is difficult, however, to draw any useful conclusions from charts and averages based on observations at 9 h., an epoch at which relative humidity is normally in process of descending from the early morning maximum to the afternoon minimum".

I would like to suggest that, on the contrary, readings taken at 9 h. can provide very useful conclusions, because the humidity at that hour approximates very closely to the average over the 24 hours.

In connexion with the moisture content attained by wooden articles in use, this Laboratory wished to arrive at the simplest way of measuring the average hygrometric conditions prevailing, and to that end I had observations of temperature and humidity taken every three hours over a period of years in several types of environment

In so far as outdoor shade conditions are concerned, it was found that the readings taken at 9 a.m. were nearer to the average over the twenty-four hours than any other single reading. For example, the average difference between them was less than 2 per cent humidity, and the maximum difference 6 per cent, throughout the period April 1934–December 1935. For many purposes this is sufficiently accurate. When an unheated shed such as a timber store was under consideration, it was found that the readings taken at midnight were within 1 per cent humidity of the average. In a heated room such as a museum or other public building, where the number of persons normally present is small relative to the size of the room, the readings taken at 11 h or noon were within 1 per cent humidity of the average during the heating season October–March

The above figures indicate, I think, that for purposes where close accuracy is not essential, it is not necessary to go to the expense of obtaining recording apparatus or the trouble of making frequent readings, and data such as those compiled by Stacey can be usefully applied.

It is not denied that observations made at 7 h., 13 h and 18 h do cover a wider sphere of usefulness, but the 9 h. observations appear to approximate more closely to the daily average humidity than even the average of the three observations mentioned above At Kew in 1935, the average daily humidity (0–24 h) was 77 per cent, and at 7 h, 13 h and 18 h it was 84, 66 and 70 per cent respectively (average 73 per cent)

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Points from Foregoing Letters

AN explanation of the effects observed in interferometric studies of light scattering in fluids and solids is given by Sir C. V. Raman and Dr. C. S. Venkateswaran. They put forward the principle that the frequency of the scattered light is the sum or the difference of the frequency of the material particles and of the radiation frequency. The scattered light should in general exhibit a continuous spectrum with maxima of intensity depending upon the direction of observation, rather than discrete frequencies as suggested by Brillouin's theory.

A. Mozley points out that the molluscs in the Sub-Arctic Region belong to archaic groups which in former times were predominant over the whole world; also that, with the exception of those of Lake Baikal, they show a lower tendency for new species formation. He ascribes this, apart from the possible effect of lower temperature, to the sameness of the environment over vast tracks in the Sub-Arctic Region.

Prof. D. Kostoff gives a list of the characters which change when the number of chromosomes in the nucleus of certain plants has become multiplied through polyploidy. These include the volume of the cells, thickness and breadth of leaves, size and weight of ovules, seeds and anthers. He points out that while the nature of the changes brought about by mutation are unpredictable, the direction of hereditary variations conditioned by euploid chromosome alterations can be predicted and are therefore of great agricultural value.

A hypothesis is offered by H. Klingstedt with the view of putting on a common genetical basis the sterility in species-hybrids and the sterility caused by recessive genes within species.

Fumaric, malonic, oxalic and pyruvic acids in concentration of 5/1,000 are found by Dr. E. Gal to inhibit completely the germination of wheat seedlings; with citric, succinic and lactic acids 60–70 per cent inhibition occurs, whilst glycerophosphoric acid of the same concentration gives only 35 per cent inhibition. An increase of 40–50 per cent in the amount of ascorbic acid present is observed, but the exact nature of the inhibitory mechanism is not yet clear

Dr W. O James submits an outline of the stages by which sugar is oxidized to acetaldehyde and carbon dioxide in barley during the plant's respiration. The following changes: sucrose → fructofuranose (+ α-β-glucopyranose) → pyranose → resistant esters → pyruvic acid → acetaldehyde, take place, and a phosphorylation cycle goes on simultaneously with the decomposition of sucrose.

Dr. W. Ramsden finds that shearing and freezing of fibroinogen paste of the silkworm produces coagulation, and directs attention to similar observations made by Foà in 1912.

H. Horodniczy and Dr. A. Jabłoński find that the width of the mercury absorption line 2537 A. broadened by admixture of helium (at constant concentration of mercury and helium) does not depend appreciably upon the temperature of the absorbing gas, as would be expected from the theories of collision damping given by Lorentz and by Weisskopf.

R. G. Bateson suggests that humidity readings taken once daily only may compare very closely with the average over the 24 hours provided that the appropriate hour is selected.

Research Items

Intoxication and Resistance to Infection

KENNETH L PICKRELL (*Bull Johns Hopkins Hosp* 63, 238, 1938) records his experiments on rabbits in which he studied the effect of alcoholic intoxication and ether or avertin anæsthesia on resistance to pneumococcal infection He found that alcoholic intoxication maintained at the point of stupor destroyed resistance to pneumococcal infection in these animals their immunity being lost even when they had been rendered highly immune by intravenous injection of anti pneumococcus serum Their loss of resistance to infection appeared to be due to the fact that intoxication profoundly inhibited the vascular inflammatory response while intoxication was maintained and in the absence of capillary dilatation and of margination of the leucocytes, leucocytic emigration at the site of infection was negligible and the bacteria therefore proliferated uninterruptedly Similar effects were obtained with ether or avertin anæsthesia

Rotter's Test for Vitamin C Deficiency

A G Zoccoli and V Lombardo (*Riforma med* 54, 1489, 1938) refer to the intradermal test described by H Rotter of Budapest (NATURE, 139, 717, 1937) for determining the degree of saturation of the organism with vitamin C, and record their own investigations on guinea pigs and human subjects The test depends upon the fact that 2 6 dichlorphenolindophenol is discoloured by the tissues at a rate depending upon the ascorbic acid content When small quantities of the dye are injected into the sole of a guinea pig, decoloration takes place much more rapidly in healthy than in scorbutic animals The value of the reaction as a rapid clinical test for vitamin C deficiency was confirmed by Portnoy and Wilkinson (*Brit Med J* 2 328, 1938), but not by the present writers, though they admit that with certain modifications the test may be of some use

Increase of Gannet Colonies in Shetland

IN a short article upon the gannets of Shetland, James Fisher, Malcolm Stewart and L S V Venables give some figures which illustrate in a remarkable way the rapid increase which may take place following upon the colonization of new and suitable haunts (*British Birds*, 32, 162, 1938) In 1914, Noss island had a single pair of gannets, in 1918, three young were reared, two years later there were 10 pairs, and since that time numbers have increased by leaps and bounds until in 1938 a careful count revealed the presence of 1518 breeding pairs, with presumably an unknown but very considerable number of non breeding birds attached to the colony The second Shetland colony, at Hermaness, probably started in 1917, and in 1938 its breeding pairs numbered 2045 There is nothing here to suggest that the gannet is on the wane in British seas, a fear expressed in a letter recently circulated in the daily newspapers

Californian Hepatics

DR D H CAMPBELL has recently given a short account of the prolific hepatic flora of California (*Ann Bryologici* 11 1938) This rich flora is interesting in view of the climatic conditions of alternation of an almost rainless summer with a wet season Of the numerous genera of thallose forms *Sphærocarpus* is the only annual The larger types become dried, but the tissues of the younger regions and sometimes the young sex organs, resist the drought in a surprisingly short time after the first rains, such species mature their reproductive organs *Sphærocarpus* growing from spores appears rather later Some species of *Fossombronia* and notably *Geothallus tuberosus* survive the dry season by tuber formation and it is evidently in this condition that *Geothallus* was introduced in soil from San Diego, where the low rainfall apparently seldom induces thallus development from the tubers The thallose liverworts of this region are either cosmopolitan species or, for the most part, confined to the Pacific coast, and show little relation to the species of the eastern United States The foliose Acrogynæ are little represented in comparison with thallose types, and their relationships are on the whole rather with European than with species of the eastern United States

Fungi of India

THE publication of the Fungi of India by Butler and Bisby in 1931 marked the beginning of a period of more exact mycology in India Records up to the year 1930 were enumerated, and it was only to be expected that during the eight years now past, an imposing number of fresh records would be made These have been collected by Dr, B B Mundkur into a supplementary volume (Imp Counc. Agric Res, Sci Monograph No 12 Pp 54 Delhi Manager of Publications Rs 1 6, or 2*s* 3*d* 1938) Myxomycetes have been included in the present compilation, and the mycological flora of India now possesses 2868 species—an increase of 517 over those previously published Plant pathogens and parasitic fungi predominated in the earlier volume, but the extension of mycological work, during recent years, to include studies of soil organisms, coprophilous fungi, and aquatic moulds, is well reflected in the supplement A new species, *Mycosphærella tinosporæ*, has been constituted in the present account, following the discovery by Ajrekar and Oza of the ascigerous form of *Cercospora tinosporæ* Syd The fungus flora of India has yielded few novel taxonomic groupings This is probably due, however, to a gratifying restraint in the evaluation of supposed new forms by those who have prosecuted the work of collecting and tabulating the records, both in the original volume and in the present supplement

A Lignicolous Fungus

THE common agaric, *Collybia radicata*, is well known to students of mycology by virtue of the long 'rooting' base to the stipe Fries pointed out so long ago as [illegible]821 that the root was connected with a subterranean tree root, and in a recent paper, A H Campbell considers its biological effects upon the host (*Trans Brit Mycol Soc*, 22, Pts 1 and 2 151–158, Aug 1938) The vegetative mycelium produces a white rot in the root of the tree, followed by delignification Limiting plates are also formed in the wood by the cementing together of cells with a brown substance very similar to the formation of sclerotia The fungus can also be grown to yield viable spores in pure culture and here also, averting mycelia or brown plates are formed if other cultures are reached The term pseudosclerotium is proposed for such limiting plates

Peach Mildew in Egypt

THE peach is the most economically important of stone fruit trees in Egypt but its fullest yield is prevented by widespread attacks of the peach mildew fungus *Sphærotheca pannosa* var *persicæ* Dr Amin Fikry has investigated methods for the control of this disease (*Min Agric Egypt Tech and Sci Serv Bull* No 183, 14 pp + 7 plates Gov Press Bûlâq Cairo, P T 3 1937) Symptoms of the malady its distribution host relations and the climatic or edaphic factors affecting parasitism, are all described in detail and are further illustrated by the plates Lime sulphur washes either home made diluted 1 in 10 or commercial concentrates diluted to 1 in 200 were found to give complete control after three applications, whilst amberene (sodium polysulphide) was also effective The addition of 0 2–0 5 per cent of soap was found to be necessary when trees with young fruits were to be sprayed, in order to wet the bloom which appears at this stage The first appearance of the disease seems to vary according to the height of the Nile flood but spray treatment must be given as soon as symptoms are noticed

The Potato Virus X

ONE of the chief difficulties of research into virus diseases of plants has been to account for discordant and puzzling observations upon the appearance of symptoms caused by a supposedly single or pure virus The conception of a disease caused by a virus complex or mixture of viruses is now firmly established, but a monograph of the potato virus X by Dr R N Salaman takes the conception still further and establishes the existence of at least six strains of this particular virus (*Phil Trans Roy Soc Lond* B, 229, 137–217 Sept 1938) All strains have particles of similar size are composed of the same nucleoprotein, and produce inclusion bodies within the tissues of their hosts They vary in the degree of dilution which they can withstand and in the severity and type of symptoms they produce upon various hosts A ten fold excess of a weak strain over a strong one may lead to the masking of the latter Several other mixtures are considered and make it possible to explain the appearance of particular types of symptoms Conversion of one strain to another, involving a loss of virulence has been established, and it is held that such conversion is a [illegible]on Questions of acquired immunity, of the [illegible] of virus particles to genes, and many other problems are further considered The only anxiety amongst Dr Salaman's adequate wealth of detail is that future classification of viruses should provide an arena for taxonomic lumpers and splitters , but that very detail directs the problem more to the physiologist than to the systematist

Recent Large Earthquakes recorded at Stuttgart

THANKS to Dr W Hiller we are able to report that earthquake shocks producing very large amplitudes on the seismograms were recorded at Stuttgart at the following times 1938 Nov 5 8h 55m 52 5s, 11h 2m 45 5s Nov 6 9h 6m 25s and 21h 51m 18 5s all in G C T The epicentre of the first of these was estimated to be at a distance of 9550 km from Stuttgart in a direction N 35° E and to be probably in the Pacific Ocean fairly near the coast of Japan The others were probably aftershocks from near the same epicentre and the first pulses in each case were compressional The first two shocks showed evidence of some considerable depth of focus in that the *pP* pulse (that is a primary pulse from the focus reflected immediately at the earth s surface before proceeding) first recognized by Scrase was recorded on November 5 at 8h 56m 19s and at 11h 3m 20s All these shocks show correlation with those recorded at Kew Observatory the depth of focus of the first shock being estimated from the Kew records to be about 75 km which is considerably below normal

Structures of Some Compounds

THE electron diffraction method has been used by K J Palmer (*J Amer Chem Soc* 60 2360 1938) in investigating the molecular structures of some relatively simple compounds The interatomic distances and angles were calculated It was shown that sulphuryl chloride (SO_2Cl_2) vanadium oxychloride ($VOCl_3$) and chromyl chloride (CrO_2Cl_2) have tetrahedral configurations which are however considerably distorted Thionyl chloride ($SOCl_2$) is pyramidal and sulphur trioxide (SO_3) is planar Sulphur chloride (S_2Cl_2) has one chlorine atom attached to each sulphur atom The S—O distances in SO_2 (previously measured by Cross and Brockway) SO_2 $SOCl_2$ and SO_2Cl_2 are nearly equal and from 0 06 A to 0 09 A shorter than the sum of the normal double bond radii which is 1 52 A It is concluded that excited electronic structures in which double and triple S O bonds are present must make a considerable contribution to the normal state of these molecules these are more important for thionyl and sulphuryl chlorides than for sulphur dioxide and sulphur trioxide

Ions in Solution

IN a comprehensive review of the present position of the physical chemistry of electrolytic solutions by several contributors, recently published (*J Franklin Inst* 225 623–743 1938) H S Harned describes the thermodynamic aspect as related to the Debye Huckel theory this includes a survey of activity coefficients as determined by several independent experimental methods and the close agreement between these is emphasized The case of weak electrolytes in salt solutions is included It is concluded that the development of these methods in the study of equilibria has reached a stage where a reliable and accurate body of evidence is becoming available The conductivities of aqueous solutions is reviewed by D A MacInnes who discusses the validity of Onsager's equation which holds accurately for very dilute solutions whilst for more concentrated solutions semi empirical equations are available Solutions in non aqueous solvents are considered by C A Kraus who concludes that a solution of the difficult problems in this field will not be found through a mere extension of the limiting laws which hold only at very low concentrations and that much more experimental work is required Kinetics in ionic systems is the subject dealt with by V K La Mer the primary salt effect the secondary salt effect generalized acid base catalysis and the effects of temperature are the main topics reviewed The derivation of ionization constants and limiting con ductivities from conductivity measurements is con sidered by T Shedlovsky The papers are accom panied by bibliographies

Capture of Orbital Electrons by Nuclei

ACCORDING to the Fermi theory of β ray emission the electrons or positrons are created at the moment of ejection by a neutron proton or proton neutron transaction Yukawa suggested that an alternative process to the emission of a positron might be the capture of an electron from the outer atom This process might occur in cases where the energy available was insufficient for positron creation L W Alvarez (*Phys Rev* 54 486 1938) discusses the evidence for electron capture The capture of an electron from say the *K* shell is followed by the rearrangement of the orbital electrons and the emission of a characteristic X ray of the daughter element Soft X rays of the right absorb ability have been observed from the artificially radioactive vanadium isotopes which are formed by deuteron bombardment of titanium In this case, positrons are also present (probably from the decay of another isotope), and the evidence for electron capture is not quite conclusive as the X radiation may have been excited in some other way A more conclusive proof was obtained by studying the activity of a gallium isotope obtained by deuteron bom bardment of zinc followed by chemical separation An electron spectrum from this substance was found to be due to internal conversion of a γ ray of 100 kv energy An X ray emission was found by absorption measurements to be definitely characteristic of zinc, but no positron emission could be detected and it seems certain that the gallium isotope decays to zinc exclusively by electron capture The zinc X rays are then formed by rearrangement of the orbital electrons The author considers that electron capture processes also occur in the cases of ^{180}Ta, ^{40}K, ^{65}Zn, ^{197}Hg, ^{106}Ag, Cd, ^{7}Be ^{54}Mn, and that it explains features of the decay of these artificially radioactive atoms which were formerly unsatisfactorily explained

Photographic Sensitivity at Low Temperatures

ACCORDING to the theory of Gurney and Mott, the production of the latent image depends on the photo-electric removal of an electron from a bromine ion into the conductivity band, in which it moves until it is trapped by a region of low potential, the sensitivity speck In the next stage, positive silver ions move up to the charged speck This ionic move ment should be very slow at low temperatures, and the sensitivity of photographic materials might be expected almost to disappear at very low tempera tures W F Berg and K Mendelssohn (*Proc Roy Soc*, A, 168, 168, 1938) have investigated the sensitivity of a process emulsion at room temperature, liquid air and liquid hydrogen temperatures. The sensitivity changes little between liquid air and liquid hydrogen—it is of the order of 5 per cent of the sensitivity at room temperature, and consider ably higher than would be expected on the Gurney Mott view At low temperatures separate variations of light intensity and exposure time have no effect on the final blackening if their product remains constant—there is no failure of the reciprocity law as at room temperature It is suggested that at low temperatures the electronic changes only take place the electrons freeze into the lattice and the ionic movements only occur on warming up At room temperature the simultaneous occurrence of electronic and ionic movements is connected with the failure of the reciprocity law

Ionosphere Radio Waves

WHEN a radio beam of angular frequency ω is propagated upwards and reaches an ionized region having N electrons per c c of mass m and charge e each of which collides with a molecule on the aver age ν times a second and the region is the seat of a magnetic field H the beam is split up into two which travel with different velocities and are polarized and absorbed differently The beam less influenced by the magnetic field is known as the ordinary and that more influenced as the extraordinary beam The calculation of the polarization of each beam, and the refractive index and absorption of the medium for it from ω N m e and ν is a laborious process and Prof V A Bailey, of the University of Sydney four years ago devised a graphical method of reducing the labour In the supplementary number of the *Philosophical Magazine* of November, he describes, in co operation with Prof J M Somerville of Armidale University College, New South Wales, a numerical method of computation which is very rapid They cal culate first the polarization, then the refractive index and finally the absorption They introduce three subsidiary functions which enable them to give the calculations on a page of the journal for the ordinary and extraordinary beams due to two incident beams

Law of Error

IT has been wittily remarked that mathematicians accept the normal law of error because they believe that it has been proved by experiment while experi menters believe that it has been proved by mathe matics A searching criticism of both bases of sup port has been given by Dr H Jeffreys (*Phil Trans Roy Soc* A 237, 231, 1938) The mathematical proof rests on the hypothesis that the error of any individual observation is the resultant of a large number of comparable and independent observations Even if this hypothesis is accepted, it is not proved that the result applies to errors of any magnitude As for the experimental facts, Karl Pearson long ago showed that there are substantial departures from the normal law Dr Jeffreys confirms this by a very detailed examination of seven sets of observations He arrives at the important conclusion that the true law governing errors in astronomy and physics is not the normal law, but one of the Pearson type $y = k(1 + x^2/2m\sigma^2)^{-m}$, with the index m between 3 and 4 The effect of the change is to increase the probability of occurrence of large random errors It appears that a number of discrepancies in experimental read ings that have been reckoned as systematic are, after all, possibly merely random

Commemoration of the Discovery of Radium

WITH the "Semaine internationale contre le Cancer", which took place at Paris between November 23 and 30, the fortieth anniversary of the discovery of radium by Pierre and Madame Curie was commemorated. Simultaneously, the discovery of the electron, the X-rays, and Hertzian waves was celebrated. The importance of recent discoveries, which are now occupying the attention of contemporary workers, is easily over-estimated, and, making due allowance for this possibility, we feel justified in considering the discovery of radium to be one of the outstanding events of the history of science. It promoted to a higher degree than any other discovery the development of the science of radioactivity, which has so deeply influenced our outlook on the nature and formation of the chemical elements, and simultaneously supplied a tool of outstanding importance alike to various branches of science and to medicine.

France is rightly proud of a great son, French by birth, and a great daughter, French by adoption, and has solemnly commemorated the fortieth anniversary of the discovery of radium. The opening of the "Semaine internationale contre le Cancer" took place at the Sorbonne. The broadcast of the President of the Polish Republic from Warsaw, in which the memory of the great daughter of Poland and her achievements were recalled, was eloquently answered by M. Lebrun, President of the French Republic. Among those present were also Mme. Dluska, the sister of Mme. Curie, and the latter's daughters Irène and Eve, Miss Johanna Hertz, daughter of the late Heinrich Hertz, and the Marchesa Marconi.

The gathering was also addressed by various representatives of the French Government, and on scientific topics by Jean Perrin, Maurice de Broglie and Langevin, who gave a short survey of the physics of the electron, the X-rays and Hertzian waves respectively, while Gutton described the technical application of the Hertzian waves, and Gendrean gave an eloquent description of the life work of Pierre and Marie Curie.

The addresses delivered on the following days dealt with biological and physical topics, with the exception of that of Rowntree, who discussed the efforts made in Great Britain in cancer therapy. Schinz discussed the possibilities and limits of the treatment of cancer by use of various radiations. The utilization of biological reactions in measuring X-ray doses was the subject of a lecture by Carter Wood, who has found in the eggs of *Drosophila* the most suitable biological material. The application of radioactive indicators in biology was discussed by Hevesy, that of the electron microscope by Marton, while Errera spoke on the effect of Hertzian waves on macromolecules. Bernal's lecture dealt with the elucidation of the structure of the virus by the use of X-rays. Several physical topics were discussed as well. The only surviving assistant of the late Heinrich Hertz, Prof. Bjerknes, gave an illuminating survey of Hertz's work. Louis de Broglie gave a lecture on the wave character of the electron, followed by G. P. Thomson, who discussed the phenomena of electron diffraction and its applications. Several lectures dealt with technical topics, including a lecture by Bouwers, who discussed the production of different kinds of penetrating radiation, mentioning the construction of a sealed X-ray tube at Eindhoven operated at one million volts.

The lectures were given at the Palais de la Découverte, which contains such a wealth of exhibits showing the trend of scientific progress in the most diverse fields in an unsurpassingly inspiring and instructive way—a fitting frame for the celebration of the fortieth anniversary of the discovery of radium.

G. H.

The Imperial Bureau of Dairy Science

IN 1936 the British Commonwealth Scientific Conference which met in London to consider the working of the organizations controlled by the Executive Council of the Imperial Agricultural Bureaux, recommended that a new Imperial Bureau of Dairy Science be established. The conference also suggested the National Institute for Research in Dairying as the most suitable place for the Bureau.

Following agreement by all the authorities concerned, the new Imperial Bureau of Dairy Science has now been established at Shinfield, near Reading. Prof. H. D. Kay, director of the National Institute for Research in Dairying, has been appointed director of the Bureau. Mr. W. G. Sutton, from Massey Agricultural College, New Zealand, has been appointed deputy director and has now taken up his duties. The Bureau is financed co-operatively by the Governments of the British Empire in the same way as the other Imperial Agricultural Bureaux.

The functions of the Bureau are to index research work in dairy science, whether carried out in the Empire or elsewhere; to collect, abstract and collate information bearing on dairy science and to distribute such information both by publication and by private communication to research workers, officials and advisory officers throughout the Empire. In addition the Bureau is charged with the duty of establishing and maintaining contact between research workers with common interests, promoting conferences of workers and visits to research centres, and in general encouraging the circulation of information, ideas, material and personnel.

The field of dairy science to be covered by the Bureau was defined by the Conference when recommending its establishment. This field includes the microbiology, chemistry and physics of milk and its products; animal diseases in so far as they affect milk and its products; the technology of processing milk and manufacturing dairy products; the physiology of milk secretion as affecting quality and quantity of milk and dairy products, standards for the composition and quality of milk and its products

The routine duties of the Bureau, such as indexing and abstracting will already be familiar to many dairy workers from the activities of the Bureaux already established in other subjects An aspect of Bureau work which may not be so well known and understood is the more informal service which can be given to research workers, teachers and field officers The Bureau will deal directly with the individual workers in dairy science, who are invited to write to the Bureau for information which is not obtainable in their own countries The Bureau may be able to supply the information itself, or to put the inquirer in touch with someone who can do so more effectively

The new Imperial Bureau of Dairy Science has been established in answer to requests for a clearing house for information in dairy science, its value to dairy science and to the dairy industry generally, will largely depend on the extent to which research workers and others avail themselves of its services

Algeria To-day

A SERIES of illustrated books on Algeria and its institutions, published during the past two years by the Gouvernement Général de l'Algérie, Algiers, coupled with a recent visit to the country, has prompted the following notes

Algeria is a land of contrasts The co operation of two widely different races and faiths over a century of steady progress, has turned a land which was dreaded in the past for the daring of its pirates into a country where agriculture, social conditions, art and learning are developed to a high degree

Owing to its excellent organization, its importance as a capital and to its easy accessibility, Algiers is often the venue of international meetings dealing with technical problems, such as the production of wheat wine, minerals, or again civil engineering, industrial chemistry anthropology, archæology and medicine Such occasions provide excellent opportunities for scholars and technicians to see a good deal of the French North African provinces

Algiers itself is worth a thorough visit East and West meet in that ancient capital of the deys, whose palace still dominates the white agglomeration of the Kasbah But the European town itself has grown considerably, thanks to an enlightened policy of public works which have really placed it among the most modern towns of the Mediterranean[1] What adds to the interest of Algiers, besides its museums, botanic gardens and well equipped hospitals, is its fully organised University, which, for the past twenty five years, has been the centre of the intellectual life of the country The faculty of arts, which includes a newly formed department of philosophy under Prof Mesnard, the faculty of science, with its well-appointed laboratories, such as that of industrial physics under Prof Verain, the faculty of laws, which is particularly important owing to the existence of two legal systems in the country, and the faculty of medicine, with its up-to-date hospitals and medical research stations—all are very active and occupy an eminent rank in higher education, thanks to the results obtained in all fields by its professors and research workers In spite of the economic crisis and the difficulty experienced by students leaving the University in obtaining posts, an average of about 2,500 students of both sexes are registered in each year

If Algiers has the only university of French North Africa, there are three higher colleges of Moslem civilization, the Medersas of Algiers, Constantine and Tlemcen But it should be mentioned that only a small percentage of the Algerian native population receives any education at all There are not sufficient schools to meet the demand for elementary education for native children, in spite of the efforts of an administration hampered by lack of funds This can be inferred also from the large number of children in the streets and lanes, especially in the villages of the south

It must be said to the credit of the authorities, however, that they spare no efforts to improve the situation[2] But they are not always helped by the natives as some of them are apt to consider official education as an attempt to interfere with their religion and customs, and with the authority of the parents over their children, while others prefer to use their boys and girls for domestic or farm work In spite of this, there are roughly 60 000 boys and 6 000 girls in the 800 native elementary schools against about 75,000 boys and 75,000 girls in the European elementary schools It is interesting to note also that there are about 2 900 Koranic schools in Algeria, with about 44,000 pupils

Technical and agricultural instruction is given to boys in a few up to date institutions which have about 3,000 pupils, one fourth of whom are natives The girls are taught domestic economy, carpet weaving and embroidery in various institutions supervised to a large degree by religious orders, such as the famous Pères Blancs and Sœurs Blanches, the apostles of the desert There are also professional training centres a pottery-school, a ceramic school and a wool-craft centre The Algerian arts and crafts centres of the town of Tlemcen have a high reputation in North Africa a magnificent saddle embroidered with gold, which was made at these centres, was presented to the King of Egypt on the occasion of the recent Cairo exhibition

Though Algeria is not regarded as an industrial country, it offers a wide field for agricultural study and experiment The northern plains and high plateaux offer excellent opportunities for farming cereals, vineyards, vegetables, olive oil, tobacco cotton and wool are produced in great quantities They compete on the French market with the home produce, and often cause friction between Algerian and French interests—a sore point for the administration of both countries It may be worth mentioning here that, after France and her colonies, the United Kingdom's trade with Algeria is more than double that of any other country Algeria imports about one million pounds worth of goods from England, and exports about 1 25 millions in value

The development of the oases of the south have opened up the desert, so to speak, to regular exploitation Owing to lack of water, this policy of development has to be slow But the results already obtained between Touggourt and Biskra, along the Oued R'ir, are most promising The co operation of the local proprietors, such as the Cheikh El Arab ben Gana, who is the head of all the Arabs of North Africa, is an invaluable asset for the progress of the country As things stand at present, there are most interesting comparisons to make from this point of view, with the methods used in Irak, Egypt and Libya for the exploitation of the desert belt of North Africa and Asia Minor

Algeria is of great importance for the historian and the geographer The imposing ruins of Timgad and Djemila[3] are an epitome of Roman history, and a testimony to the genius and power of Rome[4], while Islamic civilization has left lasting marks throughout this rich land[5] A curious experience is offered by the M'zab country, the home of the Puritans of Islam, who fled right into the desert to escape the persecutions of the orthodox Moslems, and founded there the interesting towns of Ghardaia and Guerrera and other villages, where they keep intact their religious laws and customs[6]

Then there is the unique experience offered by the Sahara, which is now open to regular traffic from one end to the other[7] The geography, geology, flora and fauna of this vast tract of land are now objects of systematic study Among the most notable achievements of French scholars in this field of research are the results obtained by Prof Reygasse, head of the Anthropological Museum of Algiers, during his expeditions in the fastnesses of the Hoggar, the land of the Tuaregs There he discovered distinct signs of a primitive civilization, which was mentioned by Herodotus The carvings and rock paintings, some of them twenty feet high, which he discovered in the Hoggar mountains, that rise to more than 8,000 feet, are among the most precious specimens of prim art

T GRFENWOOD

Algérie 1937 By various authors Pp 184

[2] Pour comprendre l Algérie By René Lespès Pp 219 (1937)

[3] Djemila By Louis Leschi Pp 40 (1938)

[4] L Afrique Romaine By Eugène Albertini Pp 70 (1937)

[5] L Algérie Terre d Art et d Histoire By A Berque Pp 369 (1937)

[6] Ghardaia la Mystérieuse By Marcel Mercier Pp 391 (Algiers Soubiron 1932)

[7] Le Sahara Algérien By Léon Lehuraux Pp 64 (1937) (Algiers Gouvernement Général de l Algérie)

Future Developments in Coal Treatment and Utilization

THE future of coal is of interest in some form or another to modern industries of all kinds, but is of special interest to the technicians and industrialists of the Tyneside area This gave special importance to the symposium on 'Future Developments in Coal Treatment and Utilization' arranged by the Newcastle on Tyne Section of the Society of Chemical Industry at King s College, Newcastle on Tyne, on December 7 last The papers dealt with quite different aspects of fuel technology, and the change of point of view of the speakers was stimulating where a similar series of papers all on the same lines might have been tiring

The papers by Dr W T K Braunholtz and by Dr E W Smith can be considered together The first was a careful survey of the growth of research in the gas industry from the early days of individual effort to the organized research of to day which embraces all subjects of interest to the industry, from retort refractories to ammonia recovery The organized work of to-day is in the hands of the Institution of Gas Engineers and of the collaborating organizations Dr Braunholtz directed attention to the important effect of former researches and hinted that the future might witness remarkable advantages in the technology of gas production He was referring, no doubt, to the Institution's researches at the University of Leeds on the complete gasification of coal or coke with hydrogen under pressure He visualized a future in which our domestic fuels will all be fluid, stating that the open grate must eventually disappear Although Dr Braunholtz may be right, it must be said that, at the moment, the development of smokeless fuels is actually stimulating interest in the open grate

Dr E W Smith took up the story where Dr Braunholtz left off, but treated the subject more from the economic point of view He started by postulating the importance of administration, without which research cannot properly serve its intended purpose Dr Smith considers that there will be no radical change in the technique of carbonization either in the coking or gas industries for some time although a steady evolutionary advance will be made in matters of detail He considers that the future tendency of the carbonizing industries will be towards increasing flexibility, and pointed out that an all gas policy does not make for overall efficiency He prefers that flexibility which is derived from a variety of products, and as one example in gas manufacture pointed out that the yield of coke for sale could be increased by as much as 143 per cent if coal gas were used for retort heating so as to liberate coke for sale This very great potential increase in the production of coke has seldom been realized

As regards the relations of the two industries, it is obvious that even closer co operation should be brought about in order to utilize properly the coke-producing capacity of coke oven plants, when metallurgical coke is not being made, and the capacity in the gas industry, and also to overcome the difficulty of discontinuity in the supply of coke oven gas to other industries

The paper by Dr J G King struck an entirely different note Pointing out that the properties of coals are still not fully known, the author gave a variety of examples to show where a greater knowledge of these properties may not only influence the preparation of coal for the market and its use in existing industries, but may also indicate new markets. Thus a study of the physical structure of coal can give assistance in coal mining and coal breaking problems, in the dedusting of fine coal and in coal cleaning. It has already been shown that the nature and extent of the bands, partings and cracks in lump coal can be examined radiographically before and after the adsorption of lead salts, and that a study of microstructure can aid in the selection of coals for the production of active carbons in which the original structure of the coal is retained.

Dr. King pointed out the importance of the changes which occur in coal on heating, to the carbonization and other industries, and admitted that we are still very ignorant of the true meaning of these changes. A greater knowledge, he said, would greatly help coal blending and the precise selection of coals for special purposes such as complete gasification and the motor lorry gas producer. Although research on the chemical constitution of coal has not yet achieved its object, Dr. King feels that new lines of attack should be tried; previous work has already indicated new processes such as the production of ash-free coke by the Pott Broche process and the production of base exchange agents by the action of sulphuric acid. The paper stimulated a lively discussion in which many and diverse points were touched upon. It seemed to be generally agreed that the proper utilization of coals would be furthered by the close definition of their fundamental properties.

The paper sponsored by Prof. A. C. G. Egerton detailed one important aspect of the properties of coal, namely the part played by its sulphur content. Since the utilization of high sulphur coals may be one of our future problems, it is desirable to know now how the sulphur can be controlled. Mr. Armstrong (research student from South Africa) detailed experiments on the partial elimination of sulphur from coke by passing various gases through the coal during carbonization in the presence of inorganic substances. The reductions are quite marked in some cases with steam, hydrogen or ammonia; but inert gases have little effect.

The sulphur problem attracted some discussion from the steel technologists present, it being pointed out that a decrease of 0.1 per cent in the sulphur of coke would represent a saving of 1*s.* per ton in the cost of pig iron.

On account of the high cost involved, the production of motor spirit and oil from coal has not greatly increased in Great Britain, but considerable strides have been made in the technical sphere. Dr. R. Holroyd described some of the important advances which Imperial Chemical Industries Ltd. have made in connexion with the control of the chemical composition and octane number of the motor spirit. Three types of catalyst are now available for the vapour phase stage of the process so that cracking, hydrogenation and isomerization reactions can be controlled to give motor spirit of the composition necessary for high knock rating. Thus spirit can be made with a very high aromatic and low normal paraffin content; this has a high octane number (80) but a low susceptibility to lead tetraethyl (4 ml. per gall. raises the octane number to 86–7). Alternatively, spirit rich in branched-chain paraffins and low boiling naphthenes can be made; this has a lower octane number (75–6) but a much higher susceptibility to lead tetraethyl, since 4 ml. per gallon raises the octane number to 89–90. Dr. Holroyd said that when similar control has been established over the liquid phase stage the hydrogenation process will have more control over its products than the oil industry.

Although not the last paper of the evening Captain J. G. Bennett's paper really constituted a final word on coal utilization. By assessing the items influenced by the type of fuel such as overheads, maintenances, repairs, etc., he was able to demonstrate mathematical relationships between the "figures of merit" for fuels, these figures of merit being technical efficiency, economic efficiency and psychological merit. For the three types of energy, coal, gas and electricity a ternary diagram may be constructed. Although his proposals are still not fully developed, Captain Bennett was able to show how this diagram can be used for the analysis of statistical and operating data referring to fuel problems; the trends in costs can be followed and the appropriate fuel chosen for any particular purpose. The proposals attracted considerable interest, although it was thought that the large number of variables would make the calculation difficult and might impair accuracy.

Scientific Research and Industrial Needs in Canada

IN a recent address to the Canadian Chamber of Commerce, Major General A. G. L. McNaughton dealt with those activities of the National Research Council that serve to enlarge the demands of industry for the produce of farms, fields and factories. At present, Canadian industry draws about 12 per cent by value of its raw materials from agriculture, or about one third, if forests be included. He referred to recent progress in the United States, where four large research institutes, each endowed with an annual revenue of a million dollars, have been established; and he laid special stress upon German progress in the same direction under the four-year plan. Whereas about 45 per cent of the annual cut of wood was formerly used for low-grade fuel, now 95 per cent is consumed by industry, and Germany is striving to replace iron and steel for construction work by synthetic resins derived from wood and agricultural products. If Canada is to survive, said General McNaughton, she must follow the same path, for the old-time one product system of farming is becoming unremunerative in view of the growth of national self-sufficiency in Europe.

At the same meeting, Dr. C. Y. Hopkins outlined some of the chemical problems now being studied in Canada with the above object in view. China wood oil has of late been replacing linseed oil in varnishes and enamels, and the production of flax-seed in Canada has much diminished; hence efforts are being made to find a satisfactory alternative either by chemical modification of China wood oil or by breeding a new variety of oil-seed that could be cultivated in Canada. A home-grown substitute for the vegetable oils now largely imported for soap-making is also being sought Among the *faits accomplis* of Canadian chemists may be mentioned standardization of tests for honey, improved maple products, a method of drying apples and other fruits with better retention of flavour, and a wax mixture for use in plucking poultry

Dr. N H Grace dealt with projects and achievements in the field of biology Growth promoting substances are now added to the dusts used for disinfecting seeds The development of rust resistant varieties of wheat is estimated to have saved the prairie provinces about 38 million dollars this year Research is proceeding on the factors that determine the malting quality of barley with the view of growing more barley of better quality In 1937, some 80,000 tons of bacon were sent to Britain, prepared in twenty-six plants, each using its own method, research is now being directed towards improving both quality and uniformity

Methods have been developed for altering the heritable characters of plants by heat and chemical treatment, and progress in producing a drought resisting and soil binding forage crop for western Canada has been effected by crossing a Russian grass with the best Canadian wheat varieties From poplars and conifers it is hoped to produce, by crossing, rapid growing varieties of trees possessing hybrid vigour and disease resistance that may be vegetatively propagated with the aid of 'plant hormones

Admiralty Laboratories at Sheffield

THE new Admiralty Laboratories at Janson Street Sheffield, were opened on December 15 by Sir William Bragg president of the Royal Society

These laboratories, which have been constructed to cope with the ever increasing amount of Government work, are designed in such a fashion as to incorporate all recent developments in laboratory architecture The two large analytical laboratories, for ferrous and non ferrous analysis respectively, embody many unusual features One was struck with the arrangements which have been made for the conducting of chemical analysis on a large scale indeed the expression 'mass production might be used with respect to the systematizing of analytical methods certain benches, for example, being given up solely to determinations of one particular element The carbon combustion room was particularly intriguing in its lay out containing several combustion apparatus all set in a line and arranged for rapid analysis of carbon in steel A particular feature is made of spectrographical analysis, for which purpose Hilger quartz spectrographs are used This method of analysis has been brought to a high state of efficiency, and complete reliance can be placed on the results obtained

One was particularly impressed not only by the orderly and systematic arrangement of plant and apparatus, but also by the system with which the work is carried out, even the chemical store is a model of order and forethought The heat treatment laboratory, containing Birlec and Wild Barfield high temperature furnaces with temperature control devices, supplies all that is required for experimental heat treatment purposes, and it is understood that a high frequency furnace is shortly to be installed One of the most pleasing features is the lighting, the lower half of the windows being of Thermolux glass, which provides insulation from both heat and from the glare of the sun, whilst the walls of the laboratories are of a very pleasing tone of semi glazed fireclay tiles The air-conditioning system is novel, and no signs of fumes can be detected anywhere in the laboratories

These new laboratories are capable of turning out all the work that is necessary, and their constructional arrangement has considerably speeded up the rate of analysis They are most pleasing premises to work in, and those in authority are to be congratulated on this new development, which is significant of the scientific progress in metallurgical work for which the Admiralty has been responsible in the past

J H A

British Institute of Radiology

Annual Congress

THE twelfth Annual Congress of the British Institute of Radiology was held in the Central Hall, Westminster on December 7–9, and in connexion with the Congress there was an exhibition of apparatus organized by the British X ray industry The Congress was opened by the president, Mr W E Schall, the opening address being followed by the nineteenth Mackenzie Davidson Memorial Lecture, delivered by Dr G Shearer on "X rays—Their Influence in Pure and Applied Science' In the course of this lecture, Dr Shearer noted that twenty five years have elapsed since Moseley first observed the regularities in the *K* and *L* X ray spectra of the elements which pointed to the general similarities in the internal structures of various atoms and led ultimately to a fairly complete understanding of atomic structure and to the placing of electrons in their appropriate energy levels This same series of observations has also led to the use of X rays in the study of the solid state, with results of great practical and industrial importance From the study of simple crystals by W H and W L Bragg, the work has advanced to such an extent that complex molecules such as the proteins can now be studied, and the results, incidentally, linked up with the work of the organic chemists Another phase of X ray work entailed the study of materials from an industrial point of view, and in many cases the physical properties of materials can be correlated with the size and perfection of the individual crystalline components, while the X-ray method is the method of choice in investigations into the phase relations in alloy systems.

The physical papers dealt with certain lesser-known uses of radiations. F. I. G. Rawlins gave a paper on "X-rays in the Study of Pictures", dealing with the work carried out, largely at the National Gallery, on the X-ray study of the works of various old masters. He showed how, using radiation excited at very low kilovoltages (about 10 kv.), the lower structures of paintings could be revealed and the existence of alterations and restorations detected. In many cases, such studies have served to verify the traditional histories of the pictures. Dr. F. G. Fraser outlined the X-ray work of the British Museum (Natural History) in his paper on "Radiography in Zoological Research". He pointed out how the complete study of the skeletal structures of specimens too rare to be subjected to ordinary anatomical dissection was often helpful in placing animals in their correct zoological classifications.

A different type of investigation was considered by L. G. Nickolls in his paper on "The Use of Invisible Radiation in Police Work". This was mainly concerned with the use of ultra-violet and infra-red radiations in the detection of forgeries and overprinting in documents and identifying the positions of various stains on materials. As regards forgeries, etc., Mr. Nickolls pointed out that, from the point of view of criminal detection, it is important not only to establish the presence of alterations but also to read the words which have been erased. In order to do this, it is important to photograph the document in such a way that the background disappears. This can often be done by means of light in various selected wave-lengths, and certain bands in the ultra-violet region have proved of great use. Similarly, infra-red radiation serves to reveal marks embodded in the lower fibres of paper. As special cases, examples of frauds connected with motor-car licences and with stamps were given. The characteristic fluorescence of practically all physiological fluids under ultra-violet light sometimes served to identify their presence, but more usually fluoroscopic examination is used to reduce the areas to be examined by the more chemical methods.

Science News a Century Ago

Royal Astronomical Society

At the December 1838 meeting of the Royal Astronomical Society, several communications were made. The first of these was an extract of a letter from Bessel to Sir John Herschel alluding principally to the means which he had employed to ascertain the effect of temperature upon measurements made with the heliometer, which consisted in observing such of the stars in the Pleiades as were visible in the coldest winter, by night, and in the warmest summer, by day. "At the approaching disappearance of Saturn's ring", he also wrote, "sufficiently powerful telescopes will probably show *all* the satellites of the planet. I believe that large reflecting telescopes will begin to supersede achromatic ones; at least, I have no doubt they are capable of greater perfection. They *can* be made with mathematical precision, which is not the case with achromatic telescopes. I think also that opticians would have devoted their attention to them in preference, if they had not been discouraged by their more rapid destructibility. If the method of making an indestructible *metallic* surface could be discovered, I should no longer doubt of a still further perfection of the reflecting telescope. Could not *hard* steel be made available? and would it not, if proper care was taken of it, be less destructible than the common metallic reflector?"

The other communications included one by the Rev. R. Main on "Errors of Heliocentric Longitude and Ecliptic Polar Distance of the Planet Venus"; another from Airy, the Astronomer Royal, "A Catalogue of 726 Stars reduced to the Year 1830, and deduced from the Observations made at Cambridge in the years 1828–35"; an extract from a letter from Henderson to Baily relative to the eclipse of the sun on May 15, 1836; and also an extract from a letter of Lassell to Sheepshanks relative to observations made with a small sextant. The instrument was of only 3 in. in radius and was by Dollond. Lassell had made observations on various stars for time and latitude for the express purpose of determining how near to the truth he might be able to approximate by its means. He found that in ordinary circumstances, the mean of one set of altitudes east and another west, would give the time truly within one second, and that a set of each north and south, at something like equal altitudes, would give the latitude within eight or ten seconds.

Armstrong's Improved Water Wheel

William George Armstrong, afterwards Lord Armstrong, who was born in 1810 and died in 1900, was trained as a lawyer, and it was not until 1847 that he joined the small firm which was developed into the famous Elswick Works. Armstrong first obtained success as a maker of hydraulic machinery.

Armstrong's attention had been directed to the use of water-power in 1838, and the *Mechanics' Magazine* for December 29 of that year contained a contribution from him entitled "On Hydraulic Power". In this he referred to the limitations of the overshot water-wheel and the need for an appliance for utilizing the head of water from streams in hilly districts. The first step he considered necessary was to confine the water within a pipe. It was, he said, extremely important that the motion of the water through the pipe should be slow, "otherwise much of the force of gravity would be expended in the production of motion, and the power exerted in the machinery would in consequence be greatly diminished" He had heard that machinery with cylinders and pistons had been used, but to these there were objections. He then described and illustrated an apparatus suitable for the purpose. In this the water flowed through a tube formed into a semicircle. The inside circumference of the semicircle was slotted. A horizontal axis carried a wheel with an edge rim which revolved in this slot. The edge rim of the wheel had four circular apertures, fitted with disks, which would just pass through the pipes. The water acting in turn on these disks caused the wheel to revolve. Curiously enough, Armstrong did not mention the use of the hydraulic turbine of Fourneyron.

Societies and Academies

Paris

Academy of Sciences (*C R* 207 1021 1076 Nov 28 1938)

M Molliard R Échevin and A Brunel Nitrogen composition of variegated leaves The amount of nitrogen (total and also as protein nitrate etc) increases with the extent of variegation A similar increase in nitrogen content occurs in radish grown in aseptic culture under increased oxygen pressure

S Mazur Linear rings

B Kwal Some relativistic generalizations f fundamental equations of analytical mechanics

G Badarau Passage and diffusion of corpuscles through Coulomb potential barriers

A Guillet Simultaneous determination of resistance current and electromotive force in absolute electromagnetic units ohms amperes volts

L Tisza Thermal superconductivity of liquid helium II and the Bose Einstein statistics

M Véron Combustion and detonation in a combustible gaseous mixture maintained at constant volume

A Goldet Measurements of indexes of refraction in the ultra violet A total reflection refractometer was adapted for the purpose

Y Ta Effects of radiations on pyro electric crystals possibility of their utilization as detectors of infra red radiation

F Moles Mlle M T Toral and A Escribano The limiting density and molecular weight of ethylene, new revision of the atomic weight of carbon The molecular weight of ethylene is 28 046 ± 0 001 atomic weight of carbon is 12 007 + 0 000, identical with Aston s mass spectrographic value

W Heller Structure of non thixotropic gels with hydrophil particles

E Carrière and Mlle R Lasri Study of the precipitation of barium molybdates as a function of *p*H

L G Sabrou and E M Renaudie Formation of asphaltic products visible under the microscope during the ageing of lubricating oils

P Gaubert Mobile rings in anisotropic drops of *p* asoxyanisol containing a small quantity of phloridzine

P Bellair Heavy [petrological] elements in desert sands

St Ghika Budesti Petrographic character of the eruptive series of Jebel Sarro (Moroccan Anti Atlas)

A P Dutertre The Lower Albian of the Boulonnais

F Tanazacq Discovery of a fossiliferous horizon in the French Ardennes in the slate massif of Rocroi

L Berthois Deposition of sediments in the western Mediterranean The greater part of the detritic elements do not extend beyond a narrow coastal band, thus sediments accumulate very slowly

C Bois The torrential rains in Tunisia The maximum recorded is 231 mm in 24 hours near Téboursouk Rainfall data for thirty stations are given.

Mlle B Biecheler The chromatic cyclosis of peridians is a stage (prophase metaphase) in their division.

A Sartory J Meyer and D Schmutz Study of the relation between the dose of heterogeneous water soluble vitamin and the quantity of bacteria initially implanted by control of the activation of growth

G Valette and R Rollé Action of quinine on amœba cellular penetration and toxicity

M Rangier and P de Traverse Urinary scatol red

M Paić Determination of the sedimentation constant of hæmolysin

Dublin

Royal Irish Academy November 14

Winifred F Frost Larval stages of the euphausiid *Thysanopoda acutifrons* (Holt and Tattersall) taken off the south west coast of Ireland Material collected at a deep water station off the south west coast of Ireland included sixteen specimens of larval Euphausians unlike any previously described It was concluded that the larvæ belonged to the species *Thysanopoda acutifrons* (Holt and Tattersall) Four larval stages were represented and these are described

November 30

Colin B Rees Notes on the ecology of the sandy beaches of north Donegal The macrofauna obtained at forty three stations which were distributed over eight beaches is listed The effect of the tide as shown by the zonal distribution of the species the exposure the salinity of the sea water, the presence of black sand and the sand grade is discussed Higher numbers of some species were obtained in the finer sands

Vienna

Academy of Sciences, October 27

E Jusa and R Steckler Formation of thio indigo dyes from isomeric 2 naphtholmonothioglycol acids

F Späth and F Vierhapper Coumarines of the drug *Semen Angelicæ*

F Wessely and F Prillinger Catalytic hydrogenation of isoflavones

E Jusa and B Hönigsfeld Azo dyes from 2 naphtholmercaptans and 2 naphtholthiomethyl ethers

G Machek Derivatives of pyridine 3 sulpho acid

Washington, D C

National Academy of Sciences (*Proc* 24 407–495 Oct 15 1938)

H de Terra Preliminary report on recent geological and archæological discoveries relating to early man in south east Asia (See Nature 142 275, 1938)

L R Blinks and R K Skow (1) The time course of photosynthesis as shown by the glass electrode, with anomalies in the acidity changes The electrode is placed in direct contact with the tissue or a layer of cells settled from a suspension, thus *p*H changes due to carbon dioxide assimilation are very prompt Immediately on illumination an acid gush occurs followed by regular increase of alkalinity due to assimilation The effect is discussed (2) The time course of photosynthesis as shown by a rapid electrode method for oxygen The principle of the dropping cathode was utilized substituting bright platinum for mercury An oxygen gush occurs on illumina tion, comparable with the 'acid gush' referred to above, on darkening, however, the oxygen content instantly falls

W J V Osterhout and S E Hill Reversal of the potassium effect in *Nitella*

J Bonner and E R Buchman Syntheses carried out *in vivo* by isolated pea roots (1) Isolated pea roots seem to synthesize vitamin B_1 from a mixture of its pyrimidine and thiazole components a specific enzyme (thiaminase) seems to be involved Another distinct and also specific enzyme (thioazolase) seems to be necessary to produce the vitamin thiazole required

C E McClung Chromosome phylogeny A discussion leading to the view that the linear order of the elements of the chromosomes represents the addition of parts to meet the growing complexity of higher forms, that this is connected with a temporal sequence and that, in the reaction system which constitutes the cell, one chromosome establishes a balance in relation to the others which is determinative in shaping the characters of the body

B H Willier and Mary E Rawles Feather characterization as studied in host graft combinations between chick embryos of different breeds Feathers in a graft area are produced by the host feather germs, but their colour or pattern is under the control of the graft

K W Cooper Concerning the origin of the polytene chromosomes of Diptera Growth of the tissues, which is largely by increase of size of cells rather than increase of number, is related to growth in number of chromonemata occurring in these large chromosomes, possibly the nuclei prepare for prophasic condensations which by some means are prevented from occurring

F B Sumner and P Doudoroff (1) Some effects of light intensity and shade of background upon the melanin content of *Gambusia* Melanin content of the mosquito fish is correlated with brightness of the background to which it is subjected for some weeks (2) Effects of light and dark backgrounds upon the incidence of a seemingly infectious disease in fishes Its incidence was highest in black bowls, and is possibly due to the same agency as that which affects the melanin

M Herzberger Theory of transversal curves and the connexions between the calculus of variations and the theory of partial differential equations

G A Miller Relative numbers of the subgroups and operators of certain groups

J L Walsh Interpolation and approximation by functions analytic and bounded in a given region

K Menger A new foundation of non Euclidean, affine, real projective and Euclidean geometry

J Douglas A Jordan space curve having the infinite area property at each of its points

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Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Lecturer in Chemistry in the Kingston-upon Thames Technical College—The Principal (December 31)

Lecturer in Physics and Chemistry in the Barbados—The Secretary (I.P.R./C.A), Board of Education Whitehall S W 1 (January 2)

Organiser of Agricultural Education in West Suffolk—The Chief Agricultural Officer, Shire Hall, Bury St. Edmunds (January 7)

Lecturer in Geography in the Portsmouth Municipal College—The Registrar

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh Vol 59 Part 3 No 20 Studies on Plumage in the Male Brown Leghorn Fowl By Dr J P Chu Pp 533-562+5 plates (Edinburgh Robert Grant and Son Ltd London Williams and Norgate Ltd) 7*s* [2311

Board of Trade Statistical Abstract for the British Empire for each of the Ten Years 1928 to 1937 (Cmd 5872) Pp xviii+337 (London H M Stationery Office) 5*s* net [2311

University of Liverpool Social Science Department Statistics Division Handbook of Social Statistics relating to Merseyside Pp 32 (Liverpool University Press of Liverpool) 1*s* net [2311

Association of Bird Watchers and Wardens Report of the Nest Adoption Scheme for 1938 Pp 4 (Haslemere Educational Museum) [2411

Universities Bureau of the British Empire Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1937 to 31st July 1938 Pp 26 (London Universities Bureau of the British Empire) [2411

British Empire Cancer Campaign Fifteenth Annual Report of the Grand Council Edited by J P Lockhart Mummery Pp viii+270 (London British Empire Cancer Campaign) [2511

Ministry of Agriculture and Fisheries Fisheries—England and Wales Salmon and Freshwater Fisheries Report for the Year 1937 Pp 59 (London H M Stationery Office) 1*s* 6*d* net [2811

The Teaching of General Science Part 2 Science Masters Association Final Report of the Sub Committee appointed in 1935 adopted by the General Committee in 1938 Pp vii+79 (London John Murray) 2*s* 6*d* [2911

Forestry Commission Report of the National Forest Park Committee (Forest of Dean) 1938 Pp 9+1 map (London H M Stationery Office) 6*d* net [2911

British Rubber Publicity Association Rubber and Agriculture Series Bulletin No 8 The Uses and Possibilities of Rubber in Agriculture By Alexander Hay Pp ii+25 (London British Rubber Publicity Association) Free [3011

Medical Research Council Special Report Series, No 231 Report on Radium Beam Therapy Research 1934 1937 By Constance A P Wood L G Grimmett T A Green and others Pp 77+22 plates (London H M Stationery Office) 4*s* net. [3011

Other Countries

Report of the Forest Department of British Honduras for the Year 1937 Pp 16 (Belize Government Printer) [2411

The Aims Methods and Activity of the League of Nations Revised edition Pp 221 (Geneva League of Nations, London George Allen and Unwin Ltd) 2*s* [2411

Osiris Vol 5 Pp 601 (Bruges St Catherine Press Ltd) [2511

Statens Meteorologisk Hydrografiska Anstalt Meddelanden Band 7 No 4 Yttemperaturen i Svenska Vattendrag Av Ragnar Melin Pp 17 1 50 kr Meddelanden Serien Uppsatser No 22 Hydrometer Beschreibungen Von Tor Bergeron Pp 24 Meddelanden Serien Uppsatser No 25 Hydrologisk Bibliografi år 1937 Pp 13 (Stockholm Statens Meteorologisk Hydrografiska Anstalt.) [2811

Annual Report of the Public Health Commissioner with the Government of India for 1936 Vol 2 Pp vi+135 (Delhi Manager of Publications) 1 10 rupees 2*s* 9*d* [2811

Indian Central Cotton Committee Technological Laboratory Technological Bulletin Series A No 44 Further Tests on the Combing of Good Quality Indian Cottons By Dr Nazir Ahmad Pp ii+25 (Bombay Indian Central Cotton Committee) 1 rupee [2811

Coconut Research Scheme (Ceylon) Bulletin No 2 Report on the Illuminating Powers of Lamps burning Coconut and Kerosene Oils By Dr J P Andrews V Appapillai and R Subramaniam. Pp iv+17 (Lunuwila Coconut Research Scheme) [2811

Geological Survey of Uganda Memoir No 4 Soil Erosion and Water Supplies in Uganda By E J Wayland and N V Brasnett, with Appendices on Water Supply, by C B Bisset and on Soils and Soil Erosion in Karamoja, by Dr W S Martin Pp iv+89+6 plates (Entebbe Government Printer) 7*s* 6*d* [2811

Journal of the Indian Institute of Science Vol 21A, Part 25 Hydrogenation of Oils by the Continuous Process Part 3 Isomerisation of Ethyl Oleate by Nickel Carbonate—Kieselguhr Catalyst By V T Athavale and S K K Jatkar Pp 295-306 1 rupee Vol 21A Part 26 Hydrogenation of Oils by the Continuous Process Part 4 Kinetics of the Hydrogenation of Groundnut Oil by Precipitated Nickel Catalysts By V T Athavale and S K K Jatkar Pp 307-320 1 rupee (Bangalore Indian Institute of Science) [2811

League of Nations Advisory Committee on Social Questions The Recreational Cinema and the Young (Official No C 256 M 152 1938 IV) Pp 31 (Geneva League of Nations London George Allen and Unwin, Ltd) 9*d*. [2811

U S Department of the Interior Geological Survey, Bulletin 885 Geology and Ore Deposits of the Lordsburg Mining District, Hidalgo County, New Mexico By Samuel G Lasky Pp v+62+25 plates 1 25 dollars Bulletin 891 Geology and Mineral Resources of the Honeybrook and Phoenixville Quadrangles, Pennsylvania By F Bascom and G W Stose Pp. v+145+11 plates 65 cents. Bulletin 895 D Geophysical Abstracts 91, October–December 1937 Compiled by W Ayvazoglou Pp ii+137-204. 15 cents Professional Paper 189-B Igneous Geology and Structure of the Mount Taylor Volcanic Field New Mexico By Charles B Hunt. (Shorter Contributions to General Geology, 1937) Pp iv+51-80+plates 7-19 45 cents. Water-Supply Paper 821 Surface Water Supply of the United States 1937 Part 11 Pacific Slope Basins in California Pp vii+358. 45 cents. (Washington D C Government Printing Office.) [2811

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The Land in Colonial Development

POSTERITY will judge the success of tropical colonization by the condition of the land at the end of the colonizing period The fire of presently burning political, social and racial questions will be consumed in the fog of history, but the land will retain for all time marks of the treatment it receives There is little in treatment of land that is likely ever to become front-page news: colonial politics that get into newspapers are mainly concerned with the rights of the people living on the soil or rights to the minerals beneath it The public does not hear much of the rights of the soil. Hence the indication that at least one important section of officialdom recognizes, and encourages, the recognition of these paramount rights is significant Evidence that this fundamentally sound point of view is gaining ground is furnished by a recent report of the Conference of Colonial Directors of Agriculture*

The personnel of the Conference was not confined to directors and deputy directors of agriculture. Practically every British Dependency was authoritatively represented, and the meetings were also attended, by invitation, by a representative of the Union of South Africa, by officers of the Imperial Agricultural Bureaux and by leading authorities on agriculture, forestry and medicine in Great Britain. The subjects discussed by this very representative assembly of administrators and men of science included soil conservation, animal husbandry, nutrition, land settlement, produce inspection, agricultural education, and publicity.

The territories concerned are located in the tropics, where an early consequence of European colonization has been, almost without exception, to exhaust the soil, often beyond the limit of safety which the stability of the soil demands The stage of rapid exploitation has been followed, at least in British Africa, by an attempt to construct a type of society in which native interests would be accommodated within a framework of European civilization. We may say that this stage has been marked by a concentration on securing and adjusting the rights of both Europeans and natives and by an almost complete neglect of the rights of the land, which is now very insistently demanding prior consideration A striking feature of the report of the Conference is the repeated emphasis laid by the Colonial delegates on this need for placing the land first in formulating agricultural policy. No attempt was made to formulate a policy at the Conference, the object of which was rather to obtain expressions of opinions for discussion A policy, indeed, is not wanted so much as a balanced sense of what the land and the people require. Hitherto, the emphasis has been laid on human needs, now one can discern a tendency to emphasize the needs of the land. The pendulum, when it swings back once more, may settle down to an intermediate position of comparative stability

The widespread exhaustion and erosion of the soil are the clearest and most unmistakable signs that the land has hitherto been neglected in Colonial development. The Conference, therefore, gave soil conservation an early and prominent place in its discussions. Although the measures needed to counteract soil exhaustion and erosion vary considerably, it was unanimously agreed that the keynote of all conservation programmes is co-operation—between agricultural, forestry, veterinary, medical, educational, railway and public-works departments: in short, a readjustment of social conditions to conform more closely with the properties of the land.

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* Report and Proceedings of the Conference of Colonial Directors of Agriculture held at the Colonial Office, July 1938 (Colonial No 156, 1938) (London H M Stationery Office, 1938) 2s 0d net

The essence of soil conservation is the establishment of a permanent symbiotic relationship between men and the land, to replace the symbiosis between plants and the land that has been disturbed by human settlement. It is becoming clear that domesticated animals must form a link between men and soil, if the desired symbiosis is to be achieved. A combination of animal and crop husbandry ties the farmer permanently to the land, and it is this tie, rather than the provision of manure and the diversification of crops, that constitutes the greatest value of mixed farming. At present, in many tropical countries serious erosion is being caused by overstocking, elsewhere soil exhaustion has been the result of too few animals being kept. The Conference expressed complete unanimity on the value of mixed farming in tropical agriculture, while recognizing the immense economic and psychological difficulties that its general adoption would involve

Directly linked with the question of introducing mixed farming is that of improving human and animal nutrition Most Colonial administrators realize the desirability of increasing the amount of protein and protective foods in the native dietary—an objective which could be attained by the general adoption of mixed farming, vegetable gardening and concentration on self-sufficient rather than export agriculture. Equally, the basic question of conditions of land tenure is very closely connected with that of soil exhaustion, but cannot be determined without reference to the type of husbandry that will finally become a permanent part of the life of the community. Mixed farming encourages long-term tenure; annual-crop farming encourages short-term tenure in temperate, and presumably also tropical, countries Memoranda presented by several Governments pointed to a close connexion between short-term leases, insecurity of tenure and the prevalence of erosion The report leaves the impression that not only security of tenure but also the desire for secure tenure need to be generally increased in most tropical dependencies Neither the average native nor the European in the tropics seems to be imbued with that innate love of, and pride in, the land which is the bedrock of European civilization Methods of education and propaganda that were discussed at the close of the Conference are directed towards inculcating into the natives a fuller understanding of the attitude the Europeans would like them to adopt towards their land.

Until we come to this final discussion, the impression may well be formed that the reform of tropical agriculture requires only a good start at any of the key points—soil conservation, mixed farming, nutrition—and it will complete itself in the development of a stable social structure which would accommodate both black and white. But the psychological link in the chain seems weak There is more hope than evidence that the average native will easily settle down to the mode of life demanded by mixed farming There seem, however, to be firm grounds for believing that tropical soils would be permanently improved by mixed farming, and could then be made to support a modified form of civilization without danger of soil exhaustion.

"Water, Water, Everywhere"

Theoretical Hydrodynamics
By Prof L. M. Milne-Thomson. Pp. xxii + 552 + 4 plates. (London: Macmillan and Co., Ltd., 1938.) 31*s*. 6*d*. net.

THERE has been a flood of books on the theory of the motion of fluids within the past few years. Some are good and others are not so good. Seventy-nine years ago, Besant published his "Treatise on Hydromechanics" in one volume, and in Great Britain the book remained as the authority on the subject for twenty years. Then in 1879 Lamb published his "Treatise on the Mathematical Theory of the Motion of Fluids", and in 1888 Basset produced his two volumes on "Hydrodynamics". The subject kept on growing, and in 1912 Ramsey, after having spent eight years on the project, published his "Hydrodynamics". By this time Lamb had brought out three successively enlarged editions of his book, renaming it "Hydrodynamics", and was more than half-way through a revision of the subject prior to bringing out a fourth edition. So the race went on, and the problem was how to keep abreast of research, research which was altering vitally general ideas on the subject. By 1932 Lamb had passed through six editions and was universally recognized as *the* authority. Ramsey's book was generally accepted as the most useful introduction to Lamb, and in 1935 it appeared in its fourth enlarged edition.

The books referred to above are capable of being used as text-books for teaching purposes In addition, many manuals of terrifying size have been published from time to time, notably by Germans and Americans. These manuals will all, I think, be superseded by a really excellent two-volume publication which has just appeared under the title of "Modern Developments in Fluid Dynamics". It is a composite work published by the Fluid Motion Panel of the Aeronautical Research Committee of Great Britain under the general editorship of Dr S Goldstein

The mathematical discipline used in classical hydrodynamics has been employed in aerodynamics, tidal theory, meteorology, geophysics, classical electrical theory, and elasticity There have been great changes in some of these subjects within living memory, but none so great, perhaps, as in aerodynamics, and to a large extent nowadays, research in hydrodynamics means research in some problem connected with aeroplanes The great change was brought about by people with a sound knowledge of practical problems who jumped over questions of mathematical rigour on the wings of 'the intelligent guess'. Prandtl, G. I. Taylor, Reynolds, Lanchester, Kármán are some of the names which spring to mind in this connexion The dissatisfaction with the limitations imposed by the mathematically rigorous methods of classical hydrodynamics was made quite clear by the interest aroused in 1926 on the publication of Glauert's little book "The Elements of Aerofoil and Airscrew Theory" It was, and still is, an excellent introduction to more recent investigations. Within a few years of its publication, it was translated into German, the language in which many of the researches it described first saw the light of day.

Since then many books have been published—American, French, German, English—each with its special contribution to knowledge, but it is extremely doubtful whether any of them show the highly developed powers of criticism and discrimination seen in Lamb, Ramsey and Glauert. Prof. Milne-Thomson's book, now under notice, is another of these. It, too, makes a contribution—a mathematical one. It is an excellent collection of worked examples in the style of the classical hydrodynamics, but with two exceptions. These are, first, the systematic use of vector notation, and, secondly, the insertion of many intermediate steps when a problem is worked out. The first of these differences is not likely to endear the book to engineers, but the second most definitel will.

Several sections and features of the book ar worthy of favourable notice The lavish use o simple diagrams is an excellent feature These diagrams and the many lines of mathematical symbols help to break up the text and give the pages an 'open' appearance as compared with the cramped look on the pages of many manuals where the words seem to crowd together in order to avoid taking up too much room Chapter ii on vectors is particularly useful as a concise summary of that part of the subject which is required in the study of hydrodynamics Similar remarks can be made of Chapter v on complex variable theory. From the point of view of physics, Chapter i is noteworthy for the simplicity of its style and for the fact that fairly complicated results are obtained extremely elegantly. The whole book is in fact remarkable for the clarity of its exposition

One major criticism that can be offered is connected with the plan on which the book is constructed Undue emphasis seems to be laid on subjects which from the present point of view are trivial. Chapter xi, dealing with the theory of discontinuous fluid motion, could be drastically curtailed if only for the fact that the theory does not give results which agree with experiment The subject is interesting historically, and nothing more Similarly, a wrong impression is given if, as in Chapter xii, the subject of "Wakes" is treated as if it were a branch of discontinuous flow. Mathematical results can be obtained and problems can be solved, but it is doubtful whether the results are of any value. The importance of "Vortices" is well recognized in Chapters xiii and xviii, but "Waves" receive insufficient treatment in Chapter xiv. Lamb devotes about 300 out of his 700 pages to waves, but in this book only 50 out of about 550 pages are given to the subject It is only in the last chapter—that on "Viscosity"—that one approaches the real problems of the present day.

There are a number of points of minor importance which might receive the author's attention in subsequent editions of the book First, no table of "Historical Notes" on theoretical hydrodynamics is complete without some reference to Prandtl, Lanchester, G. I Taylor, Kármán, Lagrange, Laplace, Cauchy and Poisson. Secondly, the footnotes, though few in number, should be drastically revised. It is surely unnecessary to define the meaning of $\underset{t\to t_1}{\text{"Lim"}}$ and "infinity" in footnotes—even if a previous knowledge of only the elements of infinitesimal calculus is assumed by the author. It is surely unnecessary too, to give a footnote to "Lewis Carroll" and a place in the index, because he used the word "burble" in Jabberwocky. The word can also be found in the Concise Oxford Dictionary! More references to Prandtl (who receives two), G. I. Taylor (who receives one) and Lanchester (who receives none) in the index of a book on theoretical hydrodynamics would not be out of place. There are a number of points of similar order of importance dealing with the text, but one does not wish to dilate upon them lest the impression be conveyed that the defects outweigh the many important qualities of the book

The 508 examples which are included in the book lead one to assume that Prof. Milne-Thomson intends the book to be used for teaching purposes. Unfortunately, the price is prohibitive so far as most students are concerned. The book, however, is a valuable asset in any library, as it indicates clearly and fully what has been done and what can be done by classical processes and by vector notation It is to be hoped that some day Prof. Milne-Thomson will turn his attention to more modern theories, and will give us as clear an exposition of them as he has of the foundations of the subject.

L. ROSENHEAD.

Exploring for Plants

The World was my Garden:
Travels of a Plant Explorer. By David Fairchild, assisted by Elizabeth and Alfred Kay Pp xiv + 494 + 129 plates (New York and London . Charles Scribner's Sons, 1938) 18*s*. net

THIS book is the autobiography of David Fairchild, written with the assistance of Elizabeth and Alfred Kay It consists of an account of his life and of his varied experiences during the course of his journeyings as a plant explorer In early manhood, Fairchild's chief interests were in the direction of plant pathology, and it was not until 1895, when he met his friend and benefactor, Barbour Lathrop, that he began to concentrate on the problems of plant introduction For the next twenty years, he travelled continuously all over the world collecting plants, particularly those of economic importance, and dispatching them to his native country He finally became head of the Division of Foreign Plant Exploration and Introduction of the U.S. Department of Agriculture, and retired in 1935

The last quarter of the nineteenth century was the golden age of the plant collector. World communications had already developed considerably, but vast new areas had only just been explored or were in the process of being put on the map. This state of affairs coincided with the great interest that was being taken in the application of science to agriculture, and Fairchild sized up the possibilities of the situation in a remarkable fashion, and made the most of his opportunities. Wherever he went he seems to have found, with comparatively little difficulty, types and varieties of cultivated crops and fruits that were either not established in, or were unknown to, the United States, and which if introduced would be of great value to the agriculturists and horticulturists of the New World.

A perusal of these pages will bring home to the reader what these opportunities were and the success that crowned Fairchild's efforts He journeyed without ceasing for many years and the record of his travels is almost kaleidoscopic in its effect on the reader He tells of trips to Iraq for new varieties of dates, to Egypt for staple cotton, to Western China for tung oil and to the Argentine for a hardy type of avocado. These are a few only of the many mentioned in this volume Much of the material was apparently picked up with comparatively little effort, for in those days the field was almost a virgin one. Later in life, he was able to consolidate his earlier work by establishing acclimatization stations in the United States.

The narrative is a long one and so packed with incidents that at times it is somewhat difficult to digest all the matter contained. It is written for the lay reader, and incidents that occurred during the various expeditions give one an insight into the adventures and hardships that were incurred. It is not simply an account of plant exploration, for the narrator makes frequent diversions from the main topic in order to mention interviews with people famous in other realms of science and incidents of fundamental importance to the history of the world, such as the discovery of Röntgen rays or Glen Curtiss's flight in a heavier-than-air machine in July 1908.

The story is presented in a direct style and is lightened by touches of natural humour. There are occasional slips, as for example on p. 123, when the late Dr. J. B. Harrison is described as being the discoverer of sugar-cane seedlings. In Barbados and the West Indies generally, this honour has always been ascribed to the late John R. Bovell.

Dr. Fairchild is an expert with the camera, and the book is well illustrated with more than two hundred beautiful photographs covering the greater part of his journeyings.

Mathematical Analysis

(1) Analyse des courbes, surfaces et fonctions usuelles, intégrales simples

Tome 1. Par Paul Appell Cinquième édition entièrement refondue par Prof Georges Valiron Pp ix + 395. (Analyse mathématique à l'usage des Candidats au Certificat de mathématiques générales et aux Grandes Écoles, d'après les cours professés à l'École centrale des Arts et Manufactures et à la Sorbonne Cours de mathématiques générales) (Paris: Gauthier-Villars, 1937) 100 francs

(2) Variables Complexes

Par Prof M A Buhl (Nouveaux Éléments d'Analyse. Calcul infinitésimal, Géometrie, Physique théoretique Tome 2. Cours de la Faculté des Sciences de Toulouse) Pp vi + 214. (Paris Gauthier-Villars, 1938) 84 francs

(3) Advanced Calculus

By Prof W Benjamin Fite Pp xii + 399. (New York The Macmillan Co, 1938) 21*s* net.

(4) Introduction mathématique aux théories quantiques

Par Gaston Julia Deuxième partie Pp vi + 218 (Cahiers Scientifiques Fas. 19) (Paris. Gauthier-Villars, 1938) 85 francs

(1) PROF APPELL'S work on mathematical analysis, of which this is the first volume, is a classic which has been appearing in successive editions since the year 1898, when it contained the substance of a course of lectures given by the author at the École Centrale des Arts et Manufactures in Paris

The present edition, sponsored by Prof. Valiron, contains all the analysis and geometry necessary for the Certificat des Mathématiques Générales at the Faculté des Sciences, and in spite of numerous modifications, additions and suppressions, conserves the spirit, if not the exact form, of the original work The book was not intended to be a treatise, far less an encyclopædia; but a course of studies proceeding consistently from the simple to the more complex. Thus, complex numbers are introduced at a late stage, so that once the student has grasped their nature, he can use and apply them at once. The geometrical introduction contained in the first three chapters is always given at the Sorbonne as a preliminary aid to the usual course in mechanics

(2) Prof. Buhl's extremely interesting monograph on the theory of complex variables, which forms the second volume of his treatise on the new elements of mathematical analysis, has as distinct a philosophical flavour as is possible for a work that is primarily a course of instruction. As in the preceding volume, the author is concerned with the presentation of mathematical ideas from the triple point of view of logic, geometry and physics, and he once more lays stress upon the duty of every professor of an advanced subject, not only to keep in contact with modern developments, but also to incorporate them so far as possible in his teaching

As Prof Buhl points out, the past twenty years have marked an epoch during which geometrical theory has been consistently and brilliantly applied to physical phenomena Although opposing schools still dispute the legitimacy of derivatives, he considers it essential to investigate the implications of functional theory in spite of the growing complexity of the task. The first chapter of the volume, therefore, is entirely devoted to functions, and is based on an initial theorem concerning even and uneven functions, which permits of generalization in the form of cyclic functions attached to roots of unity The functional point of view thus engendered reviews earlier considerations concerning periodic, elliptic and modular functions as well as modern quantic aspects A final chapter is dedicated to the work of Charles Hermite in theoretical physics.

The whole book is punctuated by remarks and criticisms which stimulate further investigation of the philosophical consequences of the theorems enunciated and a more intensive analysis of the meaning of terms and operators

(3) Prof. Fite's "Advanced Calculus" is intended as an introductory course in analysis for students who are seriously thinking of specializing in mathematics Although a preliminary course in the calculus as well as an ability to differentiate and integrate ordinary functions is assumed, the author is so convinced that no real progress in analysis can be made without a thorough understanding of these operations that he proceeds to define and explain them as lucidly as possible The real number system is discussed in the first chapter, for the benefit of those whose knowledge of it cannot be assumed. But a study of Lebesgue integration is left for the student who will continue later to specialize in the developments of analysis. Of the last two chapters, the one on the theory of functions of a complex variable will be very helpful to students who are not taking a course in the subject, while the other, albeit more specialized, in

which the calculus of variations is discussed, will provide the reader with a useful introduction to a very wide and important field.

(4) The second part of Prof Julia's mathematical introduction to quantic theories, of which the first part has been already reviewed in NATURE, is devoted to a study of Hilbert space in its various aspects—the subject of Section I—and an investigation of the linear operators of this space, which is the subject of Section II.

The geometrical investigation of Hilbert space is the result of a parallel examination of its two analytic aspects—the vectorial and the functional. These are to be found in Chapters i and ii and serve as a basis for an axiomatic definition of Hilbert space with which Chapter iii is concerned. But as Prof. Julia remarks, the order could quite well have been reversed by beginning with the axiomatic definition and deducing from it the vectorial and functional aspects.

In Section II, there is a detailed examination of the restricted linear operators of Hilbert space and their analytic representation by means of infinite matrices, together with the algebraic calculus of these operators and matrices. In particular, a study of the inversion of these restricted operators (and the resolution of linear systems in an infinite number of unknowns) has been developed so far as possible in geometric form. In paragraphs 3 and 4 of Chapter v, a number of demonstrations and propositions of a simple nature have been incorporated so as to show the geometric character of the correspondence established in Hilbert space by a restricted operator, notably in particular cases which form the basis of the theory of spectra, where this correspondence is not everywhere one–one. Prof Julia announces that a forthcoming monograph will deal with the analysis of the restricted linear operators and their spectra.

Social Organization in Bechuanaland

A Handbook of Tswana Law and Custom
Compiled for the Bechuanaland Protectorate Administration by Prof. I. Schapera. Pp. xiv + 326 + 1 map. (London: Oxford University Press, 1938) 21*s*. net

PROF. SCHAPERA'S "Handbook of Tswana Law and Custom" appears opportunely, at a moment when the future of the South African Protectorates is a matter of grave concern. It places before the people of South Africa and Great Britain a comprehensive view of the framework in law and custom of society among the native population of Bechuanaland, and at the same time gives them an opportunity of informing themselves of certain aspects of the conditions with which the administrative system has to cope in relation to native institutions. Moreover, it is significant that the inquiry, of which Prof. Schapera's handbook is the outcome, was undertaken, as Col. Rey, the former Resident Commissioner, points out in his preface, not only at the invitation of the administration, which was desirous that its officers should have for their guidance a carefully tested body of information, based upon scientific methods of inquiry, on native law and institutions, but also with the approval of the natives themselves. The older men of the tribes were disturbed, not only because a younger generation was growing up which was unacquainted with tradition and custom, but also because even among themselves there was much uncertainty as to the law They, therefore, expressed a strong desire that such a record as this should be made.

The task undertaken by Prof Schapera was by no means simple. The population of Bechuanaland is far from homogeneous Not merely has there been a long-continued process of fission and fusion among the tribes, such as is common to the history of most Bantu-speaking peoples, but also it includes Hottentot and Bushman, and it has received numerous accessions from outside its borders, both Bantu, from various sources, and Herero. Hence there is much variation in custom, which at times even appears within the same tribe, as, for example, in regard to marriage. Such problems, however, at this late date are too often a commonplace of anthropological investigation; but for this reason the author cautions the reader that the results of his inquiry in this volume apply specifically only to the Kgatla and Ngwato, who were under his direct observation, and that other tribes must be the subject of further investigation

The social organization of which Prof. Schapera has had to take account in considering the functioning of Tswana law and custom is relatively of an advanced type. At the head of the tribe stands the chief, not merely as its ruler and leader, but also, in a special sense, as the embodiment of the tribe as a whole. His powers are tempered, however, by his councils; while in relation to land he is the holder for the use of his people, rather than the absolute owner, a point on which there has been frequent misunderstanding in relation to tribal lands. The distinctive feature of this society is the delegation of control through a succession of subdivisions—section, ward and so forth down to the individual family—in each of which the headman controls the divisions and individuals below him in the social hierarchy. In the matter of the law, the chief is the interpreter and exponent, who applies traditional procedure to cases, rather than the law-giver, though that function may be assumed on occasion, as when Kgama came under the influence of the missionaries and promulgated laws on various matters of tribal practice. In view of the fact that until recently there was no written record of judgments, the distinction between law, even case law, and custom is not a matter of hard and fast rule, nor, perhaps, a matter of great significance

The aim of the administration has been to preserve the position and power of the chief, subject to certain reservations in matters in which freedom of action is considered incompatible with British control. These reservations, however, even though made with due deliberation, such as, for xample, in the restriction on inflicting the death penalty, are bound to affect the prestige of the chief Missionary influence, even though well-intentioned or well-informed, also plays its part in modifying the relation of chief and tribe, but the most serious among disturbing factors is the change in economic conditions. One example mentioned by Prof. Schapera is the evasion of the duty of performing work for communal benefit at the call of the chief, incumbent upon the regiments into which members of Tswana society, both male and female, are organized The rule of the *corvée* is broken by individuals, who thereby flout the authority of the chief, because they will not be paid, as they are when they work in the mines, or for Europeans.

Prof Schapera is careful to point out that his handbook is not a code That this should be clearly understood is essential The future of native Africa depends upon the recognition of the fact that its law and custom are not static and stereotyped, but that the principles upon which African society is based can and must be adapted to meet changing conditions, provided that the adaptive process is not allowed to become disruptive and that harmony with the soul of Africa is maintained

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A Falconer in Iceland

In Search of the Gyr-Falcon:
an Account of a Trip to North-West Iceland By Ernest Lewis. With a Memoir of the Author Pp xxiii+235+24 plates. (London: Constable and Co., Ltd., 1938.) 12*s*. 6*d*. net.

IT is delightful to turn to this book by Ernest Lewis. It refreshes the reader after a spate of books, some of them second-rate and decadent, which are flooding the market at the present time. Let it be said that Ernest Lewis's book is produced in excellent taste, from the jacket to the last page The print is good, the photographs are well reproduced, the design of the jacket is unusually pleasing.

This book describes a journey recently made by "Ernest Lewis" (the pen-name which Ernest Vesey took to hide his identity). The author has unhappily not survived to see the success of his book and it is therefore fitting that, in a feeling foreword, his father should have disclosed to us the author's real name.

Ernest Vesey travelled to Iceland to bring home young Iceland falcons to be trained in falconry. He arrived alone in that northern country, knowing well the difficulty of his task. By sea he travelled from Reykjavik up to the north-west peninsula of Iceland, to a district that is little known even at the present day. He had been led to believe that the Iceland falcon even here was a rare bird, but by perseverance, handicapped as he was by the loss of an eye and an arm, he explored, sometimes on horseback but usually on foot, desolate glens and valleys, forded on foot rivers so swift and deep that once he was swept away in the icy current, braved perilous seas in small boats, scaled cliffs considered inaccessible, and at the end of all his journeyings found that the Iceland falcon was less rare than was supposed, and succeeded in bringing back a brood to Scotland.

The book is simply and graphically written, and an intense love of all living creatures stands out from its pages Whether the author is watching the king eider in all the beauty of his plumage, or the sea eagle sailing majestically past him, or the noble Iceland falcon rushing in to do battle with the eagle, Ernest Vesey shows himself to be not only a bird observer, true and faithful, but also a bird lover.

The hardships of Icelandic life, and the cold beauty of that country, are also brought vividly before the reader in this fine book.

SETON GORDON.

Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L. Wolf. (1) Band 9, Abschnitt 3 und 4: Anregung der Spektren, von W. Hanle; Molekülspektren von Lösungen und Flüssigkeiten, von G. Scheibe und W Frömel. Pp. 184+16. 18 gold marks (2) Band 9, Abschnitt 5: Kernspektren. Von K. Philipp. Pp. xi+185–283+17–22. 11.20 gold marks. (3) Band 8: Abschnitt 2. Lichtzerstreuung. Von H. A. Stuart und H.-G. Trieschmann. Pp. ix+191+20 24 gold marks.

Leipzig: Akademische Verlagsgesellschaft m.b H., 1936, 1937.

THESE sections of the "Hand- und Jahrbuch der Chemischen Physik", like their predecessors, are noteworthy for their completeness, good presentation of experimental facts and technique, and their convenient format. It is impossible here to do more than comment upon a few of their more striking features.

(1) Hanle's discussion of the methods of excitation of spectra is well arranged and easy to follow, and the reviewer particularly liked the manner in which potential curves are explained and introduced wherever necessary The section by Scheibe and Frömel on the spectra of liquids and solutions contains a neat outline of the methods for the measurement of extinction coefficients, and a good treatment of the factors which affect molecular absorption, as, for example, the effects of the solvent upon fine structure.

(2) Perhaps the section on nuclear spectra by Philipp is the one most likely to be sought out by English readers, on account of the rate at which development in this branch is proceeding. The author gives very complete accounts of long-range alpha particles and their fine structure. He gives a careful analysis of β-ray spectra and the theory of β-ray disintegration, and his concise treatment of γ-ray spectra, with the discussion of the time of emission of γ-rays from the nucleus and nuclear composition, is very pleasing to read.

(3) Finally, we come to the section on the scattering of light. Stuart deals excellently with phenomena in the visible spectrum and Trieschmann with the coherent scattering of X-rays. Perhaps it is permissible to suggest that it would be well if, in English books on scattering of very high frequency radiation, a clear distinction between coherent and incoherent scattering were always drawn.

L. F. B.

The Geographer's Protractor

Designed by Prof. F. Debenham. Ivorine, 6 in. × 2⅜ in, with 8-page Explanatory Booklet. (London: T. Murby and Co., 1938.) 6s.

THERE are several features of this new protractor that make it most acceptable. Made of ivorine encasing a metal reinforcement, it is strong and rigid and the scales and other markings stand out clearly and are unlikely to be obscured by usage. The width is half an inch more than usual, which gives greater accuracy than is obtainable with narrower instruments for angles near 90°. The edges are well bevelled. On the edges of the reverse side are scales for the principal maps of the Ordnance Survey, six inches, one inch, and half an inch to the mile. Scales are also given for the principal Continental scales (1 : 10,000; 1 : 20,000, 1 : 50,000, 1 : 100,000; 1 · 62,500; and 1 : 250,000). The six-inch scale has also a scale of chains. A gradient scale for the six-inch map should also be useful on many occasions. The usual diagonal scale of inches and a centimetre scale are provided. On the upper side there are some useful features in the scales for the direct plotting of map projections, the use of which should save the student much time All the more usual projections can thus be drawn directly.

It is in every way a most useful protractor and most pleasing to handle. Prof. Debenham is to be congratulated on his design.

R N R. B

Trigonometry

Part 1. Intermediate Trigonometry. By Prof T. M MacRobert and William Arthur. Pp. x+206 (London: Methuen and Co., Ltd, 1937) 5s 6d.

THIS attractive volume has been designed as the first part of a complete work on trigonometry and bears the sub-title, "Intermediate Trigonometry" It begins, however, with the definition and measurement of angles and proceeds quite logically and rigorously to the solution of triangles. Amongst the many commendable features of the book the following deserve mention

Circular measure is rightly introduced in the first chapter, and is developed from the fundamental theorems upon which it is based. The chapter on graphs is not only very clearly written but also is illustrated by a series of well-drawn curves, including those of the inverse functions. Then again, in order to render the proofs valid for angles of all magnitudes, the Addition Theorems are established by an application of the theory of orthogonal projection, a very lucid exposition of which is given in the previous chapter. Finally, quite a full and stimulating chapter on the properties of quadrilaterals concludes the course.

Motor Benzole:

its Production and Use. By W. H. Hoffert and G Claxton. Second edition. Pp. xxv+933+3 plates (London: National Benzole Association, Ltd., 1938) 42s. net.

THE subject covered by this book is of great importance and one which continues rapidly to develop, as is witnessed by the fact that the new edition contains 50 per cent more subject-matter. New chapters contain information relating to the production of aromatics from gaseous hydrocarbons: there are those who predict that much motor-fuel is to be made this way in the future, which may mean that the whole of our tar production may be first cracked to gas and this synthesized to antiknock petrol. If this became true, home-produced oil would be a fact at long last.

The Trawl Fisheries: A Scientific and National Problem

By Michael Graham, Fisheries Laboratory, Lowestoft[*]

IT is common knowledge that the trawl fisheries have mainly been unprofitable for many years and that the number of British fishermen has been reduced by about thirty per cent since 1919 Some of this decline is due to loss of herring fishermen , and this article is not concerned with that section of the industry. Part of the reduction is due to loss of trawler hands and inshore fishermen and, so far as these sections of the industry are concerned, recent scientific work has a very practical bearing, and leads to a comprehensive statement on the conditions under which the industry can be permanently profitable or unprofitable

A selected list of literature on the subject would consist of references to Baranov (1916), Moek (1930), Russell (1931), Hjort, Jahn and Ottestad (1933), Thompson and Bell (1934), and Graham (1935), so that, except for Baranov's paper, which was unfortunately overlooked, we have had a scientific development of recent date, and from such widely separated places as Oslo and Seattle The present article does not attempt to give the details, but only to illustrate the modern development of the overfishing problem and its wide implications. Data will not be used except in one illustration, because they are *statistical* and therefore cumbersome, but it must not for that reason be thought that the solutions are only theoretical On the contrary, for the North Sea, three mainly independent lines of evidence have been used, and one of these, that of general statistics, is available for many other areas

Perhaps the most important fundamental conception in the problem is that of 'principal' and 'interest' of the stocks of fish. Stocks tend to grow in weight by reproduction (A) and by the increase of weight of individuals (G) They lose weight by natural mortality (M) and their 'natural' increase is

$$A + G - M \qquad . \quad . \quad . \quad (1)$$

the addition and subtraction being justifiable if all these processes are measured in a certain way. Mathematical considerations, such as this one, may conveniently be accepted in this article without explanation. The introduction to a recent paper[†] has attempted to explain the necessary mathematics 'without tears'.

Expression (1) is the 'interest' of the stock, and if fishing is no more nor less than this, the stock will be unchanged in weight Fishing, however, often takes more than this 'interest', and the weight of the stock is then reduced. So long as the fishery is profitable, this reduction of stock causes no inconvenience to the industry, and science is not called to make any suggestions for regulation Nor has the modern scientific statement anything useful to say about this consumption of 'principal' in itself At that stage, the situation has no element of permanency It is, however, in the matter of the 'interest' at different levels of 'principal' that the modern methods have, been able to draw conclusions, and that is, in fact, the problem we are required to answer—how to make the industry permanently profitable. This cannot be done as regards any particular year, because of fluctuations in stocks of fish and of markets , but the aim is to make the industry permanently profitable on the average, if such a state may be called "permanent"

The scientific problem is, therefore, what happens to

$$A + G - M$$

at different levels of stock, excluding fluctuations ?

The three known approaches to the problem may now be illustrated.

I. General Statistics

An example, from an area that is generally thought not to be overfished, is given by the fisheries for haddock and plaice at Iceland in recent years. A natural increase in the stock of cod, called by Kemp (1938) a "long-period fluctuation", has caused fishermen, of whom the British fishermen must be taken as representative, to double their effort in this area (Fig. 1) The number of hours fishing per annum rose by about eighty per cent between 1925 and 1931, and new and fast vessels with more deadly trawls were introduced during that period. At first, haddock, and, to a less extent, plaice were taken in increased quantity, but the permanent result was to lower the yields of both species to levels in 1933–1935 which they have never reached before in any three peace-time years since 1906, when these international statistics were first collected.

The difficulty of this evidence is that it does not distinguish between 'principal' and 'interest'.

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[*] Based on a paper "Rational Exploitation of the Fisheries" read before Section D (Zoology) of the British Association at Cambridge August 19.

[†] Graham (1935). We use logarithmical rates.

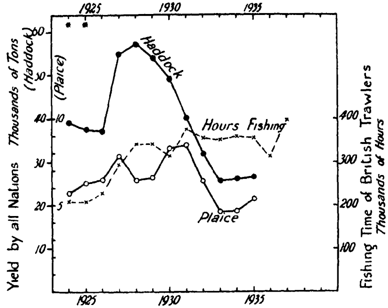

FIG. 1

However, statistics of landing per hundred hours fishing of the category 'large' show that the yields of 1933–1935 represent 'interest', there being no trend in the density of these older fish. The yields in the period before 1926 seem to have been mainly but not entirely 'interest' at a higher level of stock.

The conclusion is that this increase in expense of fishing is mainly wasted, if not worse, for these two species.

2. ESTIMATES OF RECRUITMENT, GROWTH AND MORTALITY

In fishery investigations, the rate of recruitment (A) is given by the percentage by weight of the youngest age-group observed in a census of the fishable stock, the age being determined by reading the scales or some other method There is a theoretical difficulty, which should not be forgotten, in that recruits may come in in older groups also.

G, the growth-rate, and Z, the rate of total mortality including fishing, are obtained from the same material. C, the rate of capture or fishing, is obtainable from marking experiments (Graham, 1938). If Z and C are correctly measured, then natural mortality is given by

$$M = Z - C \quad . \quad . \qquad \text{(ii)}$$

The yield, Y, is given by either

$$S(A + G - M) \text{ or } SC \; . \quad \text{(iii)},$$

whichever happens to be more convenient, where S is the weight of stock. So far, we have only been interested in the ratio Y_1/Y_2, so that absolute values of S are not required

The calculation of Y_1/Y_2, with different rates of fishing, and therefore of Z, assume a, g and m unchanged, the small letters indicating rates for particular ages. This is demonstrably justifiable for small changes of rate of fishing, in a heavily fished stock, and the information derived is at least reliable as to whether a stock is overfished or underfished It is not, however, justifiable to use this method for calculations involving large changes in rate of fishing and density of stock

Estimates of relative yield with different rates of fishing, and therefore of Z, have been made on these lines, for Pacific halibut and for cod, haddock and plaice of the North Sea In the last-named three fish the calculations had a peculiarly

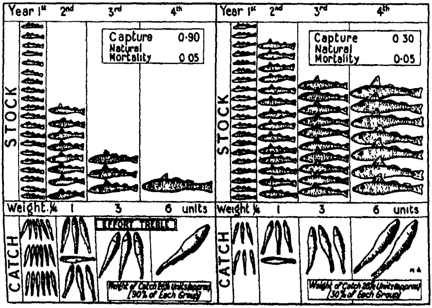

FIG. 2.

difficult form, because the data only gave the order of magnitude of the rate of natural mortality, not any more precise estimates.

An illustration of an imaginary case is given in Fig 2. Very high and very low rates of fishing are illustrated, for which large differences, as we have seen, the real calculations are not justifiable. Also the population under a low rate has been assumed to suffer sudden extinction after the fourth year, so as to keep the drawing a reasonable size The diagram is self-explanatory. It is seen that the weight of the catch can easily be the same under a low rate of fishing as under a high rate

If, now, the trawl catches thirty per cent of the fish on the strip of ground over which it is dragged, then, assuming constant replenishment, the area inhabited by these fish would have to be towed over three times in a year to give a rate of fishing of ninety per cent. But towing over the area once only would give the rate of thirty per cent and the same yield Clearly there is room here for a large cut in the expenses of fishing.

(The number of survivors in each group of, for example, the left-hand side of the diagram, is calculated by the formula $n_1e^{-it} = n_2$).

3. THE SIGMOID CURVE AND PRACTICAL IMPLICATIONS

We have seen that, however clear it may already be that fishing can be, and is, wasteful of effort, by overfishing, any estimate of the best yield and the best rate of fishing, over the whole possible range, requires experience of different rates of fishing and a theory as to how the rates of recruitment, growth and natural mortality vary with different densities of stock. A first solution of this problem has been reached for the demersal fishes of the North Sea taken together, cod plus haddock plus plaice, etc, taking into consideration the various effects of partial reduction of fishing during the war of 1914–1918.

The theory depends on two assumptions.

A. There is a limit to the weight of stock which an area will support.

B. The rate of natural increase, V, ($= A + G - M$), is directly proportional to the difference between the weight of the stock at the moment and the maximum weight the area will support. The assumption of direct proportion is only a first approximation.

With these two assumptions it will be found (graphically is an easy way to do it), that the weight of a stock growing in an empty area will follow the well-known S-shaped curve of the 'logistic' function, that has been used by Pearl and others to express the growth of populations* (Fig. 3, S).

The curve of Fig. 3 will now be used to show the practical implications of the modern statement, although it will become obvious that these implications could reasonably, but less neatly, be derived from the conclusions of general statistics or of fishery investigations (1 and 2 above)

When a fishery begins in an untouched area, the stock is represented by some high point such as S_a in Fig. 3, where V equals zero, or nearly The fishery *must*, therefore, take 'principal' as well as 'interest' and deplete the stock, a process that has caused alarm in the past, alarm which appears now to have been premature If the depletion takes the stock to S_b, and stability is allowed, V can be read off from the scale on the left as

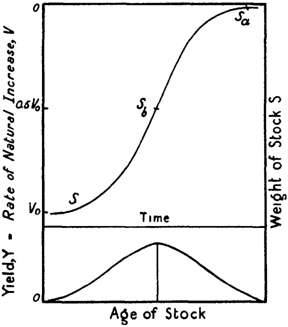

FIG 3.

$$0{\cdot}50\ V_0$$

If the fishermen were content to fish at this rate, the stock would remain at S_b and the yield would be

$$0{\cdot}50\ V_0S_b$$

But this expression is the rate, in absolute terms such as grams per annum, at which S would increase if left alone, that is, it is the differential coefficient of S at the point S_b.

Similarly, the yield at any level of stock is given by ordinates in a curve of differential coefficients, which can be plotted separately below the curve S.

As a fishery develops, the rate of fishing tends to increase, so long as there is any profit. Grounds and habits of fish become better and better known.

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* See, for example, Reed and Pearl (1927).

Dangers to gear become more efficiently avoided. Inventors constantly try to make the gear more deadly. So the stock is driven down the *S*-shaped curve, until the ratio of effort to yield becomes so great as to be unprofitable. Here a sad equilibrium is established, with the fortunate few making a profit, most fishermen just covering expenses, but persisting in the hope of a favourable fluctuation, some making losses. So long as the rate of fishing is not deliberately held at a fixed level, this quagmire effectively holds the industry If anything, such as mesh regulations, marketing schemes or cheaper fuel, promises more profit, there is a tendency for the rate of fishing to rise. Banks are more willing to lend money, owners more willing to replace ships and gear, better men are more willing to become fishermen. But if the rate of fishing rises, the stock goes further down the *S*-shaped curve, to a less profitable level So the profit in a highly developed fishery is remarkably like the crock of gold at the foot of the rainbow.

If, however, the rate of fishing could be held at a fixed level, including fishing of all nations on a given stock, there is no reason why such measures should not be profitable.

There seems, however, to be a more fruitful source of profit in a definite reduction of the rate of fishing, for this, properly arranged, means reduction of the running expenses of fishing. It is on this, the expenses side of the balance sheet, that the modern statement expects the main profit For example, the first approximation estimates the maximum yield of demersal fish in the North Sea at fifteen per cent greater than the yield of recent years But the rate of fishing to give this yield is estimated as to be reduced by twenty-five per cent, which is a greater figure

An important technical difficulty is how the rate of fishing could be controlled, because size, speed, age and seaworthiness of vessels all affect the rate of fishing, as well as skill and zeal of the crew. Nevertheless, some sufficiently good limitation of the sum total of fishing power of all vessels together expended per annum, might be devised The difficulty might, in theory at any rate, be tackled by a different approach, namely by fixing quotas of each species for each area. Apart from these important details, the choice is theoretically open as to whether reduction is in *number* of men and ships working, or *time per annum* during which they work.

At the present time, the future course of the industry is uncertain and the decline in number of fishermen makes the problem one of concern outside the section of the population that is financially interested. Under a recent voluntary scheme, some of the trawlers are laid up and others are operating under restriction, for the sake of regulating their markets. This is 'rationalization' as ordinarily understood. But the case, as outlined in this article, is something quite different —in fact unique—for rationalization in this case should mean a particular double process, namely, saving expense and giving the fish time to reach an age where the total nett growth of the stock is greater

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Chemical Research and Industry

DEPENDING upon the mood or the point of view, it is equally easy to be surprised at the large, or concerned at the small, impression which a single laboratory can make on the pile of industrial—even national—chemical problems awaiting solution. To read the report of the Chemistry Research Board and the report of the Director of Chemical Research for the triennial period 1935–1938* is to learn with what vigour and success the study of a great variety of these problems is being undertaken in the Chemical Research Laboratory at Teddington. At the same time, one is tempted to wonder whether in these progressive, competitive, and anxious days a team of a dozen such laboratories, all concerned with fundamentals, taking the long view, undisturbed by the absence of immediate profit, yet at all points initiating, supporting, and supplementing the activities of private industrial research organizations, would prove supernumerary to the desirable national establishment. To wonder anything of the kind is perhaps itself a tribute to the significance of the Teddington laboratory and an appreciation of its work.

For greater convenience in administration, the work of the laboratory is divided into ten sections. Study of the corrosion of metals involves considerations ranging from the composition of rust and the velocity and mechanism of its formation, to the conditions under which metals are attacked in stagnant or moving salt solutions and to the corrosion of locomotive boiler tubes, water supply systems, and fire extinguishers. The use of magnesium-rich alloys of the electron type in the manufacture of fuel tanks has hitherto been handicapped by the corrosive action of 'leaded' fuels in the presence of water. The separate main constituents of the anti-knock mixture, when mixed singly with petrol and water, have little effect, but together they may give much trouble It has been discovered that this severe corrosion can be entirely suppressed by the addition of 1 per cent of quinoline, which does not affect the anti-knock properties of the fuel

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*Report of the Chemistry Research Board for the Triennial Period ended 31st December 1937; with Report of the Director of Chemical Research. Pp. vii+146+7 plates. (Department of Scientific and Industrial Research.) (London: H.M. Stationery Office, 1938.) 3s. net.

High-pressure research has included the synthesis of acetic acid from methyl alcohol and carbon monoxide and an extension to higher aliphatic acids, the manufacture of higher alcohols, and the production of acids from ketones and carbon monoxide. Thus acetone and carbon monoxide under pressure in presence of phosphoric acid afford acetic and trimethylacetic acids, apparently by condensation to mesityl oxide followed by hydrolytic fission to *iso*butylene and acetic acid, the former then affording trimethylacetic acid and hydrocarbons. Experiments on the catalytic production of higher from lower alcohols have led to the determination of optimum conditions, and to the observation that the carbon monoxide employed is not an indifferent gas, but plays some part in bringing about the reactions concerned Incidentally, it has been found that, owing to the risk of explosions, great caution is needed in the use of di-*iso*propyl ether.

The researches on coal, tar, and rubber comprise, as would be expected, a great deal of work on hydrogenation. Coal, in the form of a colloidal suspension in a suitable oil, can be hydrogenated in a pipe system with 85 per cent conversion to oil. Experiments on the hydrogenation of naphthalene derivatives and of pyrene are also described. One interesting research was concerned with the composition of wood smoke as used in the curing of fish; another had as its object the development of new uses for chlorinated rubber.

Chemotherapy is represented by important work on pyridines, cyclic diazalines, and arsenicals, one of which, 'neocryl', is being subjected to extensive clinical tests.

The synthetic resins studied were obtained from phenolic or ketonic sources; both X-ray and electrical methods have been used. It is concluded that phenolic resin films can best be regarded as composed of irregularly shaped aggregates which are in contact at some, but not all, of the chemically active points. Catechin and gambier can now be used in the manufacture of laminated and moulded products. It is remarked that the present industrial development of colourless resins lends interest to attempts to produce transparent, glass-like ketonic resins, the preparation of which promises to be a comparatively cheap process.

Of particular interest in connexion with water pollution is the observation that many resins from polyphenolic substances possess good base-exchange properties Acid-exchange resins can also be prepared, so that it is possible to use these two types of resin successively to remove dissolved solids from tap water In the example given, the reduction was from 36 parts to 1 part per 100,000. An investigation has been made into the possibility of contamination of drinking water by lead arising from the use of water mains for earthing electrical apparatus. Although the necessary current would not be carried by house fuses, damage may occur to the outside of the pipes by this means A method of sampling, whereby the actual amount of lead present in water used for drinking and cooking purposes can be ascertained, is of value in assessing the suitability of domestic water supplies from this point of view.

The report on microbiology refers to the bactericidal action of oxygen under pressure at temperatures little above the optimum growth temperature The Rideal-Walker test for disinfectants has been examined, and it is found that constancy of results is very difficult to secure. In connexion with the differentiation of strains of micro-organisms, it has been shown that acclimatization to growth at temperatures higher than the general optimum varies with the strain, and that in some cases the outstanding difference is in the sodium chloride requirement Thus, for each strain of *V. aestuarii* the salt concentration tolerated reflects its origin, whether from sea water, estuarial water, fresh water, or soil, in spite of prolonged sub-culturing on media free from sodium chloride.

Studies on road tar were concerned not only with composition but also with behaviour in the open air. The surface skin formed by the combined action of evaporation, oxygen, and light is more impervious than that produced by evaporation only.

General research includes work on compounds of rhenium, ruthenium, osmium, and iridium, on the occurrence of germanium and gallium in coal, on polypyridyls and phenanthridine derivatives, and on the production of carbazole from *o*-xenylamine.

The report on chemical engineering refers to the erection of a turbulent flow high-pressure plant, to a high-pressure flow meter, and to a study of the action of hydrogen on steels at high temperatures and pressures.

Maps and Plans of Great Britain

A DEPARTMENTAL COMMITTEE on the Ordnance Survey was appointed by the Minister of Agriculture and Fisheries on May 28, 1935, under the chairmanship of the Right Hon Sir John Davidson (now Viscount Davidson), with the following terms of reference:

> "(*a*) to consider what measures are necessary to accelerate the revision of the Ordnance Survey Maps in order to bring them up-to-date and thereafter to maintain them at a high level of accuracy, while providing for such other public services as are undertaken by the Ordnance Survey Department;
>
> (*b*) to consider what immediate steps are possible in the meantime to revise Ordnance Survey Maps to the extent necessary for the purpose of town and country planning schemes;
>
> (*c*) to review the scales and styles of Ordnance Survey Maps placed on sale to the public, and to recommend whether any changes are desirable; and
>
> (*d*) to review the conditions upon which the reproduction of Ordnance Survey Maps is permitted."

At the time, the most pressing problems in these terms of reference were considered to be the provisions of maps for town and country planning, and the question of the condition upon which the reproduction of maps should be permitted, that is, paragraphs (*b*) and (*d*); and the Committee accordingly issued an Interim Report* dealing specially with these points, dated December 21, 1935. The final report†, dealing with items (*a*) and (*c*), was published on November 3 last, although it appears to have been signed so long ago as February 3.

The recommendations are, we believe, more far-reaching than those of any of the many previous inquiries which have been held on the Ordnance Survey. It is well known that the basic plans of England on the scale of 1/2500 (popularly known as 25 inches, actually 25 344 inches, to a mile) on which all the maps on smaller scales depend, were plotted as separate projections each embracing a county, or group of counties, having their own independent origins. This resulted in no fewer than thirty-nine separate projections being used for these plans, which comprise 51,456 sheets. That such a system should ever have arisen seems, to-day, surprising, but it grew up, like many British institutions, in a haphazard way, counties being selected for survey according to their supposed importance irrespective of their geographical situation. Gradually practically the whole country has been surveyed on the 25-inch scale.

Only the surveyor can really appreciate the inconvenience, not to mention the extra cost involved, especially when maps have to be revised, of this state of affairs. The Committee has fully recognized this, and it is recommended, therefore, "that as soon as it can be conveniently arranged the 1/2500 survey should be re-cast on national instead of county sheet lines on a national projection".

The re-casting of the 1/2500 series will involve the re-drawing of the whole series, which would in any event have been necessary with the majority of the sheets, in order to bring them up to date. The opportunity should therefore be taken, the Committee recommends, of altering the size of the sheets, which would apply to all scales of maps, and introducing a national grid to provide one system of reference for the maps of the whole of Great Britain. This would make it possible to apply a single reference system to all maps by which any point can be precisely defined either on the ground or on the map. The significance of this from a defence point of view, since maps of every part of the country are now liable at any moment to become of military importance, cannot be exaggerated.

It is recommended that the unit for this grid should be the international metre, which has many advantages, being on a decimal system, over any other unit. Under this arrangement the shape of the 1/2500 plans would be square, with one kilometre sides, while the 6-inch sheet would consist of exactly twenty-five 1/2500 plans. Another advantage of the application of the grid to maps is that it would provide a universal index to maps on all scales, serving the needs both of the general public and of the technical map users. Map sheets would be known by the grid co-ordinates of their south-west corners. The only condition in order to fulfil the function of an index is that the limits of sheets should be coincident with grid lines.

The natural sequence of scales derived from the basic scale of 1/2500, would be 1/25,000 and 1/250,000. The latter differs from the existing ¼-inch scale by only 1¼ per cent, a difference scarcely perceptible to the great majority of those using this particular scale. The Committee, however, did not see its way to recommending a change, though it does suggest, as an experiment, the introduction of the 1/25,000 as a new scale, with this exception, all the old scales remain the same.

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* Interim Report of the Departmental Committee on the Ordnance Survey. Pp. 16. (London: H.M. Stationery Office.) 3*d*. net. See NATURE, May 2, 1936.

† Final Report of the Departmental Committee on the Ordnance Survey (Ministry of Agriculture and Fisheries). Pp. iv+39+11 maps. (London: H.M. Stationery Office, 1938.) 5*s*. net.

The new scale, which is approximately 2½ inches to the mile, is of the utmost military importance, and this consideration alone would warrant its introduction. On this map it would be possible, with the help of the national grid, to find quickly and easily the exact distance and azimuth of any one point from another, even should the points fall on different sheets. According to the specimen shown in the Committee's report, contours would be in brown at 5 ft. intervals, and we believe, if the detail is not overcrowded, that this scale should prove popular with the general public

It is a pity the Committee did not see its way to a complete reorganization of the map scales of Great Britain, so as to conform to modern ideas Doubtless the prejudice in favour of our peculiar form of measurement was considered to be so great that a rational system of map scales would be unacceptable.

The question of revision within a reasonable time of the existing out-of-date 1/2500 plans and their future maintenance was carefully gone into by the Committee It is considered that air photography should prove useful for this purpose, especially in a country where the surface is altering so rapidly *It is recommended that the* Government should consider the formation of a special Air Survey Unit, capable of satisfying the requirements of the Ordnance Survey Owing to the small numbers of 'photographic days' in the year in Great Britain, it would be necessary to find employment for such a unit in some other part of the Empire during the English winter months This should not be difficult, as maps and photographs are urgently required for development purposes. It would also be necessary, for the best and most economical results, to build special aircraft suitable for photographic work

An appendix deals with the proposed national projection and suggests a modified transverse Mercator projection on a central meridian 2° West as most suitable. The net effect of the adoption of this projection would be to make the scale of plans in the central portion of the country, in the vicinity of the adopted meridian, about 1/2501 (0·04 per cent) too small, and the scale of the plans in the extreme east and west coasts about 1/2499 (0·04 per cent) too large, the scale of the intermediate places varying between these limits. A slight variation in scale cannot be avoided in a representation of the curved earth's surface on a plane surface, but these amounts are within the expansion of paper due to variations of atmospheric humidity.

The following is a summary of the Committee's recommendations ·

The 1/2500 scale should be retained, and should be re-cast on national instead of county sheet lines on a national projection While this work is in progress, there should be a general overhaul of the plans to eliminate the errors which have crept into the original survey in course of revision. A national grid should be superimposed on all large-scale plans and on smaller scale maps, with certain exceptions, to provide one reference system for the maps of the whole country The international metre should be adopted as the unit on which the grid should be based, and the large-scale maps in the new national series should be square in shape The 1/2500 plans when re-published in the new national series should cover one kilometre square of country, while the one inch to the mile and smaller scales should be retained in their existing form The existing six-inch plates should be retained for printing on demand for special purposes The scale of six inches to the mile should be retained, and maps on this scale should be produced in the new National Series in a square shape and containing twenty-five 1/2500 plans A new medium scale of 1/25,000 should be tried out experimentally in certain selected areas, and, if successful, should be extended to cover the whole country in a National Series

It is also recommended that when the revision of the 1/2500 plans has been completed, further investigations should be carried out with the view of establishing whether the requirements of urban areas would not be more adequately met by a survey on the 1/1250 scale When a suitable opportunity occurs, additional contours should be introduced, and the numbering of parcels should be discontinued as soon as the national grid is introduced It is also recommended that the Ordnance Survey should continue to publish archæological maps. The existing arrangements for revising the one-inch and smaller scales should continue, but a system of continuous revision should be adopted for the large-scale plans as soon as practicable Short-term contracts to civil firms, for aerial photographs, should not be continued as a permanent policy, it is suggested that the Government should consider the formation of a special Air Survey Unit, capable of satisfying the requirements of the Ordnance Survey, as soon as practicable. The Committee also recommends that the position of the Ordnance Survey should be reviewed annually with a view to the maximum practicable recruitment, until the recommendations made have become effective, and that the work should be adequately maintained.

News and Views

R. W. Paul: Award of Duddell Medal

THE Duddell Medal of the Physical Society has been awarded to Mr. Robert W. Paul, who is known as a pioneer in two distinct industries, namely, the manufacture of electrical measuring instruments and the development of the cinematograph. Mr. Paul started on his own account as a maker of electrical instruments at 44 Hatton Garden in 1891, and with the collaboration of many of the chief electrical engineers of the day, produced a series of instruments which found their way into the majority of the electrical laboratories of the world Amongst these may be mentioned the Ayrton-Mather galvanometers, electrostatic voltmeters, etc The inductometers and other instruments designed by Albert Campbell introduced to industry instruments capable of measuring high-frequency currents to an accuracy previously unobtainable In 1903 he invented the Unipivot galvanometer with which his name has been closely associated. The simplicity, robustness and high sensitivity of this instrument appeal to all users of galvanometers, and it still remains a popular instrument. During the Great War Mr Paul assisted in the development of anti-aircraft height-finders and also of anti-submarine devices. In 1919 Mr Paul's business was incorporated with the Cambridge Scientific Instrument Co. under the title of the Cambridge and Paul Instrument Co, later changed to the Cambridge Instrument Co.

MR. PAUL is also known as one of the pioneers of the cinematograph. Next to Edison he did more to develop the 'kinematograph' or 'theatrograph', as it was then called, than any other individual. His projector was first shown in operation at an entertainment at the Finsbury Technical College in February 1896; his form of intermittent motion for feeding forward the film is still employed. For many years Mr. Paul exerted himself to improve the training of young instrument makers, and it was on his initiative that the apprentices' or learners' section was introduced into the annual exhibition of scientific instruments held by the Physical Society. Finally, in very recent years, he has turned his skill in co-operation with Sir William Bragg, to the humanitarian task of making a practicable device for continuous artificial respiration. This apparatus has already saved the lives of many sufferers from infantile paralysis.

Man and Mammoth in America

IN a preliminary statement issued by the Smithsonian Institution, Washington, Dr. F. F. H. Roberts, jun., reports that in the course of last summer, his fifth season of excavation of the camp station of Folsom man on the now famous Lindenmeier site in northern Colorado, he recovered a large number of bones of the animals which formed the food of Folsom man, together with several new types of knives and scrapers, but all unquestionably showing signs of Folsom workmanship. Bones engraved with geometrical designs were again found, but none showing any attempt at either picture writing or the representation of animal forms Associated with the implements was the tusk of a mammoth. Although remains of the mammoth have been found in association with relics of Folsom man in New Mexico, this is the first indication of its presence on the Lindenmeier site

DR. ROBERTS has also made a reconnaissance in two other regions, one near the town of Sundance in Wyoming, the other near Mortlach in Saskatchewan The first yielded a number of the so-called "Yuma' points, long, slender, but heavy projectile points, or spear-heads, which are believed to bear some relationship to the Folsom point, but no evidence of Folsom man was found. In Saskatchewan, a site in the midst of the Canadian dust bowl was investigated A few Folsom points were found, but the majority were o the Yuma type. Unfortunately, owing to the conditions of the soil, in which all heavy artefacts work down to the bottom of the deposits, no evidence o stratification was obtainable. Nevertheless this result is of considerable importance. A few scattered points have been reported from time to time on the Great Plains extension into Canada; but this is the firs concentration of these nomad hunters to be reported so far north The bearing of the find on the question of the antiquity of man in North America is at present obscure, as there is no evidence to show whether these points are a relic of the entry into America or of the period when man was following the retreat of the ice sheet. Until it is agreed whether the Yuma point is pre- or post-Folsom, it affords no guidance.

Antiquities from London for Tasmania

AT an early date Tasmania will receive from the Corporation of the City of London a gift of a number of antiquities found within the boundaries of the City This gift is made under a scheme of the Corporation for promoting in the Dominions and Dependencies an interest in the past history and culture of the central city of the Empire. The collection for Tasmania, which will be housed at Hobart, will include, according to a list given in *The Times* of December 22, some one hundred and forty objects, classified under sixty-eight headings, illustrating daily life in London throughout the centuries from Roman to medieval times. About one half of the objects belong to the Roman period. Among them are coins of eight emperors, bone pins and needles, bone and bronze spoons, knives, iron nails and wooden writing tablets. Among the pottery objects is an example of the work of Eucarpus, a lamp-maker working in London at about A.D. 100, many of whose lamps have been found. There is also a mixing bowl of about the same date, such as seems to have been in use in most Roman kitchens. It is of coarse white ware, roughened on the inside with grit. It bears the stamp of the maker—Albinus of Lyons. Samian ware, so-called, is represented by, among other pieces, three bowls and some fragments of the more elaborate decorated work. There are several of the leather soles of the Roman shoes which are frequently found in London in a good state of preservation. Pottery forms a large proportion of the medieval exhibits; but there are also examples of tradesmen's tokens, bronze 'jettons' or 'casters', used in keeping accounts and making calculations in the Middle Ages, wine bottles, and other domestic objects, including examples of the familiar clay smoking pipes of the seventeenth and eighteenth centuries.

University of Prague

DR. GUSTAV ORTNER, of the Institut für Radiumforschung, Vienna, writes in connexion with the paragraph on the future of Czechoslovakia in NATURE of October 8, p. 637, that it gives an inadequate idea of the historical development of the universities in Czechoslovakia He continues, "the University of Prague [was] founded by the German Emperor Karl IV in 1348 and so is the most ancient German university. It was only in the course of the nineteenth century that lectures in Czech were given and in 1882 an independent Czech University was separated off from it. In 1920 the ancient name of 'Karls-Universität' of the German University was transferred to the Czech University. . . ." Obviously it was not possible to go into details in a brief paragraph, but the facts were correctly given It is true that Charles IV (Karl in German, Karel in Czech) was not only king of Bohemia but Holy Roman Emperor as well, yet it was as king of Bohemia that he founded the University of Prague, and the 560th anniversary of his death was celebrated there on November 27. The Czech character of the University was emphasized by his son, Wenceslas IV, in a special decree in 1409. The University of Vienna dates from 1364, and that of Leipzig from 1409, having been founded in Saxony as a challenge to Prague at a time when Czech was used as well as Latin, which was naturally the main literary language there as everywhere at that time. Thus, the University of Prague is the oldest in Central Europe, but by its foundation it cannot be considered a German university. From 1620 until 1882 it was styled the Charles-Ferdinand University. Afterwards Prague had two universities, the Charles (Czech) and the Ferdinand, or now simply, German University. Another correspondent refers at length to a number of distinguished Prague biologists and the mathematician, Bolzano, not mentioned in the further article, in NATURE of November 26, p 942.

Mathematical Films

THERE has been a considerable increase of interest recently in the use of films for mathematical teaching. The *Mathematical Gazette* of October 1938 and the *American Mathematical Monthly* of the same month both contain reviews of such films, but the majority of the films mentioned are not available in Great Britain. Mr. B. G D. Salt, of 5 Carlingford Road, Hampstead, N W 3, sends us a list of five films that are now available and can be obtained from him. Two of these are geometrical, dealing respectively with the theorem of Pythagoras concerning right-angled triangles, and with the sum of the angles of a triangle. Two others deal with differential equations, by a method devised by Robert Fairthorne, one for the differential equation of free harmonic motion, and the other for harmonic motion when the vibrations are forced The principle for free vibrations was explained in NATURE of October 24, 1936, and that for forced vibrations is somewhat similar. These four films occupy one reel each.

THE fifth film, entitled "A Hypocyclic Motion", which shows much more than its title suggests, is sold divided into three short reels In reel 1, a rigid bar moves with its end on two fixed straight lines. The instantaneous centre of rotation traces out the body and space centrodes, and it is shown that the motion can be produced by the body centrode rolling on the space centrode In reel 2, points on the circumference of the rolling circle trace out diameters of the fixed circle, showing simple harmonic motion. The motion is also shown to be derivable by another epicyclic motion In reel 3, we have an ellipse described as in the tool known as the elliptic chuck, also Oldham's Coupling, and the four-cusped hypocycloid. Finally, the reel shows the generation of an envelope by a moving line The two geometrical films are on 16 mm. only, but the other three can be obtained on 35 mm., 16 mm , or 9·5 mm. There is still considerable doubt as to the part that films should play in mathematical education. The Mathematical Association has set up a film sub-committee to consider the subject. Anyone who has suggestions to offer, especially suggestions for specific films, should send them to Miss M. Punnett, 17 Gower Street, W C.1 Approved suggestions will then be passed on to the manufacturers.

British Bird Song Survey

THE preliminary report on the first year's record of the bird song survey in the British Isles, carried out under the auspices of the British Trust for Ornithology during August 1937–August 1938, states that some eighty observers took part and there are records of the song period of the mistle-thrush from 52 localities, the song thrush from 76, blackbird from 74, chaffinch 63, yellowhammer 35 and skylark 48 Sussex and Cheshire were well covered, but there were only two sets of records from Ireland, three from Scotland and one from Wales, and none from Cornwall, Dorset, Lincolnshire, East Yorkshire, Durham, Northumberland, Stafford, Shropshire or Hereford. 10–15 per cent of the records were very incomplete, being made over less than nine months, and scarcely a quarter of the observers lived in the country and could listen to bird song throughout the day. One observer suggests that by no means all the male birds of even these common species sing at all, so that future observations are to give close attention to this point. The cold spring no doubt reduced bird song considerably in some localities. Several of the best-filled forms came in from clergymen, but fortunately a greater list of observers has been obtained for the repeat of the survey now under progress, especially from Ireland Most parts of England are fairly well represented. A good many observations, however, have been kept by people whose weekday hours of observation are very limited, especially during the short winter days.

Agricultural Meteorology in India

IN the report of the Agricultural Meteorology Section, India Meteorological Department, for the period August 22, 1935–March 31, 1937, it is stated that after reviewing the work done during the first three years of the scheme, the Imperial Council of Agricultural Research communicated to the Government of India a resolution to the effect that the Agricultural Meteorology Section should now become one of the permanent activities of Government, and that proposals for giving effect to this resolution are now under consideration by the Government of India. Work on the experimental or biological aspects of agricultural meteorology, and the maintenance of co-operation with agricultural institutions and workers in India, have been the principal concerns of the section during the period under review, the biological work being carried on mainly at the Central Agricultural Meteorological Observatory at Poona. Among subjects of research were the invisible condensation of water vapour on the soil at Poona, made evident by the decrease during the night in clear weather of water vapour in the layers of air just above the bare ground and by the increase of surface soil moisture to a maximum just before sunrise without visible deposition of dew. It was found that of all samples of soil tested, the black cotton soil of India was, when desiccated, the most efficient absorber of moisture. Researches carried out into the cooling of the earth's surface and of the lower layers of the atmosphere at night in clear weather led to the discovery that at Poona in winter the air temperature has a minimum some distance above the ground. The radiation received from the sun and sky on unit area of a horizontal surface near the ground was measured by means of a Moll solarigraph, and from the records obtained a diagram was constructed showing the intensity of the radiation at different hours of the day in different months.

Uni-directional Lighting on Roads

THE increasing use of double carriage-way arterial roads has given new problems to the street lighting engineer. Some of these are discussed in a paper on the revealing power of street lighting installations read by J. M. Waldram to the Illuminating Engineering Society on November 8. On a double carriage-way road where each carriage-way carries traffic proceeding in one direction only, an ordinary street lantern throws much of its light in the direction where it may be doing no good, that is, in the same direction as the traffic flow. This light is not only wasted, but sometimes also does harm by lighting up vertical surfaces and reducing their contrast against the bright background of the road surface. Elimination of light sources not actively producing road brightness, should result in a great increase of comfort to the drivers. The G.E.C. Research Laboratories have evolved a system of uni-directional lighting which they have tested on the carriage-way of the Great Chertsey Road in the Twickenham area. On this road the standards exist on a double staggered formation; the height of the lantern is 25 ft. and the average spacing of the standards about 189 ft. Each lantern was equipped with a 250-watt horizontal burning lamp and was uni-directional Both visibility and revealing power were found to be very good. Driving in the opposite direction on the other carriage-way, the road lighted with back cut-off lanterns disappeared completely. Traffic moving on it could be distinguished quite easily by the vehicle lights, but apart from this the impression produced was that of driving down a single carriage-way road with no traffic in the oncoming direction. The back cut-off lanterns on the other carriage-way were completely invisible The conclusions drawn are that it is practicable to light a 'one-way' road with lanterns giving light only in the direction opposed to the traffic An installation of this nature saves 50 per cent of lamp wattage.

Loud-speaker Systems on Railways

LOUD-SPEAKER systems are being installed on an ever-increasing scale on railway platforms. A critical discussion of them by O Vogel and K. Rothe is given in the second number for 1938 of the quarterly *Review* published by Siemens and Halske. Until quite recently, orders were shouted to the shunters by the shunting foreman or optical signals were employed. But these methods had certain drawbacks Shouting was the most satisfactory, partly because it is independent of weather or illumination but mainly because it is heard by the shunters in any position. The transmission of orders by means of loud-speakers is an improvement as it ensures a uniform distribution of ample acoustical energy over the entire shunting yard, and all the requirements of safety and speed are satisfied. The old but satisfactory method of calling out times of departure in railway station waiting-rooms could never be entirely replaced by means of optical devices. The introduction of loud-speaker systems has now supplemented optical train indicators very helpfully and these devices are at the same time available for many other kinds of announcements. The authors also discuss portable loud-speaker systems suitable for race-courses, etc., where the normal traffic is small To ensure the complete success of a stationary system, it is necessary to study the local conditions in every case. In halls, waiting-rooms and corridors, difficulties are often encountered owing to echoes.

Thickness of Metal Walls

A PAPER by B. M. Thornton and Prof. W. M Thornton, upon which written discussions are to be sent to the secretary of the Institution of Mechanical Engineers before January 31, 1939, gives a method

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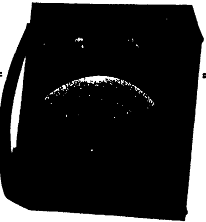

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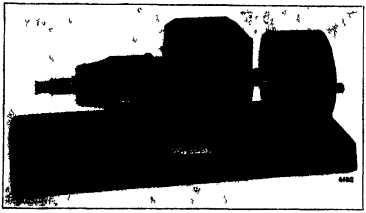

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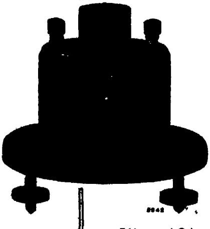

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Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Anderson, William Ballantyne. Physics for Technical Students: Sound, Electricity and Magnetism, Light. Third edition Med. 8vo. Pp. x +361–796. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15s.*

Bénézé, G. Critique de la mesure. (Actualités scientifiques et industrielles, 527) Roy. 8vo Pp. 54 (Paris · Hermann et Cie., 1937.) 12 francs *

Bowman, F. Introduction to Bessel Functions. Demy 8vo. Pp. x +135. (London, New York and Toronto · Longmans, Green and Co, Ltd, 1938.) 10s. 6d. net.*

Frank, Philipp. Exposés de philosophie scientifique. 2 Interpretations and Misinterpretations of Modern Physics. (Actualités scientifiques et industrielles, 587.) Roy. 8vo. Pp. 58. (Paris: Hermann et Cie., 1938.) 18 francs.*

Goldstein, S., Edited by. Modern Developments in Fluid Dynamics: an Account of Theory and Experiment relating to Boundary Layers, Turbulent Motion and Wakes. Composed by the Fluid Motion Panel of the Aeronautical Research Committee and Others. (Oxford Engineering Science Series) 2 vols. Roy 8vo. Vol. 1. Pp. xxiv +330 +29 plates Vol. 2. Pp. xii +331–702 + plates 30–35. (Oxford: Clarendon Press: London: Oxford University Press, 1938) 50s. net.*

Gunjikar, K. R. An Introduction to the Calculus Cr. 8vo. Pp. xiv +341. (London. Oxford University Press, 1938.) 4 rupees.*

Hardy, G. M., and Wright, E. M. An Introduction to the Theory of Numbers. Roy. 8vo. Pp. xvi +404. (Oxford · Clarendon Press, London: Oxford University Press, 1938.) 25s. net.*

Harnwell, Gaylord P. Principles of Electricity and Electromagnetism. (International Series in Physics.) Med. 8vo. Pp. xiii +619. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 30s.*

Keesom, Anna Petronella. Enkele thermische eigenschappen van vloeibaar en vast helium. Proefschrift ter verkrijging van de graad van Doctor in de Wissen Natuurkunde aan de Rijksuniversiteit te Leiden, op gezag van den Rectormagnificus, Dr. P. C. Flu, hoogleraar in de Faculteit der Geneeskunde, voor de Faculteit des Wisen Natuurkunde te verdedigen op Vrijdag 7 October 1938, des namiddags te 4 Uur. Roy. 8vo. Pp xii +96. (Leiden: Eduard Ijdo, 1938.)*

Milne-Thomson, L. M. Theoretical Hydrodynamics. Sup. Roy. 8vo. Pp. xxii +552 +4 plates. (London: Macmillan and Co., Ltd., 1938.) 31s. 6d. net.*

Shackel, R. G. Concise School Physics: Electricity and Magnetism. Cr. 8vo. Pp. viii +467–661. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 2s. 9d.*

Shackel, R. G. Concise School Physics. Complete edition. Cr. 8vo. Pp. viii +661. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 6s. 6d.*

Tolman, Richard C. The Principles of Statistical Mechanics. (International Series of Monographs on Physics.) Roy. 8vo. Pp. xix +662. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 40s. net.*

Twyman, F. Spectrochemical Analysis in 1938. A Companion Book to "Spectrochemical Abstracts, 1933–38". Roy. 8vo. Pp. 68. (London: Adam Hilger, Ltd., 1938.) 4s. 4d. net.*

Westphal, Wilhelm M. Physikalisches Praktikum: eine Sammlung von Übungsaufgaben für die physikalischen Übungen an Universitäten und Hochschulen aller Gattungen. Med. 8vo. Pp. viii +336. (Braunschweig: Friedr. Vieweg und Sohn, 1938.)*

Engineering

Anderson, J. W. Diesel Engineering: a Text-Book. Med. 8vo Pp x +269. (New York and London: McGraw-Hill Book Co, Inc., 1938) 18s.

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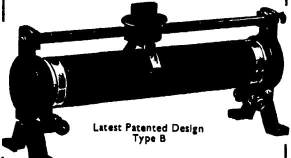

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of measuring the thickness of metal walls from one surface only by electrical means A reference was made to this device by Prof Thornton in his contribution to the discussion on non destructive testing at the Institution of Electrical Engineers on November 25 He states that there is a definite need in the engineering industry for an instrument which will determine accurately the thickness of a metal wall from one side only, especially if it is easy to operate, robust, portable, and independent of external power supply It is claimed that the instrument described in the paper fulfils all these conditions The method is essentially that of comparing the resistance of the metal wall under test with that of a similarly shaped wall of the same material, of which the thickness is known Current usually less than ten amperes is supplied by a 12 volt battery to two current contacts held against the wall and usually spaced about three inches apart The current in the circuit is adjusted by varying the rheostat or the number of cells of the small motor car battery employed until the very small potential drop indicated by the deflection of a galvanometer connected to two potential contacts reaches a predetermined fixed value The instrument was originally designed for measuring the thickness of boiler tubes, and examples are given showing that its accuracy is within a few thousandths of an inch It has been found in practice that the instrument can be used to measure the thickness of mild steel plates up to 1 25 in and of iron castings up to three inches, with the same order of accuracy It can also be used for the measurement of engine cylinder walls to detect core shift

World-Wide Survey of Education

IN this year's issue of the well known biennial official survey of education in the United States is included a sketch of the salient features of the history of education in other parts of the world in the decennium 1926–36 (Washington, D C Govt Printing Office, 1938 Pp 98 15 cents) It was an era of drastic—in some countries of revolutionary—changes In Europe, sudden changes in the direction of educational policies were effected in connexion with general revolutionary movements in Austria, Bulgaria, Germany, Portugal, Spain and the Soviet Union Pronounced but gradual changes, long planned and deliberately considered were introduced in Czechoslovakia, England, France Norway, Poland and Sweden The most conspicuous movements in Europe were in the direction of nationalization One aspect of this tendency was the ousting of private by public schools, notably exemplified in Norway and Albania, another, manifested throughout Europe, was the increasing subjection of private schools to public regulation, another, the placing of more of the support and administration of schools in the hands of national instead of local officials, yet another, the progress attempted, with varying success, towards the goal of equal educational opportunity for equal intelligence The doctrine that education is a public function has, in fact, achieved general acceptance, and States 'have been rapidly taking wider and closer control of their cultural institutions, but not always in the way that advocates of public education have desired

NATIONALIZATION in the extreme sense of subordination of all other educational aims to the purpose of promoting and perpetuating the national Government's political and economic theories and practices was established in Italy, the Soviet Union and Germany The survey briefly indicates its outstanding features and some sources of information about it Attention is directed to the fact that in the Soviet Union communistic doctrine has had a much less important place in the school curriculum since 1934 than before Other sections deal with European educational history under such headings as adult education physical education, technical and vocational education A chapter on Latin America points out that the spirit of intense nationalism so rampant in post War Europe has manifested itself there also A formulation of the purposes of the education policy of Colombia for example, contains the following We no longer speak of public instruction but of national education the state ought to educate, that is to say, form the will and heart of the youth rather than instruct by loading them down with knowledge more or less useful However the extreme type of nationalization found in Italy Germany and the Soviet Union has no counterpart in America except in Mexico, and this example is not likely to be followed we are told, in other Latin American countries Throughout these countries a very lively interest in the problems of vocational training has been aroused and developments have taken place that deserve study elsewhere

Education in Civilian Camps

A BULLETIN by H W Oxley director of civilian conservation corps camp education issued by the U S Department of the Interior (No 19 1937), describes the growth and development of camp education, particularly its achievements in vocational guidance and in recreation The programme endeavours to develop powers of self expression, self entertainment and culture, and to promote co operation, in addition to vocational instruction, attempts have been made to remove illiteracy and to correct common school deficiencies The Bulletin also includes a summary of three university studies in counselling and guidance technique in camp education, which indicate that only a beginning has been made in the camps with job and vocational instruction Most of those enrolled come from the working class, and about 12 per cent of those interviewed had received no vocational guidance Many of those enrolled regarded the camp as a transition from home to employment, and the studies indicated the necessity for much more comprehensive vocational training and more careful interviewing A further study of successful practices in the development of a co-ordinated recreational programme in these camps, in which four universities participated, is also summarized in the Bulletin This analysis of activities indicated the pressing need for adequate space, equipment and instructors, and led to a number of definite recommendations for the development of a co-ordinated programme for leisure time in C.C.C camps.

The Radio and Culture

AT the recent annual meeting of the Institut de France, Dr Georges Duhamel, the well-known writer and editor of the *Mercure de France*, deplored what he called the *constitutional defects* of the radio, which he declared has an unfavourable and even demoralizing effect on the intellectual habits of the middle classes. In the first place he asserted that the radio draws many persons away from reading by depriving them of part of their leisure and making them gradually lose the habit of active cerebral work Some people, he continued, are misled by the radio into imagining that the mind can attend to two objects at the same time, which is a mistake Far from contributing to true culture, the radio encourages a taste for superficial ideas which are easily acquired and soon lost In answer to the objection that the radio adds to without supplanting the other modes of information and knowledge, Dr. Duhamel maintained that we cannot safely disregard or decry a system of culture which has been tested for centuries in favour of a new process of which the remote results are necessarily quite unknown As regards the plea that the radio is a source of pleasure, Dr. Duhamel retorted that no pleasure can last several hours a day, and that for some people the radio ceases almost at once to be a pleasure and becomes a craving.

London School of Hygiene and Tropical Medicine

THE report for 1937–38 of the London School of Hygiene and Tropical Medicine by the dean, Prof. W. Jameson, recently issued, surveys the administrative changes and the teaching and research work of the School during the year. In the Departments of Bacteriology and Epidemiology studies have been in progress for eighteen months on the effect of diet on the fertility, survival and growth of mice, and their resistance to infection, which show that a diet containing a proportion of animal protein, compared with one containing vegetable protein only, renders individual mice more resistant to infection of *Bact. typhimurium*, and significantly reduces the mortality in herds in which the disease is spreading by natural contact. In the Department of Entomology much work has been done on the biology of mosquitoes, the bed bug, lice and other parasites, and an important investigation continued on the spread of mineral oils on water in relation to anti-malarial work by destruction of mosquito larvæ In the Department of Bacteriology studies have been continued upon the isolation of the antigenic components from various bacteria, and their value as immunizing agents. The physiological problems of air raids precautions, in particular gas-proof clothing, helminthic parasites of domestic animals, and problems connected with the root eelworm disease of potatoes, are a few of the other subjects that are under investigation. The Ross Institute of Tropical Hygiene reports upon its anti-malarial work in various Colonies, Yugoslavia and South America.

Malaria in Albania

IN an inaugural thesis (*Thèse de Paris*, No. 548, 1938), F. L. Richards states that malaria is the most prevalent disease in Albania, especially in the low-lying regions, where it is closely associated with the presence of lakes, marshes and other places inundated by the mountain water courses. It is more or less endemic in villages near streams and their affluents. Most of the patients under treatment in the hospitals are suffering from this complaint, which in some parts of the country affects 50 per cent of the population. All clinical forms of the disease are found, malignant tertian being the commonest. In addition to its high incidence in the civilian population, malaria is the most frequent disease in the Albanian army Its prevalence is highest in June, July, August and September, and sometimes there is a rapid rise in the number of cases in October; but August and September are the months in which the disease is most intense. The death-rate is higher in children than in adults. The spread of the disease is favoured by the unhygienic habits of the Albanian people and is therefore most pronounced among the poor. At the suggestion of the King of Albania, a five-year plan has recently been introduced for combating the disease

Microscopy for the Chemist

A RECENT article by Prof Alois Herzog (*Zeiss Nach*, 2, Hefte 5 and 6, 1938) is based upon the value of the microscope to the chemist for qualitative analytical determinations with minimal amounts of material A number of simple methods is described involving the use of sublimation, distillation, precipitation, drying, crystallization, spot reactions, and other procedures with or without the addition of specified reagents, whereby crystals and other deposits having characteristic microscopical appearances are obtained, which serve to identify various metals and metallic and other salts, etc. Screens (sieves), animal and vegetable fibres, and miscellaneous inorganic substances like asbestos, and the use of the polarizing microscope are also briefly described. The article is illustrated with 97 excellent photomicrographs of the appearances obtained in the reactions, and full details are given as to how the objects were photographed, namely the camera, objective and ocular used, the illumination and the time of exposure.

Physics in Crime Detection

THE Physics Forum of the November issue of the *Review of Scientific Instruments* is devoted to an account of the use made of physics in the detection of crime in the United States. It is written by J. Edgar Hoover, of the Federal Bureau of Investigation of the Department of Justice. Although the author refers to the use of radio in rapidly communicating information, the account is mainly concerned with optical methods the microscope for the identification of hair, shreds of clothing or other small particles, for the examination of minute markings on bullets so as to identify the weapon used or the markings on a cut window bar to identify the bolt cutter used and with the addition of polarizing prisms the identification of soil stains on shoes or clothing The spectroscope is used for identification of stains of all kinds ultra violet light for the identification of materials by their fluorescence for the detection of erasures in documents or for reading documents written in secret ink invisible in ordinary light X rays are used for the examination of suspected parcels without opening them and infra red light for reading obliterated writing or printing on paper and other materials

Manganese Ores

IN view of the great importance of manganese ores in modern steel manufacture much interest is attached to a small book by Dr A W Groves on Manganese (Second Edition Imperial Institute 1938 3*s* 6*d* net) It is one of the series of monographs on mineral production Ores occur in many lands but large scale production is confined to the Soviet Union, India the Gold Coast the Union of South Africa, Brazil Egypt and Cuba It is noteworthy that with the exception of the Soviet Union and to a small extent the United States all great steel producing countries have to rely upon imports from distant lands for their supplies of manganese These ores are thus one of the most essential constituents of ocean trade The book gives details of occurrence and production in all lands where the ore has been found and ends with a long bibliography

The Night Sky in January

THE moon is full on January 5 and new on January 20 Lunar conjunctions with the planets occur as follows on January 14 with Mars on January 16 with Venus on January 23 with Jupiter and with Saturn on January 26 Mercury Venus and Mars are morning stars Mercury is at greatest western elongation (23°) on January 3 and Venus reaches greatest western elongation (47°) on January 30 Venus rising shortly before $4\frac{1}{2}^{h}$ U T is pre eminently the bright and morning star Jupiter southing in the early afternoon is conspicuous in the evening sky Saturn is due south shortly after 18^{h} on January 1 The bright stars of the constellation of Orion and its associated constellations are passing the southern meridian about 22^{h} in mid January The Quadrantids radiating from Draco may be looked for about January 2 On January 1, an occultation of the planet Uranus (mag 6 0) takes place, at Greenwich the disappearance occurs at $17^{h}\ 0\ 1^{m}$ at position angle 51° from the north point of the moon's image On January 26, δ Piscium ($4\ 6^{m}$) is occulted at $17^{h}\ 1\ 2^{m}$, and on January 30, ϵ Tauri ($3\ 6^{m}$) at $19^{h}\ 39\ 2^{m}$, the respective position angles at disappearance being 12° and 83° from the north point

Announcements

PROF ERWIN SCHRODINGER has been appointed by the Fondation Francqui as a visiting professor for the next six months to a Chaire Francqui in the University of Ghent Belgium His address is Laboratory of Physics Plateaustraat 22 Gand Belgium

M EDMOND ROTHÉ director of the Institute for the Physics of the Earth University of Strasbourg, has been elected a *correspondant* for the Section of Astronomy of the Paris Academy of Sciences in succession to the late Prof P Stroobant

DR ERROL IVOR WHITE has been appointed deputy keeper in the Department of Geology of the British Museum (Natural History) with effect from December 21 and Mr Frederick Allan Bannister has been appointed deputy keeper in the Department of Mineralogy with effect from December 31 Dr White entered the Museum as an assistant in 1922 He took the degree of D Sc in 1935 and throughout his service at the Museum has specialized on the fossil fishes, upon which he is a recognized authority Mr Bannister entered the Museum in 1927 as an assistant keeper and has specialized in the analysis of mineral structure by means of X rays in the development of which method he has taken a leading part

THE annual meeting of the Mathematical Association will be held in King's College Strand London W C 2 on January 2 3 under the presidency of Mr W Hope Jones The subject of Mr Hope Jones's address will be Simplicity and Truthfulness in Arithmetic Discussions on the teaching of applied mathematics in technical colleges and on the second report on the teaching of geometry have been arranged and papers by Prof W L Bragg on the symmetry of patterns and by Lord Stamp on education and statistical method in business have been promised Further information can be obtained from Mr G I Parsons Peckwater Eastcote Road Pinner Middlesex

THE Government of Cuba has decided to devote a million dollars to the campaign against tuberculosis

A CEREMONY in commemoration of the biologist and physician Lazzaro Spallanzani (1729 1799) will be held at Padua next spring at the same time as the International Congress of Experimental Biology which will be under the patronage of the Italian Academy

THE Alvarenga do Piauhy (Brazil) Prize for 1939 which is worth about 200 dollars, will be awarded by the College of Physicians of Philadelphia in July next for the best memorial or the best unpublished essay on any branch of medicine Recent publications brought to the attention of the committee before May 1, 1939, will receive attention Further information can be had from the Committee for the Alvarenga Prize, 19 South Twenty second Street, Philadelphia U S A

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1163.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Methæmalbumin (Pseudo-methæmoglobin)

IN a previous communication[1], I suggested the name pseudo-methæmoglobin for a new blood pigment, formerly confused with methæmoglobin, which Fairley and Bromfield[2] had found in the plasma of blackwater fever cases. Serial quantitative observations based on the degree of dilution necessary for the extinction of the α bands of pseudo-methæmoglobin and oxyhæmoglobin indicated that pseudo-methæmoglobin was derived from extracorpuscular oxyhæmoglobin. Since then we have demonstrated the same pigment in nocturnal hæmoglobinuria, incompatible transfusion[3] and pancreatic cyst fluid[4]. Foy and Kondi[5] made a spectrographic analysis of this pigment, and confirmed its incidence in blackwater fever in Macedonia.

Experimental Observations. It had long been recognized that, on incubation, solutions of hæmoglobin yielded methæmoglobin and later hæmatin, but our experiments showed that when oxyhæmoglobin was incubated at 40° C. for 24–72 hours in the presence of human plasma, pseudo-methæmoglobin was produced. Similarly, when alkaline hæmatin, prepared from purified hæmin, was added to human plasma or serum, pseudo-methæmoglobin immediately appeared. This suggested that hæmatin was coupling with some protein or other nitrogenous constituent of the plasma to form a new compound. Unpublished investigations last year, undertaken to determine the nature of this unknown plasma constituent, yielded negative results with crystallized horse albumin and with pseudoglobulin and euglobulin fractions of human serum supplied by Dr. Muriel Adair. Further experiments then unexpectedly revealed that only human and simian plasma contained the constituent coupling with hæmatin to form pseudo-methæmoglobin; the plasma of ten other species of mammals gave negative results.

In the light of these later findings, further investigations have recently been made by R. J. Bromfield and me with serum protein fractions prepared by Dr. C. Rimington from man and monkeys (*Macacus rhesus*). Alkaline hæmatin uniformly produced pseudo-methæmoglobin only with the albumin fractions and never with the pseudoglobulin or euglobulin fractions. The different proteins contained in the albumin fraction from human serum, that is, crystalbumin, globoglycoid and seroglycoid, prepared by Dr. L. F. Hewitt, were next tested. Only crystalbumin proved capable of forming pseudo-methæmoglobin. Finally, when 12·5 mgm. of alkaline hæmatin per kilo were injected intravenously into monkeys (*Macacus rhesus*), pseudo-methæmoglobin was immediately formed; similar injections failed to produce it in rabbits.

Spectrum of the Synthesized Pigment. On the Hartridge reversion spectroscope, the α band of synthesized pseudo-methæmoglobin (6230 A.) is colinear with that of pseudo-methæmoglobin produced in intravascular hæmolysis or by incubation, and is not far removed from that of methæmoglobin (6300 A.). In addition, there is a general diffuse absorption commencing in the green about 5485 A. and extending towards the short-wave end of the spectrum. This corresponds with what has been observed in occasional specimens of hæmoglobin-free plasma derived from cases of blackwater fever and nocturnal hæmoglobinuria.

In intravascular hæmolysis, pseudo-methæmoglobin is generally associated with free oxyhæmoglobin, the α and β bands of which approximate to the β and γ bands of methæmoglobin: a composite spectrum results with α, β and γ bands somewhat resembling methæmoglobin. This probably explains why, since Hoppe-Seyler's discovery of methæmoglobin in 1865, pseudo-methæmoglobin has remained unrecognized by the clinical pathologist.

Chemical and Physical Behaviour. There are, however, easily demonstrable differences between the two pigments. Stokes's reagent, ammonium sulphide (10 per cent), sodium fluoride, hydrazine hydrate (50 per cent) and hydrogen peroxide (10 vol.) immediately disperse the α band of methæmoglobin, whereas that of pseudo-methæmoglobin persists with the first three reagents and is only gradually dispersed with the last two. In the presence of sodium hydrosulphite, methæmoglobin forms reduced hæmoglobin, whereas pseudo-methæmoglobin forms a hæmalbumin compound which, on further treatment with sodium hydroxide, produces an albumin-hæmochromogen indistinguishable on the Hartridge reversion spectroscope from globin-proto-hæmochromogen. When pseudo-methæmoglobin is treated with sodium hydrosulphite and coal gas, a carboxy-hæmalbumin compound is formed very similar spectroscopically to carboxy-hæmoglobin.

Other properties of synthesized pseudo-methæmoglobin and of that occurring in blackwater fever serum were reported on by Dr. A. S. McFarlane as follows: "In blackwater serum or in the human albumin-hæmatin mixture the pseudo-methæmoglobin sediments in the ultra-centrifuge at the same rate as serum albumin. The human albumin-hæmatin mixture in the cataphoresis tube shows a homogeneous pseudo-methæmoglobin boundary migrating at a slightly different rate from serum albumin. There is present a small amount of unchanged serum albumin. These facts indicate a firm union of albumin and hæmatin which probably involves chemical linkage."

The data available indicate that pseudo-methæmoglobin is modelled on the methæmoglobin pattern, but that while the prosthetic group is similar, the protein component is native serum albumin instead of native globin. The iron is held in the trivalent state, and is even more resistant to reducing agents than methæmoglobin itself. In view of these findings, I propose, as suggested to me by Dr. Rimington, to change the name of pseudo-methæmoglobin to methæmalbumin.

Physiological Significance Methæmalbumin is never found within the corpuscles, and cannot function as a respiratory pigment It is derived from circulating extracorpuscular hæmoglobin liberated during intravascular hæmolysis, or from blood which has escaped into cysts or other cavities Evidently during the extracellular katabolism of extra corpuscular hæmoglobin hæmatin is formed and in man and monkeys this unites with serum albumin to produce methæmalbumin, the molecular size of which renders it impermeable to the kidney For this reason, it never appears in the urine

The finding that only human and simian albumin combine with alkaline hæmatin to form methæm albumin reveals a hitherto unsuspected chemical difference between these serum albumins and those of other mammals

N HAMILTON FAIRLEY

Hospital for Tropical Diseases
London W C 1
Dec 7

[1] Fairley N H NATURE 130 588 (1937)

[2] Fairley N H and Bromfield R J *Trans Roy Soc Trop Med and Hyg* **28** 307 (1934)

[3] Fairley N H and Bromfield R J *Trans Roy Soc Trop Med and Hyg* **31** 139 (1937)

[4] Fairley N H and Bromfield R J *Trans Roy Soc Trop Med and Hyg* **31** 372 (1938)

[5] Foy H and Kondi A *Trans Roy Soc Trop Med and Hyg* **32** 49 (1938)

[6] Hoppe Seyler F Handbuch der physiologisch und pathologisch chemischen Analyse 2 Auflage 205 (1865)

Production of Artificial Hibernation

As I have shown previously[1,2,3], the serum magnesium of the hedgehog is increased during hibernation and regular sleep, while calcium remains nearly constant While serum magnesium reaches its maximum during the deepest hibernation, the adrenaline of the adrenals and the blood sugar simultaneously show their lowest seasonal values[4,5]

When magnesium injections (1 mol $MgCl_2$) were given subcutaneously to hedgehogs in autumn the animals went into the cold blooded state became very limp and insensible, and the depth and rate of their respiratory movements diminished When the animals under magnesium anæsthesia received a calcium injection (1 mol $CaCl_2$) they returned rapidly to the warm blooded state At the same time, sensibility, muscle tone and motility returned 1 mol sodium chloride solution caused no appreciable change in the animals

Table 1 shows that the magnesium caused also a considerable rise in blood sugar and in the adrenaline of the adrenals After the animals had been revived by means of calcium, adrenaline and blood sugar had fallen again

TABLE 1

	Blood sugar (mgm %)	Adrenaline (mgm %)	Serum	
			Mg (mgm %)	Ca (mgm %)
Normal hedgehogs	125	86	3 2	10 0
After Mg injection	286	100	25 4	11 0
After Mg and Ca injections	138	45	17 3	23 9

The amount of injected magnesium is unnaturally large, but the intention was to give so much magnesium that the body temperature would fall to a level corresponding to that found in hibernation

Typical features of hibernation are the transformation of a warm blooded animal into a cold blooded animal, increase in serum magnesium, hypoglycæmia, and decrease in the adrenaline of adrenals Magnesium injections caused the hedgehogs to go into the cold blooded state, but produced hyperglycæmia and an increase in the adrenaline Therefore to other animals insulin was given subcutaneously with magnesium

These animals also went into the cold blooded state, resembling, in contrast to those which had received only magnesium, very closely naturally hibernating animals Sensibility and muscle tone were preserved The animals were rolled up in the natural manner, and continued sleeping until they were sacrificed for analyses

In Table 2 the results of these experiments are given

TABLE 2

	Blood sugar (mgm %)	Adrenaline (mgm %)	Serum	
			Mg (mgm %)	Ca (mgm %)
Normal hedgehogs	1	86	3	10 0
Artificial hibernation (Mg and insulin)	44		9	1 2
Natural deep hibernation	49	40	6 0	11 9

The results show that blood sugar and the adrenaline of the adrenals in artificial hibernation were approximately the same as in natural hibernation Particular attention is directed to the fact that blood sugar always adjusted itself to approximately the same level as that found in natural hibernation although the amounts of injected insulin varied within a wide range (1 10) Similar amounts of insulin given without magnesium caused fatal hypoglycæmia

PAAVO SUOMALAINEN

Biochemical Institute
Helsinki
Nov 1

[1] NATURE **141** 471 (1938)

[2] *Suomen Kemistilehti* B **11** 25 (1938)

[3] *Suomen Kemistilehti* B **11** 29 (1938)

[4] *Ann Acad Sc Fennicæ* A **45** (1935)

[5] *Biochem Z* **295** 145 (1938)

Anti-Encephalomalacia Activity of *dl*-α-Tocopherol

RECENT work on K avitaminosis in chicks offered an opportunity of studying the nutritional encephalomalacia of growing chicks receiving certain supplements to their basal diet Some groups of chicks were kept on diet 108 of Pappenheimer and Goettsch[1] On this diet the animals developed the symptoms as described by these authors We have now studied the effect of the addition of certain vegetable products, as it was our intention to carry out an elaborate fractionation of these materials along with the search for vitamin K In the meantime, synthetic *dl* α tocopherol prepared after the method of Karrer *et al*[2] was made available*, and we therefore tested the effectiveness of this substance directly against the disease Daily doses of the substance increasing proportionally to the weight of the animals in quantities of 0 0075 mgm per gm body weight per day completely protected the chicks against encephalomalacia

In an earlier experiment in which another basal diet containing less fat was used, we had already noted that the growth of the chicks was stimulated by the same substance This latter observation is in accordance with the findings of H M Evans, G A Emersom and O H Emerson[3] in experiments with rats

Several authors agree that there are two forms of the anti encephalomalacia factor, namely a fat soluble and a water soluble form The above observations show that the fat soluble form is either identical with, or may be substituted by the synthetic vitamin E It should further be possible to standardize vitamin E in fats by means of the anti encephalomalacia activity

Biochemical Institute, { HENRIK DAM / JOHANNES GLAVIND
Psychiatric Laboratory, { OLE BERNTH / ERIK HAGENS
University of Copenhagen
Nov 29

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[*] By courtesy of F Hoffmann La Roche & Co Basel

[1] Pappenheimer A M and Goettsch M *J Exp Med* **53** 11 (1931)

[2] Karrer P *et al* *Helv chim Acta* **21** 520 (1938)

[3] Evans H M, Emersom G A and Emerson O H *Proc Soc Exp Biol and Med* **38** 197 (1938)

The "Du Noüy Phenomenon"

SOME years ago, du Nouy discovered the very interesting fact that blood serum is able to maintain its normal surface tension When a surface active substance like sodium oleate is brought on the surface of a serum solution, the surface tension is lowered for a very short time, but in a few minutes regains its original value (whereas the decrease of surface tension of water is a persistent phenomenon)

Du Nouy believed this phenomenon to be due to the adsorption of oleate on the surface of the large protein molecules, the oleate molecules being thus eliminated from the surface of the liquid The action of other strongly surface active substances, such as sodium taurocholate and glycocholate, is equally well neutralized by the serum molecules To quote du Nouy, it explains why the liberation of these substances in the circulation does not carry with it a fatal haemolysis of the red cells—in the case of jaundice, for instance—although present in sufficient quantities to lower considerably the surface tension of an equal volume of saline solution The antagonistic action of the plasma proteins counteracts the effect of the excess of bile salts and owing to this phenomenon of defence, the surface tension of the blood is not lowered to a dangerous degree [1]

This interpretation is now generally accepted, and the description of the 'du Nouy phenomenon appears in many text books and reviews on surface phenomena of biological fluids (Brinkman[2], Herčík[3], and others)

In the course of our experiments, we met with direct evidence that the capacity of the blood serum to neutralize the action of such substances as sodium oleate has little to do with colloidal adsorption If we prepare an ultrafiltrate of diluted serum, the fluid, although deprived of colloids, preserves its former capacity to neutralize the action of oleate On the other hand, if, instead of ultrafiltration, we precipitate the calcium ions of the serum by addition of some oxalate, the capacity of such an 'oxalated serum' to neutralize oleate is greatly depressed Finally, we used a pure solution of calcium chloride containing as little as 1 0 or 0 5 mgm per cent calcium, which roughly corresponds to the calcium content of 1 in 10 to 1 in 20 serum dilutions The neutralizing capacity of such calcium chloride solutions did not differ markedly from that of the above serum concentrations

We thus arrive at the conclusion that the neutralization of oleate (and probably also of bile salts) is not a colloidal but rather a salt effect, which is chiefly due to the calcium ions of the serum

A detailed description of these experiments will be published elsewhere

D RUBINSTEIN

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du Noüy Surface Equilibria of Biological and Organic Colloids (New York 1926)

Brinkman, R Aberhalden s Handbuch der biolog Arbeitsmethoden IV 4 1417 (1927)

[3] Herčík F Oberflächenspannung in der Biologie und Medizin (Dresden Leipzig 1934)

Crystalline Vitamin B_6 (Adermin)

ANALYSES of vitamin B_6 (adermin), isolated in a crystalline state from yeast by Kuhn and Wendt[1] from rice polishings by Keresztesy and Stevens[2] and by Ichiba and Michi[3], established its empirical formula as $C_8H_{11}O_3NCl$ It seems, however, that vitamin B_6 was prepared so long ago as 1932, though its physiological importance was not recognized In a paper by Ohdake[4] dealing with oryzanin (vitamin B_1 from rice polishings) a by product, obtained from the so called basic silver fraction ($pH = 6\ 8–9\ 0$) is described and the formula $C_8H_{10}O_3N\ HCl$ assigned to it.

Considering the properties of the substance, the presence of trivalent carbon or quadrivalent nitrogen is very unlikely, so the total number of hydrogen atoms should be either 10 or 12, instead of 11, calculated from the analyses If twelve atoms of hydrogen are present, the empirical formula of adermin results and, if one compares the properties stated* ('long, colourless plates, easily soluble in water, less in alcohol, not in acetone, benzene, ether etc , melting point 204–205°, uncorrected (decomposition), strong Pauly's reaction , precipitated by phosphotungstic acid") with those reported for adermin, the resemblance becomes very clear

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[*] The original paper being no longer accessible to me these data have been translated back into English from a note in Dutch

Kuhn R and Wendt G *Ber* **71** 1118 (1938)

[2] Keresztesy, J C and Stevens J R *J Amer Chem Soc* **60** 1267 (1938)

[3] Ichiba A and Michi K *Sci Pap Inst Phys Chem Res* (*Tokyo*) **34** 623 (1938)

[4] Ohdake S., *Bull Agric Chem Soc Japan* 1932

Rigidity in Protein Films, and the Properties of the Force-Area Curves

PROTEINS when spread upon aqueous solutions at sufficiently low surface concentrations exhibit the mechanical properties of two dimensional liquids A change of state occurs upon compression, the film acquiring marked rigidity in the plane of the surface , upon the slender basis of an analogy with the behaviour of proteins in bulk, the film in this rigid condition has been called a 'gel'[1] A consequence of this rigidity is that whereas in the liquid film any change in pressure can be transmitted through a small aperture dividing the film into two portions, this should be no longer possible in the case of the solid film, and the presence of a constriction will result in an uneven distribution of pressures and surface concentrations We have observed such effects in protein films divided by slits of various widths and have also noted in the liquid solid transition region a phenomenon resembling thixotropy

Since considerable pressure differences in films of egg albumin can be maintained indefinitely across a slit 100 mm wide, it seemed possible that even in the absence of a slit, frictional drag at the sides of the trough during compression might cause the film to become heterogeneous , thus the stresses recorded by a surface balance situated at the end of the trough remote from the compressing barrier would not correspond to an homogeneous strain and the resulting force area diagrams would be in error

That such conditions exist in highly compressed films is clearly demonstrated by the following experiment Talcum powder is sprinkled in a narrow thread across the liquid protein film at right angles to the direction of compression Upon compression of the film, the line of powder at first moves uniformly, and continues to do so up to pressures considerably above those at which the slit phenomena referred to above are to be observed , finally, however at pressures of 25–30 dynes/cm , a differential movement becomes apparent, so that the powder near the sides of the trough drags behind that in the centre If the compressed film is left undisturbed the distribution of powder likewise remains unchanged

A direct test of the magnitude of the errors occasioned by this property at various degrees of compression therefore seemed desirable Accordingly, after the force area curve for an ovalbumin film had been recorded in the usual way, the surface was divided into two or three equal parts by means of one or two brass strips (conditioned with ferric stearate) extending from the surface balance to the other end of the trough Thus the area of the film was practically unchanged, while the length of wall in contact with it was in one case doubled, in the other trebled For ovalbumin spread upon 0 01 or 0 10 M hydrochloric acid, the force area curves taken under these conditions were identical, to within 0 1 dynes/cm , with those taken in absence of the longitudinal strips

We conclude that, of the various mechanical properties of ovalbumin films indicated by the character of the force area diagrams, none can be attributed to experimental artefacts arising from the rigidity of the film

An account of these mechanical properties will be published elsewhere

J B **Bateman**
L A **Chambers**
Eldridge Reeves Johnson Foundation
University of Pennsylvania,
Philadelphia Nov 22

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[1] Hughes and Rideal *Proc Roy Soc* A **137** 70 (1932)

The Lorentz 'Polarization' Correction and the Behaviour of Radio Echoes from the Ionosphere at Frequencies near the Gyro-frequency

In a recent communication[1], we presented certain experimental observations of the reflection of medium radio waves from the ionosphere These results were interpreted as indicating that the Lorentz 'polarization' correction was zero in the ionosphere This conclusion has since been criticized by Appleton, Farmer and Ratcliffe[2] (AFR), and by Booker and Berkner[3] (BB) These two groups of workers advance interpretations of the experimental observations which besides being widely different from ours differ widely themselves

In our communication we showed that for radio frequencies somewhat below the magneto ionic gyro frequency f_H, two echoes were returned from the F_2 region of the ionosphere The echo of shorter delay we identified as the ordinary magneto ionic component The second echo was interpreted, not as the usual extra ordinary component, but as a second component produced by reflection deep in the F_2 region, at the second reflection level of the ordinary component We were led to this interpretation after detailed quantitative consideration of the time retardation and intensity of this echo, which were seriously inconsistent with its interpretation as extra ordinary

AFR suggest that this upper echo is simply the 'extra ordinary component which has been retarded in regions E_1 E_2 and the lower part of F_2 and they point out that penetration into the upper part of F_2 past the first reflection level of the ordinary component is most improbable On the other hand the experimental results of BB show conclusively that the abnormal retardation of this echo is not produced between the E and the F regions Moreover observations which we have made on 440 occasions during the past six months show that the polarization of this echo is a complex mixture and has not the characteristics of the simple extra ordinary component found on higher frequencies

BB, avoiding some of the difficulties encountered on AFR s viewpoint, suggest that the retardation occurs because of lateral deviation in the lower part of the E region Since infinite retardation is found to occur at 1 38 Mc /s in Washington, while the gyro frequency f_H is 1 53 Mc /s at this level they adopt the Lorentz dispersion formula, which gives infinite deviation (and therefore infinite retardation) at the Lorentz frequency f_λ (1 27 Mc /s) In order to reconcile the discrepancy still remaining they postulate the existence of approximately 2×10^6 heavy ions per c c thus bringing f_λ to the observed frequency of 1 38 Mc /s

The accompanying table shows the values of f_H and f_λ at various heights above Washington and Sydney

CALCULATED GYRO AND LORENTZ FREQUENCIES AT VARIOUS HEIGHTS ABOVE WASHINGTON AND SYDNEY

Level	f_H Washington	f_H Sydney	f_λ Washington	f_λ Sydney
Ground	1 61	1 63	1 34	1 48
100 km	1 53*	1 55*	1 2	1 41
200 km	1 4	1 49	1 2	1 35
300 km	1 41	1 43	1 1	1 30
340 km	1 38	1 40	1 1	1 2

We have observed, in Sydney, the frequency at which infinite retardation of the echo in question occurs This happens at a frequency of 1 40 Mc /s , which is very nearly equal to f_λ at a height of 100 km If BB's views are correct, there must therefore be a negligible number of heavy ions at this height above Sydney

It seems to us unlikely that such an enormous difference should obtain between the ionic densities above Sydney and Washington

From our own point of view, the retardation occurs high in the F_2 region, reflection occurring at the reflection level of the second ordinary component Infinite retardation is experienced when $f = f_H \cos\theta$, where θ is the angle between the earth's magnetic field and the direction of propagation. On the wave passing the first reflection point of the ordinary component, however, $\theta \rightarrow 0$ and infinite retardation occurs when $f = f_H$.

The frequencies of infinite retardation experimentally observed at Washington and Sydney are therefore simply explained as being the values of f_H at equal heights (340 km) above these two places Penetration of the wave to these great heights is rendered possible by the fact that it travels *along* the magnetic field, in which direction no barrier exists. If our view be accepted, then the Sellmeyer, and not the Lorentz, dispersion formula is to be applied in the ionosphere, in agreement with Darwin's[4] theoretical conclusion

This work, which will be fully described elsewhere, is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research.

D. F. MARTYN.
G H. MUNRO

University of Sydney
Nov. 17.

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[1] Martyn and Munro, NATURE, **141**, 159–161 (1938)

[2] Appleton, Farmer and Ratcliffe, NATURE, **141**, 409–410 (1938)

[3] Booker and Berkner, NATURE, **141**, 562–563 (1938)

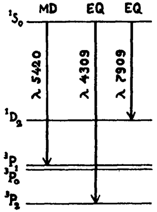
[4] Darwin, *Proc Roy Soc* , A, **146**, 17–46 (1934)

'Forbidden' Lines in the Te I Spectrum

A FEW years ago, one of us developed a method of obtaining the emission of 'forbidden' atomic spectral lines of various metals These lines have appeared in the spectrum of high-frequency electrodeless discharges in the mixtures of a small quantity of a given metallic vapour with some inert gases such as argon or helium This method of excitation being applied to lead vapour led to the experimental proof of the existence of the magnetic dipole radiation.[1]

In the spectrum of tellurium under the same excitation conditions, on a very strong background of Te-bands only faint traces of the 'forbidden' atomic magnetic dipole line λ 5420 were found[2]. In our present experiments the main effort was to increase the dissociation of tellurium molecules. Satisfactory results were obtained when tellurium vapour of the density corresponding to that of the saturated vapour at 350°–400° C was heated to about 900° C The forbidden line λ 5420 A. (${}^3P_1 - {}^1S_0$) appeared even in the case of pure tellurium vapour When argon or helium was admitted to the tellurium vapour the intensity of this line became considerably larger with increasing density of the added gas Two other 'forbidden' Te I lines, λ 4309 A (${}^3P_2 - {}^1S_0$) and λ 7909 A. (${}^1D_2 - {}^1S_0$), were also found. These lines are much weaker as compared with λ 5420 and appear in the mixtures of tellurium vapour with inert gases only, argon being in this respect much more effective than helium.

The accompanying diagram represents the energy levels of the neutral tellurium atom belonging to the same lowest electron configuration $5s^2\,5p^4$. All these energy-levels, except the ground-level ${}^3P_2$, are metastable and no spontaneous transitions between them accompanying the normal electric dipole radiation may occur in accordance to the Laporte selection rule Transitions corresponding to the emission of the obtained 'forbidden' Te I lines are indicated by arrows The measured wave-lengths of those lines are in complete agreement with those calculated from the known values of spectral terms.



The transitions corresponding to these 'forbidden' lines are to be considered as spontaneous ones since the lack of any sufficiently strong external or intermolecular electric fields excludes the possibility of electrically perturbed transitions Taking into account the selection rules for the quantum numbers *J* and *L* for the electric quadrupole and magnetic dipole radiations, the line λ 5420 (${}^3P_1 - {}^1S_0$) is to be regarded as due to the pure magnetic dipole radiation, and the lines λ 4309 (${}^3P_2 - {}^1S_0$) and λ 7909 (${}^1D_2 - {}^1S_0$) as due to the pure electric quadrupole radiation.

A more detailed account of these experiments will be published later

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Nov. 15.

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[1] Niewodniczański, H , *Acta phys Pol* , **2**, 375 (1933) , **3**, 285 (1934) , *Phys Rev* , **44**, 854 (1933) , *C R* , **198**, 2159 (1934)

[2] Niewodniczański, H , abstract in the programme of the Seventh Congress of Polish Physicists, Cracow, p 26 (1934)

Atomic Absorption Coefficients and Transition Probabilities

THREE recent letters raise the question as to whether there is any experimental basis for applying Kramers' equation for continuous absorption to astrophysical problems[1]. Ditchburn cites the anomalous phenomena shown by alkalis at the absorption series limits as the only direct experimental evidence. A series of papers[2] by me on the emission spectra of cæsium vapour gives direct evidence as to the transition probabilities for the continuous spectra and line spectra of the levels 6 *P* and 5 *D* The first paper indicated that the probability of recombination depended on the pressure but subsequent work showed this to be erroneous, and the last paper (published after the appearance of Ditchburn's letter) shows that the continuous transition probabilities remain nearly constant with electron concentrations ranging from 10^{13} to 10^{16} per cm³ and with pressures from 0·001 mm to 17 mm of mercury

By the principle of detailed balance, the continuous atomic absorption coefficients at the series limits can be derived The values are $3·6 \times 10^{-17}$ at the 6 *P* limit and roughly 3×10^{-17} at the 5 *D* limit while Gaunt's[3] theoretical equation for hydrogen with frequencies effective quantum numbers and weights appropriate to cæsium gives $2·5 \times 10^{-17}$ and $3·7 \times 10^{-17}$ There is no reason to expect exact agreement here

As concerns astrophysical applications the discharge conditions of pressure and electron concentration cover the range of conditions to be expected in stellar atmospheres but not of course, in nebulæ Line transition probabilities in the *F* and *D* series also have nearly hydrogenic values but values for the S series are abnormally low Page has assumed that the intensity of hydrogen emission lines measures the rate at which electrons recombine into the excited states while Menzel suggests that interactions between atoms electrons etc will give a temperature distribution of excited states Experiments on the cæsium discharge show a temperature distribution at pressures above 0·1 mm but not at low pressure It is very desirable to obtain more experimental data on transition probabilities in hydrogen but conclusive experiments require measurement of the concentration of excited or ionized states as well as of the intensity of the radiation

FRED L MOHLER

National Bureau of Standards
Washington D C
Nov 17

Page T L NATURE **141** 1137 (1938) Menzel, D H NATURE **142** 433 (1938) Ditchburn R W NATURE **142** 756 (1938)

[2] *Bur Stand J Research* **10** 771 (1933) *J Research Nat Bur Stand* **16** 227 (1936) **17** 45 and 845 (1936) **21** 697 (1938)

[3] *Proc Roy Soc* A **126** 654 (1930)

Electrolytic 'Polishing' of Zinc

IT has been pointed out to us by Prof C O Bannister and Mr P G McCarthy, University of Liverpool, that the current/voltage relationships shown by the curve given in our previous communication[1] do not apply to conditions in which the electrical energy is obtained directly from a suitable low tension supply, as distinct from the potentiometer type' of circuit used in our work We have confirmed that with electrolyte and electrodes as previously described, the use of a 12 volt storage battery (with adjustable series resistance) gives a curve precisely similar to that obtained by Hedges[2] for the anodic polarization of zinc in 8 per cent solution of sodium hydroxide Up to a critical value in the neighbourhood of 1 volt, the potential difference across the bath terminals may be progressively increased, with an accompanying rapid increase in current density, as in our original experiments The fall in current density beyond this point, however, is now accompanied by a sudden rise in potential to about 4 volts, no intermediate values being obtainable Polishing of the zinc anode may still be effected, but only at the higher potentials, with simultaneous evolution of oxygen Polishing at lower (controllable) potentials without gas evolution, occurs only under conditions which give rise to the characteristic curve previously recorded, and this, we now find, is dependent on the use of the potentiometer arrangement, the advantages of which, in this type of work, are confirmed

In our original experiments a 60 ohm adjustable rheostat in a 240 volt D C circuit was used as a potentiometer from which the current supplied to the bath was taken Lower tension supplies may however, be employed provided that the potentiometer resistance is reduced accordingly, for example we have obtained precisely similar curves using a 12 volt battery with a 4 ohm potentiometer resistance The criterion is that the resistance of that section of the potentiometer in parallel with the cell shall be small in comparison with the cell resistance

Under these conditions, relatively large increases in cell resistance due to anodic polarization have a negligible effect on the resistance of the joint system and hence on the potential difference across the cell terminals, that is this potential difference is controlled by the particular fraction of the potentiometer resistance in the joint circuit Any increase in cell resistance is accompanied however by an immediate fall in the current (in our experiments this marks the commencement of the polishing range) which thus affords a sensitive indication of changes taking place within the cell On the other hand if the potentiometer tapping resistance is high compared with the cell resistance the potential difference across the terminals is controlled by the cell resistance itself the net result being similar to that which obtains for the low tension source of current with series resistance that is, the arrangement does not permit the cell voltage to be controlled externally throughout the range investigated Using the arrangement previously described the characteristic curve has now been established both for high purity zinc (more than 99·99 per cent zinc) and for zinc containing 1 per cent lead The cathode may be either zinc or copper but should preferably have about ten times the area of the anode

We are indebted to Prof Bannister and Mr McCarthy for directing our attention to the possible alternative current/voltage curve which we have discussed above and also for their concurrence in the publication of this further note

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Dec 15

NATURE **142** 477 (1938)

[2] *J Chem Soc* 2581 (1926)

The N'Goureyma Meteoric Iron

A UNIQUE type of meteoric iron fell at N Goureyma French West Africa, on June 15, 1900 It fills the 65th group of Brezina's classification[1], 65 *Breccia like Octahedrite N Goureyma group*, Obzg Molten and drawn out Iron of the Zacatecas group Brezina defined Zacatecas as 64 *Breccia like Octahedrite Zacatecas group*, Obz Octahedral nuggets breccia like with globes of Troilite

N Goureyma was described by E Cohen[2] with excellent photographs of the very remarkable external sculpturing of the iron I desire to refer to Cohen's suggestion, which appears to have been generally accepted that the iron 'in consequence of its very flat form, softened throughout its mass perhaps to the melting point, as it entered the atmosphere' In support of this he adduces "a large number of phenomena which, up to the present, have never been observed in any other iron ' Among these he gives "the fluid arrangement of the troilite—forming an arrangement closely resembling the fluid structure of terrestrial rocks; the lack of an alteration zone; the unusually varied and in part bizarre relief of the anterior surface", etc

I have recently polished and etched a full-sized transverse section of this iron It shows an alteration zone which varies in thickness from up to 2 mm. at the ridges to ½ mm. or less at the hollows of the surface. This alteration zone can be duplicated, for example, in the iron which fell at Rembang, Java, on August 30, 1919, the interior of which is a normal octahedrite. There appears to be no valid reason for the assumption that the internal structure of N'Goureyma is due to softening or melting in its flight through our atmosphere, or for regarding it as an exception to the general rule that such heat effects are confined to a shallow skin and that the interior remains cold during the fall In the case of meteorite craters, as at Henbury[3] and Kaalijärv[4], fragments of the crater meteorites are found remarkably distorted in their internal structure by heat and shock, but this effect is attributed not to friction in the air, but to the momentum of exceptionally large and fast meteorites being sufficient for them to reach the ground with much of their cosmic velocity unimpaired, the sudden stop resulting in a great rise of temperature throughout the mass No such effect is suggested in the case of N'Goureyma.

There remain two possible explanations of the structure of this meteorite. The first, and most probable, is that it is due to plastic flow within a cosmic body approaching planetary dimensions of which the meteorite is a fragment The other is that, in course of its wanderings, an iron of Zacatecas type approached near enough to the sun to be softened and drawn out Such an explanation has been suggested by Dr L J Spencer[5] for the 'metabolite' structure of Murnpeowie, but that meteorite does not show the unique 'drawn-out' structure of N'Goureyma, which it is difficult to visualize as a heat effect in free space.

R. BEDFORD.

Kyancutta Museum,
South Australia.
Nov. 12

[1] Brezina, A, *Proc Amer Phil Soc*, Philadelphia, **43**, 245 (1904)
[2] Cohen, E, *Amer J Sci*, [iv], **15**, 258 (1903)
[3] Spencer, L J, *Min Mag*, **23**, 387 (1933)
[4] Spencer, L J, *Min Mag*, **25**, 75 (1938)
[5] Spencer, L J, *Min Mag*, **24**, 13 (1935)

Formation of Widmanstätten Figures in Meteorites

IN a recent communication[1], Prof. E. A. Owen advances a theory to account for the Widmanstätten figures in meteorites He suggests that the meteorite is heated to a high temperature in its passage through the earth's atmosphere and is then suddenly cooled on coming to rest in the earth and that in consequence a distorted body-centred lattice, in metastable equilibrium at ordinary temperatures, is produced. He supposes further that the Widmanstätten figures grow by "prolonged annealing" at ordinary temperatures in the earth.

It is, however, generally accepted that a meteorite will not be heated appreciably, except near its surface, in the very brief period during which it traverses the earth's atmosphere, most of the heat and liquefied and vaporized portions of the surface being carried off by the air itself. This conclusion rests upon the well-known observation that in an octahedrite it is only near the surface ("the burnt zone") that the Widmanstätten figures are much broken down and confused. The same effect can easily be produced artificially by heating a piece of 'normal' meteoric iron

The most direct evidence for this contention is provided by such meteorites as Cabin Creek and Charlotte. Both of these were seen to fall and, when examined afterwards, both exhibited normal Widmanstätten figures surrounded by the usual burnt zone.

It may, therefore, be concluded that the heating produced by passage through the earth's atmosphere is insufficient to affect the structure of the meteorite beyond a depth which does not generally exceed half an inch, and that the Widmanstätten structure is one which existed in the body before it traversed our atmosphere.

In view of these facts, Prof. Owen's theory appears untenable

We hope shortly to publish the results of some extensive studies of the constituents of meteoric iron which we have made, using thermo-magnetic micrographic and X-ray methods, and to discuss their significance.

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J. YOUNG

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Dec 7

[1] NATURE, **142**, 999 (1938)

Relationship between Household Income and Food Expenditure

SINCE publishing the results of a study of the consumer-demand for milk among 300 poor working class families in Leeds[1], an analysis has been made of data relating to household income and food expenditure collected during investigation. 'Household income' refers to the money the housewife had for housekeeping purposes and not the total earnings of the members of the household. 'Food expenditure represents the expenditure on all foodstuffs, including groceries, meat, vegetables, milk and similar goods

The average household income was £1 16*s*. 11*d* per week, and the average household food expenditure was 19*s*. 1*d*, or 9*s* 9*d*. and 5*s* 1*d*. per head per week respectively. The regression equation connecting income (V) and food expenditure (F) was derived to determine if the relationship between the two factors was linear or curvilinear. The coefficient of income[2] (V^2) was not significant and the equation became

$$F = 0\cdot62V - 3\cdot83.$$

The correlation coefficient R_{FV} was 0 92. Thus there is a close linear interdependence between income and food expenditure among families examined. and on the average for every 1*s*. change in income food expenditure changed 7½*d*. The partial correlation coefficient $R_{FV\cdot XY}$ connecting income (V) with food expenditure (F) after eliminating changes in the number of adults (X) and children (Y) in the families was 0·85, which indicates that in households of constant constitution there is a close relationship between the factors under consideration.

The conclusion drawn from this analysis is that among the families examined a change in income (according to the definition adopted) is reflected by a proportionate change in food expenditure

E R BRANSBY

National Milk Publicity Council,
14 Blenheim Terrace,
Leeds 2 Dec 7

Bransby E R *Medical Officer* **60** Nos 7 and 12

A Comprehensive Fundamental Electrical Formula

THE equation given by Dr C V Drysdale in NATURE of December 3 presents a useful picture in electrical concepts of the forces acting respectively upon stationary and moving electric charges By incorporating permeability in the term for the velocity of electric wave propagation, he avoids, if he does not annihilate, magnetic notions In the second term of his equation, the force is seen to depend not on the *difference* of the velocities, V and V', of the charges, but on their *product* This suggests that the force is determined by velocities solely with respect to a basic medium There is still hope therefore of immortality for Maxwell and for that "glorious work of fine intelligence", the ether

ROLLO APPLEYARD

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Dec 9

A Visual Phenomenon

THE interesting visual phenomenon described by Mr Dartnall in NATURE recently[1] was observed by Helmholtz many years ago[2] The effect—the appearance of a purple after image in a patch of light alternating at a frequency just below the critical frequency—no doubt arises from the differential rate of development of after images of different colour, but some observers whom I tested a year or two ago were unable to see the phenomenon at least under conditions when it could be readily observed by myself and others I then found that those who could not see the effect were those who gave a delayed type of recovery curve after light adaptation[3] as recorded by the binocular matching method

The number of observers tested was insufficient to make the correlation absolutely certain, but the relation may prove of further interest in connecting adaptation processes with after image phenomena, and the effect might prove of practical value in distinguishing one type of observer from another

W D WRIGHT

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Dec 16

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[1] NATURE **142** 1000 (1938)

[2] v Helmholtz, H Physiological Optics **2** [illegible] (Edn by Optical Society of America 1924)

[3] Wright W D Perception of Light (Blackie and Son 1938)

Points from Foregoing Letters

DR N HAMILTON FAIRLEY reports the synthesis of pseudo methæmoglobin from alkaline hæmatin and native serum albumin derived from man and monkeys, and renames the pigment methæmalbumin This pigment has not been found within the blood corpuscles and cannot function as a respiratory pigment It is not excreted by the kidneys, apparently owing to its large molecular size

Injection of magnesium given subcutaneously to hedgehogs in autumn produces, according to Dr Paavo Soumalainen, a cold blooded state similar to hibernation, but also increases the amount of adrenaline and sugar in the blood By injecting insulin at the same time, the formation of excess sugar is prevented and a state almost identical to hibernation is induced

Synthetic vitamin E (*dl* α-tocopherol) in doses of 0 0075 mgm per gm body weight per day protects chicks against encephalomalacia (a deficiency disease brought about by feeding chicks on a special diet), according to experiments by Dr. H Dam, J Glavind, O Bernth and E Hagens

The ability of the serum to counteract the surface tension lowering effect of sodium oleate and similar substances (du Nouy phenomenon) is due, according to Prof D Rubinstein, to the presence of calcium ions and not to proteins, as generally assumed

Experiments carried out by J B Bateman and Dr L. A. Chambers with surface films of egg albumin on dilute hydrochloric acid, with various ratios of wall to surface, show that the drag-effect of the walls which, it was thought, might account for some of the rigidity effects observed does not in fact appreciably influence the force area diagrams

Dr D F Martyn and G H Munro discuss criticisms by Appleton, Farmer and Ratcliffe, and Berkner and Booker, of their former conclusion that the Lorentz 'polarization' term is zero in the ionosphere They advance further experimental facts in support of their point of view

The 'forbidden' lines 5420, 4309 and 7909 A in the Te I spectrum have been obtained by Prof H Niewodniczański and F Lipiński by heating tellurium vapour of suitable concentration to 900° C, especially in presence of argon or helium The measured wave lengths agree with those calculated from the known values of spectral terms

Measurements of transition probabilities in the cæsium discharge for transitions giving rise to the continuous spectrum in the visible region have been made by Dr F L Mohler over a wide range of conditions Values of the transition probabilities and of the continuous absorption coefficients seem to be independent of pressure and electron concentration, and the numerical values are similar to the theoretical values for hydrogen

Dr W H J Vernon and E G Stroud point out that the characteristic current/voltage curve obtained in their process for the anodic 'polishing' of zinc depends on the use of a potentiometer arrangement for the supply of current to the bath A possible alternative form of curve is discussed

Research Items

Recent Discovery and the Upper Palæolithic

Dr Dorothy A E Garrod has pointed out the need for re orientation and revision in the study of the cultures of the Upper Palæolithic in the light of archæological discoveries of the last twelve years, more especially as a result of research outside Europe (*Proc Prehist Soc* N S 4, 1, 1938) The traditional classification based upon evidence mainly French must now give way to a classification based upon the three cultural elements of primary importance manifested in the hand axe industries, flake industries, and blade industries of which the first two run back as far as we can see, while we are beginning to realize that the origin of the third may have to be sought much farther back than we have suspected In Europe the blade industries appear after the extinction of Neanderthal man and the arrival of *Homo sapiens* though in certain areas industries of Mousterian tradition linger on into Upper Palæolithic times Reviewing recent evidence from France Spain Italy, North and South Germany, Moravia Rumania, South Russia Transcaucasia Palestine, Egypt North Africa and Africa as a whole, a theoretical picture is presented in which the Chatelperronian the earliest identifiable phylum of the blade cultures, emerges in some as yet unidentified centre in Lower Palæolithic times Ultimately it sends out two branches one to East Africa and one to north east Europe, which develops into the Gravettian Meanwhile another stock, the Aurignacian, pushes westward and separates into two great provinces From the Aurignacian and Gravettian centres, migration moves into central and eastern Europe along the southern edge of the ice sheet, until at the extreme limit of this journey we get the characteristic French sequence At the close of the Pleistocene, migration on a large scale comes to an end, and numerous local variations grow up all over the palæolithic world

Iron Deficiency in Pregnant Rats

H L Alt (*Amer J Dis Child*, 56, 975, 1938) made a study of female albino rats which were fed with an exclusive diet of whole milk powder and subjected to one or two pregnancies He found that a single pregnancy did not cause anæmia but resulted in a marked depletion of the iron content of the liver, while a second pregnancy caused moderate anæmia due to deficiency in iron The first litter of female rats with mild iron deficiency had normal hæmoglobin values at birth, but there was a considerable reduction in the total iron content The second litter of rats on a diet deficient in iron showed a decrease in the hæmoglobin content of the blood at birth, and the total iron content of these animals was reduced to one fourth the normal On the other hand, supplements of iron to the milk powder diet completely protected the mother and offspring against iron deficiency

Vitamin C in Pregnancy and Lactation

H M Teel, B S Burke and R Draper (*Amer J Dis Child*, 56, 1004, 1938) have found that the amount of ascorbic acid in plasma from the umbilical cord blood of infants at birth was two to four or more times greater than that in maternal plasma taken at the time of delivery, and that plasma from the umbilical vein contained slightly more ascorbic acid than that from the umbilical artery They have come to the conclusion that the maternal need for vitamin C was considerably increased during pregnancy and that the fœtus *in utero* acted parasitically on the mother as regards vitamin C T H Ingalls R Draper and H M Teel (*ibid*, 1011) made a study of the vitamin C content of the breast milk and of maternal and infant blood plasma during the nursing period, with the following results Fresh breast milk from mothers on the usual diet of a maternity ward contained an average of 4 5 mgm of ascorbic acid per 100 c c during the first two weeks of lactation and the breast fed babies of such mothers received an average of 28 mgm of ascorbic acid daily When a liberal amount of vitamin C was added to the mother s diet, the ascorbic acid content of the breast milk increased to 7 3 mgm per 100 c c, and the babies of such mothers received an average of 46 mgm of ascorbic acid daily The breast milk of mothers who sold their excess supply contained an average of 3 7 mgm of ascorbic acid which decreased to 0 3 mgm after pasteurization and marketing so that the infant fed on pasteurized human milk received an inadequate supply of vitamin C unless he was given an additional amount of the vitamin

Development of the Vertebrate Head

Edward Phelps Allis Jun, is well known to morphologists for his researches, extending over many years, on the structure of the vertebrate head, and he now sets forth his views on the development of the prechordal portion (*J Anat*, July 1938) His article includes a consideration of the Plagiostomi Holocephali, Cyclostomata, and Ganoidei, and proposes to consider the Teleostei Dipnoi and Amphibia It is suggested that possibly in all vertebrates the polar cartilage is the pharyngeal element of the mandibular branchial bar, while the trabecular and palatine cartilages are the dorsal and ventral halves of the premandibular branchial bar which develops in the mandibular process In the chondrocranium the ethmoidal region is in the main derived from premandibular branchial rays The septum nasi in the Elasmobranchs always contains a cavity which is the ventral part of the embryonic cavum internasale The hypophysis is developed in relation to a fold actual or implicit that lies approximately between the cranial and visceral ectodermal surfaces The internal opening of the fold lies opposite the hind end of the infundibulum, and the external opening lies opposite the pre optic recess

A Population Study of an Australian Earth Mite

Pamphlet No 84 of the Australian Council for Scientific and Industrial Research has recently been issued under the title "A Population Study of the Red legged Earth Mite (*Halotydeus destructor*) in Western Australia', by Mr K R Norris The mite is a notable pest of clover pastures in the west While it can be controlled on a small scale, as, for example in market gardens, by spraying, this method cannot be applied economically on grazing land Here help must be sought chiefly from methods of altering the environment of the mite, such as by changing the composition of the pasture, or by introducing a natural enemy The foundation for work of this type is an accurate knowledge of the relationship of the mite to its environment, and of the conditions which influence its abundance Appreciating this position, the University of Western Australia appointed two Hackett students to make a careful study of the biology of the pest The present pamphlet constitutes the results of the field investigations which were carried out The work is now being continued by the Council, which is being assisted by a committee representative of the University of Western Australia, the Department of Agriculture of Western Australia, and of itself Mr Norris shows that three generations of the mite occur during a year at Guildford, Western Australia It does not occur during the summer, but pastures are attacked in the autumn, winter and spring, especially severe damage being done in the first named season The mites are carried over the summer in the egg stage In the search for limiting factors which influence the abundance or scarcity of the mite, very few have been found to be of direct significance The mite appears, *in fact*, to be limited in the main by the amount of vegetation available—predators and parasites, it seems, play little or no part at all

Apple Storage

THE work of Kidd and West has demonstrated that it is bad practice to store apples of differing degrees of ripeness in the same store, since the ethylene produced by ripe fruit shortens the storage life of unripe fruit The same authors have now shown (*J Pomol and Hort Sci*, 16, 274, 1938) that lenticel spots may be produced on apples of a given variety by storing with ripe fruit of a different variety Similar lots of Bramley's Seedling, Edward VII, or Laxton's Superb apples in the pre climacteric condition were placed in store on October 4 with either Worcester Pearmain or James Grieve fruits The latter varieties were yellow, ripe and greasy and definitely past the climacteric peak Gas mixtures of either (*a*) air or (*b*) 10 per cent carbon dioxide, 10 per cent oxygen and 80 per cent nitrogen were passed through the chambers Control chambers contained the ripe and unripe fruits stored separately. When the fruits were examined on January 31, severe lenticel spotting had occurred on the Laxton's and Bramley's stored with the ripe varieties, but no spotting occurred on the Edward s nor on the now over ripe Worcester's and Grieve's Identical spotting was produced on gas stored Bramley s and Laxton's by adding 1 part in 500 of ethylene to the storage atmosphere for three weeks Ethylene also hastened the ripening of the gas stored fruits, but the ripe Worcester's and Grieve's had no such effect It is suggested that the concentration of ethylene produced by the ripe fruit was lower than that of the pure ethylene added, whilst a further possibility is that the ripe apples produced a volatile substance which delayed ripening

Earthquake in the East Indies

IN co-operation with Science Service and the Jesuit Seismological Association, the U S Coast and Geodetic Survey have made a preliminary determination of the epicentre of the earthquake of October 20 from records received at Fordham, Honolulu, Georgetown, Weston, San Juan, Apia, College (Alaska), Phu Lien, Manila, Pasadena, Chicago, Burlington, Philadelphia and Euancayo The epicentre is determined provisionally as near lat 10° S, long 123° E This is just to the north of the Island of Rotti, in the Suva Sea, and a little to the west of south of the epicentre of October 10 The time of origin of the later shock is estimated to be 2h 19 3m G C T, and the depth of focus normal No damage has been reported from this part of the world though this is probably because the epicentre was submarine and the nearest land very sparsely inhabited

Gas Works Effluents and Ammonia

IN the past, Great Britain has suffered greatly in loss of amenities and beauty of landscape from want of forethought in the disposal of trade wastes and liquid and gaseous effluents Industrialists have been too ready to assume, and the State and the public too ready to concede, the impossibility of preventing or remedying a nuisance arising from manufacturing processes Each industry should be expected to take every possible step to prevent its operations from becoming a nuisance Dr Key s recent book ('Gas Works Effluents and Ammonia", Institution of Gas Engineers, pp 150, 5s net) records how the British gas industry has faced just such a problem In 1926, on the initiative of the president, Mr C F Botley, the Institution of Gas Engineers began a study of the problem of disposing of ammoniacal liquor and the effluent resulting from its treatment This problem had been rendered more acute by the fall in the value of ammonia and the change in the composition of gas liquor following changes in the process of gas manufacture The Research Committees of the Institution have spent £13,000, and many gas undertakings have in addition spent large sums The results have been brought together in this book and show that the problem is by no means so formidable as was supposed, provided that rational and scientific control is applied in practice Dr Key s work touches upon all aspects It gives in a concise form just the information which the practical man will need and will certainly find a welcome wherever coal is carbonized It records an example which other industries might well follow

Production of Negative Ions

THE production of negative ions by the impact of positive ions on metal surfaces has been observed It has been suggested that positive ions may capture two electrons from the metal R H Sloane and R Press (*Proc Roy Soc*, A, 168 284; 1938) have investigated the positive ions produced by bombardment of the negative electrodes in a hot cathode discharge in mercury vapour The ions were analysed in a magnetic field and found to be mainly the relatively light ions CO^-, $C_2H_2^-$ They are probably formed by the sputtering of occluded films The ions apparently leave the metal with appreciable velocities, since they have energies greater than could be imparted to them in the electric field Special experiments were done to eliminate the possibility that these energies were acquired from unsuspected electrical oscillations In further experiments, a double mass spectrograph was set up, a metal plate was bombarded with known ions (Hg^+ Hg^{++}) and the negative ions emitted were analysed and found to be CO^-, $C_2H_2^-$ There seems to be no doubt that a metal surface bombarded by ions of one kind can emit ions of another kind The existence of the Hg^- ion, formed by electron capture, seems to be still in doubt

Transition Stages between Order and Disorder in Condensed Phases

ONE necessary stage in the learning of physical chemistry is that in which the crystalline state is represented as one of perfect order—one molecule to each lattice point only disturbed by the thermal motion a quivering of the structure as a whole—and the liquid and gaseous states as entirely disorderly the equation of van der Waals being used to demonstrate that a disorderly assembly of molecules can undergo a two phase condensation This was the stage which the education of physical chemists as a whole had reached a few years ago but now the gradual accumulation of new knowledge about the detailed molecular structure of condensed matter is forcing us to learn lessons of which such pioneers as Boltzmann and Mie were in principle aware by the turn of the century They had perceived already in particular from specific heats and densities that molecules in a liquid must undergo very much the same motions as in the solid state Now we are learning that there may be a great deal of order in the liquid and a great deal of disorder in the crystalline state, and it is even by no means so obvious as once it seemed that liquid and crystalline solid *must* form two sharply distinct phases

This is the state of knowledge which makes most opportune the German Bunsen Society's second discussion meeting which was organized by Prof C Wagner at Darmstadt on October 28 29 The main purpose which this meeting served was to bring together very fully and systematically all the methods by which the molecular structure of condensed matter can be investigated and the results in respect of departure from the crude classical picture which have been obtained

Any of the following sorts of disorder may occur in the crystal (1) unlike atoms especially if not *too* unlike can exchange places, (2) lattice spaces may be unoccupied, (3) molecules (atoms, ions) may be present at wrong sites (interlattice spaces), (4) molecules or ionic groups may be wrongly oriented or may rotate

(1) is a common occurrence in alloys In such cases for example β brass there is at low temperatures a superlattice of orderly alternation of copper and zinc atoms which becomes increasingly disordered on heating and finally vanishes in a transition of second order to a random distribution while the ground structure, disregarding the differences between copper and zinc atoms remains substantially unaltered Borelius brought together a great deal of experimental data on these place change transitions in alloys which have aroused revived interest since Bragg and Williams offered an explanation of them The basic principle of this explanation is that a small amount of disorder weakens the potential maintaining the structure so that each further step towards increasing disorder becomes easier and easier, a fact which reveals itself in a continuously accelerating rate of change with rising temperature, and a high and rising specific heat which drops abruptly when the disorder is completed This is known as a co-operative change

A number of very sensitive optical electrical, and photo electric methods of investigating small amounts of disorder in ionic crystals have been developed by Pohl and his collaborators one of these the measurement of electrolytic conductivity in the solid has been recently applied by Wagner to give quantitative determinations of the disorder present following a theoretical attack on the problem in conjunction with Schottky This is particularly sensitive to (2) a vacant ionic space behaves as a mobile ion of the opposite charge To obtain additional information he purposely produces vacancies by adding impurity of another ionic type for example $CdCl_2$ to AgCl Vacant spaces may be formed spontaneously in something like vapour concentration ions of both signs being missing in greater concentration as the accompaniment of (3) that is when some ions are displaced in the crystal in almost any concentration when impurities of another ionic type are added or when ions of variable valency are present or finally in stoichiometric amount when the numbers of lattice points for cations and anions is not in the same ratio as the numbers of ions Usually the large anions form a substantially perfect simple lattice while the cations form a more disordered one in the interstices For example in silver bromide the bromine ions form a cubical close packed lattice At room temperature all but about one in a thousand of the silver ions occupy a similar lattice in the octahedral interstices of this one but by 400° C (the melting point is 416° C) no less than 16 per cent of them are displaced into the smaller tetrahedral interstices α AgI provides a more extreme case in this the anions form a looser body centred cubic structure and the silver ions are distributed practically at random over forty two possible sites in each unit cell—in fact they may well be regarded as forming a positively charged liquid permeating the anionic crystal, and they give rise to a very large electrolytic conductivity which is practically unaffected when the crystal melts Such gross disorder as the latter is of course accessible to X ray investigation, and this method has produced a multiplicity of examples, much more complex than these simple ones and of a variety which would soon have become overwhelming without the newly devised systematic classification used by Laves in reporting on this field

Following these two accounts of experimental results, their theoretical background in statistical mechanics was painted in by Schottky, with his usual meticulous attention to fundamental detail But even so there remain many difficulties to be disposed of in this complex field of theory Schottky and Laves suggested that a complete description can be given in terms of the extent of occupation of a number of interpenetrating partial lattices, but Debye in discussion indicated that it is also necessary to consider how the occupation of any particular point in one partial lattice influences the probability of occupation of neighbouring points in that and others This is of course implicit in the theory of co operative changes, which Schottky presented in Kirkwood's approximation

After these sorts of disorder characteristic of rystals composed of monatomic elementary particles we come to another, (4) above, which only enters where independent covalently bound groups of atoms are present here we find a characteristic group of phenomena which may be confidently attributed to rotation or not fully determinate orientation of those groups within the crystal Where polar molecules are present we find large dielectric constants Pauling predicted this for HCl in 1930, and its confirmation enforced the acceptance of a hypothesis which had been received very sceptically when first proposed by Simon to account for specific heat anomalies, but it was certainly a shock to all preconceived notions when Yager and Morgan found that the dielectric constant of molten camphor does not alter when it freezes only dropping to a low value in a transition 120° below the melting point in spite of the size and rigidity of the molecule In many cases we find specific heats considerably exceeding the values of similar monatomic substances (for example NH_4Cl compared with NaCl) The onset of rotation as temperature rises is commonly marked by a range over which the specific heat rises o very large values to produce a λ point transition —this is the characteristic sign of a co operative ffect it means that the rotation of a few molecules reduces the potential hindering the rotation of others and the theory of it is essentially the same as that of the co operative place change transitions in alloys

The word rotation, incidentally, should be interpreted rather cautiously for in many respects the same properties result if each molecule has a choice between two or more possible orientations The actual extent to which the rotation is hindered must vary very widely from case to case For polar molecules it can be actually determined when dielectric dispersion or absorption is observed, and may be declared to be low when it is not Rough estimates can also be made from the specific heat urves, if the necessary data to reduce these to constant volume are available Usually they are not, nd to meet this Eucken made bold use of empirical rules in preparing what was in the outcome a very instructive review of the changes in specific heat which accompany rotational transitions It may e presumed that the empirical rules are least reliable recisely in the interesting regions where there are arge co operative structural contributions to the pecific heat, but this does not weaken the conclusion that in many cases something like free rotation is ttained The X ray method is unable to give much nformation for the smaller molecules with only one eavy atom, but reveals rotation of paraffin chains s Pauling pointed out in his first paper on this ubject, and has recently been applied by Hassel o cyclo hexanol and its derivatives It will be interesting to see the result of an X ray study of amphor

The discussion of disorder arising in the crystal was completed by Gerlach s report on the ferro magnetic Curie point, the prototype of co operative second order transformations, and a brief account sent by Scherrer of the behaviour of Rochelle salt, its dielectric analogue

The rest of the discussion was devoted to the complementary case of the order which is present in substances which are not crystals, that is, in liquids, rystalline liquids, glasses and rubber Debye was hiefly concerned to explain all the known lines of ttack by which we can discover the extent of the quasi crystalline structure present in liquids The specific heat at constant volume of monatomic liquids indicates that the atoms possess considerable potential energy not very different from that in the solid The fine structure of the Rayleigh line in scattered light reveals the same Light is only scattered from irregularities of density in the body having the same scale as its wave length Hence the molecular structure has no influence but the scattering irregularities are thos produced by the thermal motion In a crystal it is known that the close coupling of the motions of neighbouring molecules causes these motions to take the form of trains of sound waves and the observed scattered light is reflected from these wave trains according to the Bragg reflection law A doublet structure results as a Doppler effect from wave trains going in opposite directions It was at one time supposed that the liquid gave a triplet structure owing to its intermediary state between gas and crystal but it appears that this is only a secondary result of the large difference between C_p and C_v in most liquids in water at 4° Ramm found only a doublet There is however an appreciable broadening of the component lines which as Zernike remarked indicates that the wave trains are shorter in the liquid, showing higher damping

The damping of supersonic waves in liquids can be directly measured and is found to be much larger than can be explained by the viscosity and thermal conduction It can be explained if part of the compressibility of the liquid involves molecular rearrangement having a relaxation time of the order of magnitude 10^{-10} sec This method has not been properly exploited yet The newest and best method of measurement again uses the diffraction of light in this case from artificially produced wave trains

To find the structure on a molecular scale we must use radiations of much shorter wave length The blurred rings in the X ray diffraction pattern of liquids discovered by Debye and Scherrer and given their full interpretation by Prins and Zernike tell us the average value of the product $\delta_1 \delta_2$ for any desired value of r, where δ_1 and δ_2 are the deviations from the average electron density at any two points a distance r apart from one another Though this does not suffice to give us a complete unambiguous picture of the structure, it tells us a great deal about it and allows us to reject false proposals We find that the arrangement of atoms in liquid mercury is more nearly crystalline than random rather like a bag of marbles and that long shaped molecules favour parallel positions, like a bag of nails Along any line drawn in imagination through the substance we shall find a regular fluctuation in density, with much the average amplitude and period in the liquid as in the crystal the great difference is that this periodic fluctuation is coherent over great distances in the crystal, but only over short distances in the liquid

When dipole molecules are present, we can again use the dielectric properties to gain information about the freedom of orientation of molecules the dielectric constant of a dipole liquid is often much less than it would be if the molecules exerted no influence on each other s orientation Although the Debye theory of hindering potential is doubtless not general enough, and must give place to some such description as Onsager s, it directed attention to this source of information and provided the first quantitative treatment sufficient to rule out any suggestion that the molecules in a liquid rotate freely, unhindered by their neighbours The structure is quasi crystalline with regard to orientation as well as to translation

In the concluding reports Kast dealt with anisotropic liquids, Jenckel with glasses and Wittstadt with rubber The transformation of such a liquid as *p* azoxyanisole to the nematic state, at which we know from the optical properties that some 30 per cent of the rod shaped molecules suddenly become roughly parallel to one another over fairly wide regions while the X ray scattering diagram scarcely alters and the fluidity actually increases, is probably one of the simplest of all transitions of a quasi crystalline to a crystalline state Kast s presentation of the facts was very favourable to Frank s theoretical description of the change Jenckel concerned himself mainly with the transformation point of glasses This is the temperature at which the viscosity becomes so high (about 10^{13}) that molecular rearrangement no longer takes place in times compatible with human patience Below this temperature the coefficient of expansion and the specific heat are much smaller It is chiefly interesting in the present connexion for showing that molecular rearrangement in the liquid contributes largely to these properties above that temperature Rubber provides a superb example of the way in which the various lines of attack described above, thermal, Röntgenographic dielectric and statistical mechanical, have been applied to the elucidation of a peculiarly complex case The presence together of Kuhn, Meyer and Thiessen ensured a lively discussion

Prof Wagner and the Bunsen Gesellschaft are to be congratulated on the success of this, the second *Diskussionstagung* which it has organized after the Faraday Society model, circulating all main contributions in full beforehand F C FRANK

Science and the Army

AT the Science Museum, South Kensington, there has been arranged a special War Office Exhibition which for a period of three months, gives visitors an opportunity of acquainting themselves with the numerous points at which science comes into contact with the work of the British Army It will probably surprise many to learn that, at the several training centres for boys who enter at fourteen years of age, technical instruction, both practical and theoretical, is given which compares favourably with that obtained by the average apprentice in civil life At the Military College of Science, Woolwich this reaches its highest development in the training for the grade of artificer, Royal Artillery, the course for which extends over five years and produces men of high technical skill Mechanization accounts for a great increase in the engineering requirements of Army services, and the extent of this will be realized from the exhibits showing the preparations for the driving and maintenance of transport vehicles and tanks and for the repairs carried out in the heavy workshops operated by the Royal Engineers and Royal Army Service Corps The high stage of development reached in the signals and wireless services is demonstrated and here, to a large extent, the apparatus has to be specially designed for the conditions of use in the field, though, so far as possible, commercial forms are adopted

In certain branches, it will be seen that the Army has been leading the way, and this is notably the case in the making of maps The exhibit shows that the War Office, breaking away from the Continental practice, has developed a comparatively simple method of aerial surveying, and the various stages of making the types of maps which can be produced in the field are illustrated The manifold services of the Royal Engineers can be seen in exhibits of different kinds of bridges made and used in war, and in examples of demolitions, water supply arrangements with well sinking and distribution, and such work as the drainage schemes carried out in conjunction with Royal Army Medical Corps anti-malarial measures at places like Singapore Medical science is represented by models of field disinfectors, water purifiers and the latest type of small cooker for use in tanks

In the Air Defence Section some highly scientific exhibits are to be seen The sound locator is based on the principle of human hearing whereby when waves of sound reach the ear, the head is turned until they come equally to each ear So, the locator is turned until its trumpets, one pair for bearing and one pair for elevation, give the position of the source of the sound The Vickers predictor is, in a like sense, a pair of mechanical eyes In addition to ranging its target, it gives the bearing, the elevation and the right fuse setting making allowance for trajectory curve, wind, and even for variation in barometric pressure in the upper air Its information is transmitted electrically to dials on the guns, and all that the men on the gun have to do is to keep mechanical pointers in line with the electrical pointers

Research in Army matters is much more coordinated than it is in civil affairs Development in one direction has immediate repercussions in others —if, for example, a gun of higher rate of fire is visualized, questions as to ammunition, supplies and possibly man power will have to be dealt with—and consequently the research organization is very broadly based as the exhibition will show A most interesting exhibit is the R D Camera which films shells as they are actually fired The Ballistic Section also shows the Brown Hall photographic lorry which enables this filming to be done in the field and the cascade thyratron which measures bullet velocities when 'bursts' are fired The Chemical Research Branch at Porton and the Experimental Establishment at Biggin Hill are also represented, and this section of the Exhibition conveys an impression of the unceasing scientific inquiry that is conducted by the War Office to ensure that the highest efficiency of man and material may be attained in the requirements of the Service

Carnegie Institution of Washington

Dedication of Elihu Root Hall

TO foster its programme for the interpretation of scientific research, the Carnegie Institution of Washington dedicated, on December 8 last a new wing for its administrative building in Washington The new wing contains a beautiful auditorium, seating nearly 500 people and also exhibition halls and additional offices

Mr Elihu Root, former Secretary of State Secretary of War and United States Senator, who from 1902 until his death in 1937 served as a member and later as chairman of the Board of Trustees of the Institution, was the directing head of the movement to provide funds for the erection of the new wing and the new hall has been named after him

Dr John C Merriam president of the Carnegie Institution of Washington who is retiring on December 31 after eighteen years of service, in introducing Sir Richard Gregory to deliver the Elihu Root Lecture on Cultural Contacts of Science" (see NATURE of December 17 p 1059), said that the dedication of the Hall marked the realization of a plan which had been in the mind of Mr Root and before the Board for many years, as furnishing the possibility of better interpretation of researches conducted by the Institution "This very beautiful auditorium furnishes an unusual environment favourable for presentation of statements concerning research or for discussion of critical problems touching science Assuming that the programme of Carnegie Institution of Washington will maintain a pace comparable to that of past years, we may expect future decades to note the continuing importance of this auditorium as a place from which there will be an increasingly significant diffusion of knowledge on subjects relating to science and research

The most striking features of the Elihu Root Hall are the two huge murals which fill the entire sides of the auditorium and depict heroic figures contemplating the world, figures which symbolize the research workers of the Institution surveying the fields of fundamental research On one wall is the Atlantic Ocean and on the other, the Pacific By ingenious use of perspective the scenes give the illusion of standing on a high mountain top and looking out over whole continents and oceans

Notable, too, is the ceiling of the hall, containing large transparencies of the sun and of the moon in eight of its phases That of the sun represents a combination of two photographs taken with the spectroheliograph, one of the disk in calcium light and showing sunspots, and the other of the limbs in hydrogen light and showing numerous prominences Those of the moon are reproductions of photographs made at the Newtonian focus of the great 100 inch telescope at Mt Wilson Observatory

The acoustics of the hall have been specially designed to incorporate the latest advances in reducing reverberation and in ensuring the optimum acoustical conditions for human hearing The architect for the new wing and auditorium was Mr William A Delano, and Mr J Monroe Hewlett painted the murals on the walls of the auditorium

The opening of the Elihu Root Hall with its exhibition galleries and offices marks a stage in the development of the two fold purpose of the Carnegie Institution, namely, the development of natural knowledge by research and its interpretation to as wide a public as possible The Institution maintains a staff of research workers in Washington and in the field, who present reports from time to time of their work These reports take the form of papers presented and discussed at conferences and the trustees of the Institution provide annually for the printing and distribution of such reports to the principal libraries of the world where the information they contain is available to all who desire it Thirty seven Year Books comprising sixteen thousand pages of summary reports of work in progress seven hundred and twenty eight monographs aggregating more than two hundred thousand pages and eleven thousand five hundred papers, represents a mass of scientific data prepared by the specialist for the specialist reader

The other side of the Institution's activities is occupied with the interpretation of these data and the explanation of their significance to the non technical citizen This problem has been approached in various ways through the schools the press the exhibition hall the lecture platform the radio and the cinematograph Simply written articles on current advances are prepared and distributed as separates to schools of the secondary type, and bound volumes of such separates are prepared for their libraries Suitable articles for newspaper use are also sent out as well as short notes of news character The annual exhibitions, consisting of exhibits arranged and demonstrated by the research workers responsible for the investigations illustrated, bring home even more vividly to those able to visit them the significance of recent developments

The public lectures provided by the Institution consist of two distinct series One of these series is given during the winter and spring months by the members of the staff of the Institution, who deliver general lectures on the progress of investigation in their own particular fields The other series was established in memory of Mr Elihu Root, who was much interested in the idea of arranging special lectures upon the influence of science and research upon current thought The intention of these lectures is to direct attention not only to the development of science but also to its deeper meaning for life and civilization, and to this end leading thinkers of international repute are invited to Washington to deliver their message

In addition to these formal lectures, the staff of the Institution frequently give lectures to local scientific and other interested bodies

The Carnegie Institution of Washington, through its research workers, is contributing substantially to the sum of human knowledge and is also providing for the presentation and preservation of the records of their labours Further, the Institution has attacked, with marked success, the equally important problem of conveying the import of current scientific developments to a wider public, on the knowledge and understanding of whom depends the future of civilization itself

Science News a Century Ago

Ancient Carthage

THE *Gentleman's Magazine* of December 1838 contains the following information: "Sir Grenville Temple has employed himself for the last six months in making excavations on the classic soil of Carthage. On the site of the temple of Ganath, or Juno Coelestis, the great protecting divinity of Carthage, he found about seven hundred coins and various objects of glass and earthenware. But the most remarkable and least expected of his discoveries is that of a villa, situated on the seashore, and buried fifteen feet under the ground. Eight rooms have been completely cleared, and their size and decorations proved that the house belonged to a wealthy personage. The walls are painted, and the floors beautifully paved with mosaic, in the same manner as those at Pompeii and Herculaneum, representing a great variety of subjects, such as marine deities, both male and female, different species of sea-fish, marine plants, a vessel with female figures dancing on the deck, and surrounded by admiring warriors, other portions representing lions, horses, leopards, tigers, deer, zebras, bears, gazelles, hares, ducks, herons, etc. Ten human skeletons were found in the different chambers. In another house are mosaics, representing gladiators contending in the arena with wild beasts, and over each man is written his name. In another part are seen horse races and men breaking in young horses."

The Asiatic Society

ON January 5, 1839, a communication by Lieut. James Raymond Wellsted (1805–42) of the Indian Navy was read relating to the identity of the Himyaritic writing and the dialect of Job with that still spoken by the inhabitants of Mahrah. In his letter, Wellsted described his discovery of inscriptions in the south of Arabia and gave his reasons for supposing they contained the ancient Himyaritic language. The great Himyaritic Empire is said by Arabian historians to have lasted about 2,000 years and to have extended its limits to India. Many persons had doubted the existence of this empire, but recent discoveries had shown that it had been the seat of large and populous cities. Wellsted also referred to the discoveries of Mr. Cruttenden, at Sana, similar to those which he himself made, and concluded with the hope that other officers of the Indian Navy would endeavour to add to our knowledge of those parts. He was able to state that the newly appointed governor of Bombay, Sir James Revett Carnac, would further their efforts.

Flora of the London District

AT a meeting of the Botanical Society on January 4, 1839, the curator, Mr. Daniel Cooper, read a paper entitled "Remarks on the Dispersion of Plants in the Environs of London, and the Formation of Plans Exhibiting the Distribution of Species over Localities". The Metropolitan botanist, he said, can certainly boast of a flora, perhaps not to be equalled throughout the whole of England. Surrey is particularly rich in orchidaceous plants; twenty six out of the thirty six species are found dispersed within thirty miles of London. In Kent, it may be observed that the species are not quite as abundant, in the ratio of twenty one to thirty six, including two species which had not, to Mr. Cooper's knowledge, been found in Surrey, at least within the range before specified by *Ophrys fucifera* and *Ophrys tetrophos anthos*. This tribe is not confined to the counties of Surrey and Kent in the London district as might be supposed; they occur also in Essex and Middlesex, but not so frequently.

The *Athenæum* and Steam Navigation

THE *Athenæum*, in its first issue of January 1839 again dwelt at length on the subject of steam navigation, the article being prompted by the appearance of various publications relating to steam navigation to India and across the Atlantic. "With these, and many similar documents before us," the writer of the article said, "and standing as we do on the threshold of a new year, the prospects which open to us are of an extraordinary character, to which in the retrospect of the past, we can find no parallel. Steam navigation, hitherto in its infancy, is now rapidly advancing to gigantic maturity; and the future achievements of the infant Hercules may readily and safely be predicted from the growing feats of the athletic youth. It is manifest that this globe of ocean and earth is about to be enclosed in a continuous network of communications by steam. In this development Great Britain must necessarily for a long period of time be the principal instrument of extending and maintaining this gigantic system of communication. She alone possesses the requisite machinery, workshops, artificers, enterprise, public spirits and capital for so stupendous an undertaking."

Having thus approached his subject, the writer then went on in a well informed manner to the design of ships, their size, their subdivision, materials for them and improvements in machinery. Large vessels were, he said, safer, surer and drier, while facility of construction, economy and strength made iron construction desirable.

University Events

LONDON.—The title of reader in the University has been conferred on the following in respect of posts held at University College: Mr. C. R. Bailey (chemistry), Dr. R. O. Buchanan (economic geography).

The degree of D.Sc. has been conferred on Mr. T. G. Pearson, an internal student of the Imperial College (Royal College of Science).

The William Henry Hudson Memorial Prize has been awarded for 1938 to Miss Margaret E. Willy, of the New Cross Goldsmiths' College Centre.

The Graham scholarship in pathology has been awarded to Mr. R. M. Calder.

OXFORD.—In Congregation on December 10, the honorary degree of D.Sc. was conferred on Dr. Irving Langmuir, director of the Research Laboratories of the General Electric Company of the United States.

Dr. W. Hume Rothery, formerly senior demy of Magdalen College, has been elected to a fellowship.

Societies and Academies

Paris

Academy of Sciences (C R, 207 1077 1136 Dec 5 1938)

B Cabrera Influence of water on the values of the magnetic constants of the rare earths When allowance is made for combined water accurately determined, the values of the magnetic constants are nearer the theoretical values

B Jessen A problem of Lagrange concerning the argument of a trigonometrical polynomial

L Beschkine A class of mechanisms with two degrees of freedom

J Virgitti Axial field in the tube support of the collector of a high tension generator, utilizing an electrified aerosol for the transport of charges

W Heller and **J Rabinovitch** A possible determination of the topography of weak and heterogeneous magnetic fields The change of birefringence of colloidal solutions of iron or iron oxide is used

R Forrer Activation and composition of the elementary moment of ferromagnetic alloys

R Ricard and **F Valancogne** Spectrum of rubidium in the extreme ultra violet (2000 1050 A)

L Dunoyer Emission of luminescent tubes, general formulæ

J Amiel Paramagnetism of cupric salts of long chain fatty acids

G Le Clerc Catalytic activity of cubic sesquioxide of iron in the synthesis of hydrocarbons by hydrogenation of carbon monoxide at atmospheric pressure The optimum temperature for alkalinized iron catalysts coincides with one of their Curie points, 250° C

R Dubrisay and **J J Goupil** Action on metals of certain organic acids in solution in non aqueous liquids

Mlle J Gutman Action of dimethylamine on methyl 1 dibromo 1 2 cyclohexane

Mlle B Tchoubar and **O Sackur** Action of organo magnesium derivatives on α bromocyclohexylformaldehyde

Mmes P Ramart and **M Grumez** and **M Martynoff** Structure and absorption of coloured diamine derivatives of acridine

R Quelet and **J Allard** New method of synthesis of paramethoxy α, β dichloro ethylbenzene, passage to the β and the α chloro para methoxy stryolenes

F Trombe Determination of quartz by differential thermal analysis The method is used for identifying different kinds of quartz in a powder

H Vincienne Co existence of tungsten and gold in the mineralized zone of Salsigne Villanière (Aude)

G Deflandre and **L Dangeard** *Schizosphærella*, a new microfossil, hitherto unrecognized, of the middle and upper Jurassic

H Grisollet Study of the light diffused by the particles in suspension in the air

Mme G Feldmann Mazoyer A new genus of Mediterranean Ceramiaceæ

L Plantefol Respiratory exchanges of plant tissues in cultures

P Gavaudan, Mme N Gavaudan and **J Durand** Induction of polyploidy in somatic cells of some Gramineæ by the action of vapour from acenaphthene Confirms Kostoff's results, that the effect is identical with that of colchicine

M Simonet Inheritance of tetraploid mutations of *Petunia* obtained after the application of colchicine The descendants of tetraploid plants show giantism, etc and cytologically are tetraploid (inheritance of a mutation)

Y Le Grand Fluorescence of the crystalline [of the eye]

P Joyet Lavergne Action of folliculin in the experimental transformations of male organisms into intersexuals or females Folliculine acts directly on the living cell, diminishing its oxidizing power

G Champetier and **E Fauré Fremiet** X ray study of secreted keratins [as distinct from epidermal keratin]

M Mazille Unipolar electro dialysis of blood serum

Budapest

Hungarian Academy of Sciences November 21

Gy Prinz Surface of Central Asia

G Rados Independence of the conditional equations which exist between the coefficients of the unitarian substitution

G Zemplén New and abundant synthesis of primeverose and its derivates

J Jelitai Autobiography of Janos Bolyai

M Hermann and **L Zombory** Crystalline limestone stratum of Biharkapu (Portale)

G Entz and **O Sebestyén** Studies of biometric variation in *Ceratium hirundinellum* from Lake Balaton

I Vitalis Coal of Hungary

L Jugovics Data on the basalts on the right bank of the Danube

Dublin

Royal Dublin Society November 22 1938

W J Looby and **J Doyle** The life history of *Saxegothæa conspicua* Lindl The female gametophyte and the post fertilization phases leading to the proembryo resemble those described for *Podocarpus* and *Stachycarpus* The embryonic cells pass through a bi nucleate stage Two sub equal male cells are formed which do not completely separate

H H Poole (1) On the use of a model and photo electric cells for the determination of the daylight illumination in a proposed building Tests with two Weston cells under opal glasses one in the open air (in the absence of direct sunlight) and the other at various points inside a model of a proposed office and adjacent building (scale ½ in to 1 ft), enabled the daylight factors on the working plane to be found for different window arrangements and heights of ceiling As a result, it was decided to modify the original design (2) On the effect of the colour of the light on the curvature of the light current characteristic of rectifier photo cells Photometer bench tests on two Weston and eight Electrocells under illuminations ranging from about 360 to about 23,000 lux on the bare cells using a 10 ohm galvanometer and constant resistance attenuator, showed that in all cases the deviation from proportionality of current to light was, for a given current, considerably larger when a deep red Jena *RG*5 filter was mounted in front of the cell The results for other filters (Jena *RG*1 and *BG*12 and Corning green) differed less from each other and from those for the bare cell but in most cases the curvature was least for the blue *BG*12 and greatest for the light red *RG*1 It is suggested that this effect is due to the increased leakage of current caused by the photo conductivity of selenium which reaches a maximum in the red

Rome

National Academy of the Lincei (*Atti* 27 317 388 1938)

G Abetti Height of the chromosphere in 1937 and the progress of the solar cycle

G Brunelli and G Cannicci Biological characteristics of Lake Tana

A Finzi The reduction to the normal form of the gravitational equations of Einstein

U Morin Uni rationality of the algebraic surface of the fifth order

I Popa Projective-differential geometry of families of surfaces

O Pylarinos Congruences of straight lines normal to the same surface

C Cattaneo Contact of two elastic bodies local distribution of the forces (1)

G Krall Wave propagations and transmission of energy in a hydraulic lattice

R Piontelli Influence of ultra sonics on the discharge potential of hydrogen

P Peola Probable existence of the palæolithic in the Ægean Islands and the geological vicissitudes of the latter during the quaternary

M Fedele Nervous system of the Ascidiacea in the plane of organization of the Chordates

V Famiani Normal rhythm of some secretions

G Solarino Histological changes of the central and peripheral nervous system in experimental beri beri of birds

F Rasetti Memorial lecture on Orso Mario Corbino

Atti, 27 397–420, 1938

G Dantoni Systems of resultants

L Gialanella New researches on the solar group of stars (2)

R Manzoni Ansidei and M Rolla Absorption spectrum of pyrrole thiophene and furane in the middle infra red

V Capraro (1) Thyroxin injection and experimental beriberi (2) Expression and calculation of the beriberi quotient Q_b (3) Castration and experimental beriberi in pigeons

Atti, 27, 421 466 1938

L Carnera Results obtained from the study of latitude variations in the years 1936 and 1937

G Giorgi Magnetometer of Rogowski

S Baglioni Microchemical determination of the total soluble nitrogen and of the urea and amine fractions in blood

C Cattaneo Contact of two elastic bodies local distribution of the forces

G Krall Stability and wave propagations in a hydraulic lattice with a turbine having an isodromic regulator

M Zeuli Pendulum of variable length

L Vignoli Lipidic leucoplasts of *Agave*

E Biocca Series culture of *Trypanosoma brucei* in the hen embryo

A Signorini Memorial lecture on Gian Antonio Maggi

Forthcoming Events

Friday January 6

Institution of Mechanical Engineers at 6 —H Scott Paine Some of the Aspects and Problems of the Development of High Speed Craft and its Machinery (Thomas Lowe Gray Lecture)

Mathematical Association January 2–3 Annual Meeting to be held in King s College London

January 2 —W Hope Jones Simplicity and Truthfulness in Mathematics (Presidential Address)

Physical Society January 3–5 Annual Exhibition to be held at the Imperial College of Science and Technology

January 3 —Dr J D Cockcroft F R S The Cyclotron and its Applications

January 4 —C S Wright Geophysical Research in Polar Regions

Science Masters Association January 3–6 Annual Meeting at Cambridge

January 3 —Prof J Gray F R S The Role of Science in Education (Presidential Address)

Geographical Association January 3–6 Annual Conference to be held in the London School of Economics

January 3 —Sir Thomas Holland F R S The Geography of Minerals (Presidential Address)

Institute of British Geographers, January 5–6 Annual Meeting to be held in the London School of Economics Houghton Street W C 1

Appointments Vacant

Applications are invited for the following appointments on or before the dates mentioned

Junior Scientific Officer in the Forest Products Research Laboratory—The Establishment Officer Department of Scientific and Industrial Research, 16 Old Queen Street Westminster S W 1 (Ref J 39 1 January 10)

Assistant Lecturer in Zoology in King s College London—The Secretary (January 1)

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Smoke Abatement Society Ninth Annual Report 1938 9 Pp 32 (London National Smoke Abatement Society) [3011

National Physical Laboratory Metrology Department Schedule of Fees of Tests on Volumetric Glassware Pp 10 (Teddington National Physical Laboratory) [3011

Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September 1937 (Cmd. 5595) Pp vii+209 (London H M Stationery Office) 3*s* 6*d* net [3011

National Institute of Industrial Psychology Annual Report and Statement of Accounts for the Year ended 30th September 1938 Pp 39 (London National Institute of Industrial Psychology) [212

Ninth Annual Reports of the National Radium Trust and Radium Commission 1937 1938, including a Statistical Report. (Cmd 5888) Pp 63 (London H M Stationery Office) 1*s* net. [212

Other Countries

Jamaica Annual Report of the Department of Agriculture for the Year ended 31st December 1937 Pp vi+83. (Kingston Government Printing Office) [212

Journal of the Faculty of Agriculture Hokkaido Imperial University Vol. 44, Part 1 Physico-Chemical Properties of the Virus of Broad Bean Mosaic By Daiki Murayama Pp. 32+1 plate. Vol 42, Part 2 Die Bibioniden Japans (Diptera, Nematocera) von Ichiji Okada Die Phryneiden und Pachyneuriden Japans (Diptera, Nematocera) von Ichiji Okada Pp 189–235+plates 6–9 (Tokyo Maruzen Co. Ltd) [212

Standards on Transmitters and Antennas 1938 Pp vi+42 50 cents Standards on Electroacoustics 1938 Pp. vi+37, 50 cents (New York Institute of Radio Engineers Inc) [212

Indian Agricultural Research Institute (Pusa)
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This book can be issued on or after ______

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